Rev: 04

SYLLABUS

For

3 YEARS BSC ZOOLOGY PROGRAMME

(Revised Syllabus Approved by Academic Council)

Dept. of Zoology

JUNE, 2018

UNIVERSITY OF SCIENCE &TECHNOLOGY, MEGHALAYA

Techno City, 9th Mile, Baridua, Ri-Bhoi, Meghalaya, 793101

SKELETON FOR UG SYLLABUS

SEMESTER-I

Course Code	Title	Credit	Nature of course (T/P)	Marks Allotted		
				Internal	End Semester	Total
BSZ-101	Core Course**(CC-1)**Non-Chordates: Protista to Pseudoceolomates	4	T	30	70	100
BSZ-102	Core Course**(CC-2)** Ecology	4	T	30	70	100
BSZ-103	Core Course**(CC-3)** Non-Chordates: Protista to Pseudoceolomates	2	P	15	35	50
BSZ-104	Core Course**(CC-4)** Ecology	2	P	15	35	50
BEN-711	Ability Enhancement Compulsory Course**(AECC-1)** Communicative English	4	T	30	70	100
BSB-711	Generic Elective (**GE-1**) BOTANY Diversity of Cryptograms	4	T	30	70	100
BSB-712	Generic Elective- **(GE-2**) BOTANY Diversity of Cryptograms	2	P	15	35	50
Total						**550**

SEMESTER-II

Course Code	Title	Credit	Nature of course (T/P)	Marks Allotted		
				Internal	End Semester	Total
BSZ-201	Core Course **(CC-5)**Non-Chordates II: Annelida to Echinodermata	4	T	30	70	100
BSZ-202	Core Course **(CC-6)** Cell Biology	4	T	30	70	100
BSZ-203	Core Course **(CC-7)** Invertebrate-II	2	P	15	35	50
BSZ-204	Core Course **(CC-8)** Cell Biology	2	P	15	35	50
BEV-721	Ability Enhancement Compulsory Course **(AECC-2)**Environmental Studies	4	T	30	70	100
BSB-721	Generic Elective (**GE-3**) BOTANY Diversity of Seed Plants- Morphology, Anatomy & Systematics	4	T	30	70	100
BSB-722	Generic Elective (**GE-4**) BOTANY Diversity of Seed Plants- Morphology, Anatomy & Systematics	2	P	15	35	50
Total						**550**

SEMESTER-III

Course Code	Title	Credit	Nature of course (T/P)	Marks Allotted		
				Internal	End Semester	Total
BSZ-301	Core Course **(CC-9)**Diversity of Chordates	4	T	30	70	100
BSZ-302	Core Course **(CC-10)**Physiology: Controlling and Coordinating systems	4	T	30	70	100
BSZ-303	Core Course **(CC-11)**Fundamentals of Biochemistry	4	T	30	70	100
BSZ-304	Core Course **(CC-12)**Vertebrate	2	P	15	35	50
BSZ-305	Core Course **(CC-13)**Physiology	2	P	15	35	50
BSZ-306	Skill Enhancement Course **(SEC-1) Economic Zoology**	2	P	15	35	50
BSC-731	Generic Elective**(GE-5)** CHEMISTRY	4	T	30	70	100
BSC-732	Generic Elective**(GE-6)** CHEMISTRY	2	P	15	35	50
Total						**600**

SEMESTER-IV

Course Code	Title	Credit	Nature of course (T/P)	Marks Allotted		
				Internal	End Semester	Total
BSZ-401	Core Course **(C-14)**Comparative anatomy of Vertebrate	4	T	30	70	100
BSZ-402	Core Course **(C-15)**Physiology: Life Sustaining Systems	4	T	30	70	100
BSZ-403	Core Course **(C-16)**Biochemistry of Metabolic Processes	4	T	30	70	100
BSZ-404	Core Course **(C-17)**Comparative Anatomy	2	P	15	35	50
BSZ-405	Core Course **(C-18)**Biochemistry	2	P	15	35	50
BSZ-406	Skill Enhancement Course **(SEC-2)** Fish and Poultry Farming and Nature Photography	2	P	15	35	50
BSC-731	Generic Elective**(GE-7)** CHEMISTRY	4	T	30	70	100
BSC-732	Generic Elective**(GE-8)** CHEMISTRY	2	P	15	35	50
Total						**600**

SEMESTER-V

Course Code	Title	Credit	Nature of course (T/P)	Marks Allotted		
				Internal	End Semester	Total
BSZ-501	Core course-**(C-19)** Molecular Biology	4	T	30	70	100
BSZ-502	Core course-**(C-20)** Principles of Genetics	4	T	30	70	100
BSZ-503	Discipline Specific Elective- **(DSC-1)**Fish and Fishery	4	T	30	70	100
BSZ-504	Discipline Specific Elective- **(DSC-2)**Parasitology	4	T	30	70	100
BSZ-505	Core course-**(C-21)** Molecular Biology	2	P	15	35	50
BSZ-506	Core course- **(C-22)** Principles of Genetics	2	P	15	35	50
BSZ-507	Discipline Specific Elective- **(DSC-3)**Fish and Fishery	2	P	15	35	50
BSZ-508	Discipline Specific Elective- **(DSC-4)**Parasitology	2	P	15	35	50
						600

SEMESTER-VI

Course Code	Title	Credit	Nature of course (T/P)	Marks Allotted		
				Internal	End Semester	Total
BSZ-601	Core course-**(C-23)**Developmental Biology	4	T	30	70	100
BSZ-602	Core course-**(C-24)** Evolutionary Biology	4	T	30	70	100
BSZ-603	Discipline Specific Elective- **(DSC-5)**Reproductive Biology	4	T	30	70	100
BSZ-604	Discipline Specific Elective- **(DSC-6)**Wildlife Conservation and Management	4	T	30	70	100
BSZ-605	Core course-**(C-25)** Developmental Biology	2	P	15	35	50
BSZ-606	Core course-**(C-26)** Evolutionary Biology	2	P	15	35	50
BSZ-607	Discipline Specific Elective- **(DSC-7)**Reproductive Biology	2	P	15	35	50
BSZ-608	Discipline Specific Elective- **(DSC-7)**Wildlife Conservation and Management	2	P	15	35	50
PAPER	Skill Enhancement Course **(SEC-3)**	Non Credit				

606		Mandatory				
Total						**600**

CC: Core Course **AECC:** Ability Enhancement Compulsory Course **SEC:** Skill Enhancement Course
DSE: Discipline Specific Elective **GE:** Generic Elective **(**Multidisciplinary Course)

Note: 1. Syllabus skeleton and nomenclature of courses may vary from programme to programmeand credit to credit.

Outlines of Choice Based Credit System:

1. **Core Course (CC)**: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. The purpose of fixing core papers is to ensure that all the institutions follow a minimum common curriculum so that each institution/university adheres to common minimum standard. Also the course designed for papers under this category aim to cover the basics that a student is expected to imbibe in that particular discipline.

2. **Discipline Specific Elective (DSE) Course**: Elective courses offered under the main discipline/subject of study is referred to as Discipline Specific Elective. The list provided under this category are suggestive in nature and each University has complete freedom to suggest their own papers under this category based on their expertise, specialization, requirements, scope and need. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

3. **Skill Enhancement Course (SEC) Course:** These course may be chosen from a pool of courses designed to provide value based or skill based knowledge and should contain both theory and practical/hands-on/training/field work. The main purpose of these courses is to provide students life-skills in hands-on mode so as to increase their employability.

4. **Ability Enhancement Compulsory Course (AECC):** These courses are based upon the content that leads to knowledge enhancement. (i) Environmental Science/Studies and (ii) English/Hindi/MIL Communication are mandatory for all disciplines.

5.**Generic Elective (GE) Course (Multidisciplinary Course)**: An elective course chosen from an unrelated discipline/subject, with an intention to seek exposure beyond discipline/s of choice is called a Generic Elective. The purpose of this category of papers is to offer the students the option to explore disciplines of interest beyond the choices they make in Core and Discipline Specific Elective papers. The courses are suggestive in nature and each

University has complete freedom to suggest their own papers under this category based on their expertise, specialization, requirements, scope and need.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

UNIVERSITY OF SCIENCE & TECHNOLOGY, MEGHALAYA
B.Sc. Zoology (Major) 1st Semester

Program Name: B.Sc. Zoology
Program Code: BSZ
Program Specific Outcome:

PSO-1: Demonstration of a broad understanding of animal diversity, including knowledge of the scientific classification and evolutionary relationships of major groups of animal.

PSO-2: To recognize the relationships between structure and function at different levels of biological organization (e.g., molecules, cells, organs, organisms, populations, and species) for the major groups of animals.

PSO-3: To characterize the biological, chemical, and physical features of environments (e.g., terrestrial, freshwater, marine, host) that animals inhabit. Explained how animals function and interact with respect to biological, chemical and physical processes in natural and impacted environments.

PSO-4: Enable to understand how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system. Drawing upon this knowledge, they are able to give specific examples of the physiological adaptations, development, reproduction and behavior of different forms of life.

PSO-5: To understand the applied biological sciences or economic Zoology such as sericulture, apiculture, aquaculture, Industrial microbiology, rDNA technology and medicine for their career opportunities.

Course Code: BSZ-101 (Theory)
Course Title: Invertebrate-I: Non-Chordates (Protista to Pseudocoelomates) (4 Credits)
Course Outcome:
CO1: To know the basic concept of biosystematics and procedure in taxonomy.
CO2: Identify the taxonomic status of the entire non-chordates up to annelids and undertsnad the evolutionary model of the group.
CO3: To understand the general biology of few selected non-chordates useful to mankind.
CO4: To know about some of the important and common protozoans, helminthes of parasitic nature causing diseases in human beings.
CO5: To Understand the importance of metamerism in annelids.

Contents:
UNIT: I

INVERTEBRATES:	Concept, diversity, and outline classification- major and minor phyla
Protozoa:	Classification up to order, Locomotion, nutrition, reproduction Structural organisation of Paramaecium/Euglena Protozoa and Human Disease

UNIT: II

Porifera:	Classification up to order and General Organisation Skeleton and canal system Economic Importance of Sponges
Coelenterata:	General characters and Classification up to order, Polymorphism, Coral reefs and their formation;

UNIT: III

Ctenophora:	General Characters & Classification upto order Affinities
Platyhelminthes:	Classification up to order Features of significance in life-cycle of *Fasciola hepatica* Parasitic adaptations of *Taenia*

UNIT: IV

Aschelminthes:	General Characters and Classification up to order Some common Nematode Parasites of Man- Ascaris (common roundworm), Ancylostoma (common hookworm) and Wuchereria (Filarial worm)
Rotifera:	Morphological and anatomical features Affinities

Course Code: BSZ-102 (Theory)
Course Title: Ecology (4 Credits)
Course Outcome:
CO1: To know the distribution of fauna in different realms and their interaction.
CO2: To understand Animal behaviour and response to different instincts
CO3: To understand the various ecosystem of different animals.
CO4: To understand the different aspect of pollution
CO5: To understand the importance of Wildlife conservation & management.

Contents:
UNIT: I
1. Concept and Scope of Ecology, Important terminologies and Approaches to Ecology
2. Ecological factors- Abiotic and Biotic
3. Components of ecosystems, Food chain – detritous and grazing, ecosystem energetics.
4. Ecosystem and its types

UNIT: II
5. Population ecology: Basic concept, Population Character, Population dynamics.
6. Community ecology: Definition and characteristics; Composition, structure, origin. Methods of study of communities; classification of communities.
7. Ecological succession and concept of climax
8. Liebig law of minimum, Shelford's law of tolerance, Significance of limiting factors, Ecotone and Edge effect.

UNIT: III
9. Biogeochemical cycles –carbon, nitrogen, sulphur cycles, impact of human activity on nutrient cycles.
10. Environmental Pollution- Air, Water, Soil.
11. Natural resource and their conservation.
12. Major environmental regimes of Earth, Environmental monitoring, Environmental impact assessment and environmental management plan.

UNIT: IV
13. Study and concept of different protected areas.
14. Wildlife Management with special reference to Northeast India.
15. National and International efforts for conservation: Indian Wildlife Protection Act, Indian Forest Act, Wildlife Trade and CITES, IUCN and criteria for Extinct (EX), Extinct in the wild (EW), critically endangered (CE), Low risk (LR), Data deficient (DD) and Not evaluated.

Course Code: BSZ-103 (Practical)
Course Title: Non-Chordates: Protista to Pseudoceolomates (2 Credits)
Course Outcome:
CO1: To get familiar with the different types of invertebrate with the help of the preserved animals available in the laboratory.
CO2: To learn the techniques how to prepare the temporary & permanent slides.
CO3: To learn the procedure of culture of *Paramecium* and the observation.
CO4: To understand the symmetry of some invertebrate in the laboratory.

Contents:
1. Microscope and its practical use

2. Symmetry: i) Asymmetric organization: Amoeba,
ii) Radial symmetry: Sea anemone/Aurelia,
iii) Bilateral symmetry: Planaria/Liver fluke

3. Animal Diversity (identification from specimen/model)
Protozoa: Euglena, Plasmodium, *Paramecium*;
Porifera: Grantia, Spongilla;
Cnidaria: Physalia, Vallela, Aurelia, sea anemone and any one coral;
Platyhelminthes: Planaria, liver fluke and tapeworm;
Aschelminthes: *Ascaris*- male and female.

4. Preparation of Permanent Slide

5. Identification of prepared slides:
Euglena, Hydra, Obelia colony, Polystomella, Sponge spicules, TS of Ascaris

6. Study of *Paramecium* culture to observe food vacuole, contractile vacuole and ciliary movement.

7. Viva

8. Practical Record Book

Course Code: BSZ-104 (Practical)
Course Title: Ecology (2 Credits)
Course Outcome:
CO1: To learn the procedure of determination of pH, DO and CO_2 in pond water.
CO2: To learn how to how to determine the air temperature and humidity.
CO3: To learn the estimation of Primary productivity in ecosystem, estimation of Chloride of water sample and estimation of total alkalinity and hardness.
CO4. Study of Zooplanktons and its role in pond ecosystem.

Contents:

1. Determination of P^H of pond water (lovibond disc comparator/ P^H meter) and Turbidity of water.
2. Estimation of DO and CO_2 in pond water
3. Determination of air temperature and humidity.
4. Estimation of primary productivity in aquatic ecosystem.
5. Estimation of chloride of water sample.
6. Estimation of total alkalinity and hardness.
7. Study of zooplanktons and its role in a pond ecosystem.
8. Analysis of physical parameters of soil determination of soil moisture.
9. Submission of laboratory notebook.
10. Viva voice.

Course Code: BSZ-711 (Theory)
Course Title: Invertebrate Diversity, Ecology and Biotechnology (4 Credit)
Course Outcome:
CO1: Identify the taxonomic status of the entire non-chordates up to annelids and undertsnad the evolutionary model of the group.
CO2: To understand the general biology of few selected non-chordates useful to mankind.
CO3: To Understand the importance of metamerism in annelids.
CO4: To understand the various ecosystem of different animals.
CO5: To understand the importance of Wildlife conservation & management.

Contents:

UNIT-I: Diversity of Animal Kingdom I

1. Introductory concepts: Coelom and its type, Symmetry, Segmentation and Cephalization, Organisation: Protostomus and Deuterostomus, Unicellular and multicellular, Diploblastic and triploblastic, acoelomate, pseudocoelomate and eucoelomate
2. Animal Protists: classification up to classes, Study of Euglena/Paramecium
3. Porifera: Classification up to classes, Skeleton and canal system
4. Cnidaria: Classification up to classes, Polymorphism, General features and life history of Obelia.
5. Platyhelminthes: Classification up to class, Lifecycle and pathogenecity of *Fasciola/Taenia*
6. Nemathelminthes: Classification up to class, Lifecycle and pathogenecity of *Ascaris*

UNIT-II: Diversity of Animal Kingdom II

7. Annelida: Classification up to classes; Coelomoducts and nephredia, Digestive and urinogenital system of leech
8. Arthropoda: Classification up to class, Larval forms in Crustacea; different types of mouth parts in insects (cockroach, mosquito, housefly, and butterfly), compound eye. Phylogenetic status of Peripatus.
9. Mollusca: Classification up to subclasses, Feeding and respiration of Pila, torsion and detorsion in gastropods.
10. Echinodermata: Classification up to subclasses, larval forms and water vascular system.
11. Minor phyla: Systematic position of Rotifera

UNIT-III: Basic Concept of ecology

12. Components of ecosystems, Food chain – detritous and grazing, ecosystem energetics.
13. Concept of biogeochemical cycles: (nitrogen and phosphorus), Human activities affecting biogeochemical cycles.
14. Wetland ecosystem and its importance

15. Pollution: types, sources and effects of major pollutants of air, water, soil and noise, Control of pollution

UNIT-IV: Basic Concept of Biotechnology

16. Definition, an overview of achievements and scope.
17. Fundamentals of laboratory techniques in biotechnology: Safe handling of equipments, Sterilization techniques, Molecular separation techniques
18. Principle and applications: Paper chromatography, TLC and Electrophoresis- Agarose and PAGE
19. Environmental Biotechnology : Bioremediation- Concepts and applications

Course Code: BSZ-712 (Practical)
Course Title: Invertebrate Diversity, Ecology & Biotechnology (2 Credit)
Course Outcome:
CO1: To get familiar with the different types of invertebrate with the help of the preserved animals available in the laboratory.
CO2: To learn the techniques how to prepare the temporary & permanent slides.
CO3: To learn the procedure of culture of *Paramecium* and the observation.
CO4: To learn the procedure of determination of pH, DO and CO_2 in pond water.
CO5: To learn how to how to determine the air temperature and humidity.

Contents:
UNIT I: Levels of organization in Animal kingdom (demonstration)

Symmetry: i) Asymmetric organization: Amoeba,
ii) Radial symmetry: Sea anemone, Aurelia,
iii) Bilateral symmetry: Planaria / liver fluke
Acoelomate: T.S. of Planaria / liver fluke
Pseudocoelomate: T.S. of Ascaris
Coelomate: T.S. of Earthworm

UNIT II: Animal Diversity (identification from specimen/model)
Protozoa : Euglena, Plasmodium; **Porifera**: Grantia, Spongilla; **Cnidaria**: Physalia, Vallela, Aurelia, Sea anemone and any one coral; **Platyhelminthes**: Planaria, Liver fluke and Tapeworm; **Nemathelminthes**: Ascaris- male and female; **Annelida**: Aphrodite, Amphitrite,Nereis, leech; **Arthropoda**: Limulus, Julus, Stick insect, Bellostoma, Lepisma, butterfly and moth; **Mollusca**: Chiton, Octopus, Mytilus; **Ecinodermata**: Seacuccumber, Echinus, Ophioderma, Clypeaster; **Minor Phyla**: Sipunculus, Peripatus, Balnoglossus.

UNIT III:
Mounting
Temporary: Setae of Earthworm, Statocyst of Prawn, salivary apparatus of Cockroach
Permanent: Euglena, Hydra, Obelia colony, Crustacean larvae

Identification of prepared slides
Polystomella, Sponge spicules, T.S of Asccaris, T.S. of Leech (through crop region), Mouth parts of
mosquito (Culex) and butterfly, T.S of arm of Starfish, Larvae of Echinodermata.

UNIT IV
Ecological practical

Determination of P^H of pond water (Sacchi disc comparator/ P^H meter), soil moisture, Turbidity of water, DO and CO_2 in pond water. Determination of air temperature and humidity.

6. Biotechnology Practical

Chromatography (paper/Thin layer) for detection of amino acid

Viva

Practical Record Book

Course Code: BSZ-201 (Theory)
Course Title: Non-Chordates II: Annelida to Echinodermeta (4 Credit)
Course Outcome:
CO1: To understand the general characters and classification up to orders in Annelids with coelom and metamerism.
CO2: To understand the general characters and classification up to orders in Arthropoda. Also to understand the different larval forms of crustacia and different types of mouth parts in insect.
CO3: To understand the General characters and classification up to Orders in Mollusca and to understand the gastrovascular system, torsion and detorsion.
CO4: To understand the General characters and classification up to Orders in Echinodermata and their water vascular system.
CO5: To know about the significance of Phylogenetic status of Limulus &Peripatus.

Contents:
UNIT I:
Annelida:
General characters and classification upto orders with example. Coelom and metamerism in annelids. Excretion, reproduction and importance of Earthworm, General features and reproductive system of Leech, Parasitic adaptation of Leeches. Trochophore larva and its significance.

UNIT II:
Arthropoda
General characters and classification upto orders with example, Larval forms of crustacean, respiration in arthropods (prawn, cockroach and scorpion), different types of mouth parts in insects (Cockroach, mosquito, housefly and butterfly), compound eye. Insect metamorphosis, social organization of termites and honey bees. Phylogenetic status of Limulus and Peripatus.

UNIT III
Mollusca:
General characters and classification upto orders with example, digestive, respiratory and excretory system of Pila, shell diversity, torsion and detorsion in Gastropoda.

UNIT IV
Echinodermata:
General characters and Classification upto orders with example, water vascular system of starfish. Regeneration of echinodermata, larval forms Affinities with chordates.

Course Code: BSZ-202 (Theory)
Course Title: Cell Biology (4 Credit)
Course Outcome:
CO1: To understand the Cell, cell diversity- shape and size. Cell structure- prokaryotes and eukaryotes.
CO2: To understand the different cell components like Mitochondria, Golgi Complex, Endoplasmic reticulum, Ribosome, Lysosomes and Nucleus.
CO3: To understand cellular membrane structure and function, fine structure and function of cell organelles.
CO4: Understand the scope of cell biology as cell is the basic unit of life.
CO5: To know the basic cytoskeletal structure of cell components.

Contents:

UNIT-I

1. Introduction to cell, cell diversity- size and shape
2. Cell theory and its modern interpretation
3. Cell structure- prokaryotic and eukaryotic
4. Protoplasm- physical and chemical properties
5. Plasma membrane- structure and functions.

UNIT-II

1. Cell components- structure and functions of
    a) Mitochondria,
    b) Golgi bodies,
    c) Endoplasmic reticulum,
    d) Ribosome,
    e) Lysosome,
    f) Nucleus
2. Cell division- types, cell cycle and its mechanics
3. Structure and function of chromosome
4. Cytoskeleton- types, its structure and function. Role of cytoskeleton in formation of mitotic apparatus and chromosome movements.
5. Structure and function of cilia, flagella. Its role in cellular movement.

Course Code: BSZ-203 (Practical)
Course Title: Invertebrate-II (2 Credit)
Course Outcome:
CO1: To visualised the different types of invertebrate with the help of different Museum specimen.
CO2: To observe the life cycle of Muga silk worm or Eri Silk worm at laboratory and also in the field.
CO3: To observe and understand the differences of mouth parts of different types of Mosquitoes.
CO4. To understand the salivary apparatus of insect with the help of dissecting the Cockroach.

Contents:

1. Study of Museum Specimens- (Identification and Classification upto order. Generic name must be given). Leech, Earthworm, Polychaetes, Cockroach, Spider, Honey bee, Grasshopper, Stick insect, Praying mantis, Prawn, Crab, Sepia, Pila, Squid, Octopus, Antedon, Clypeaster, Starfish, Sea cucumber.
2. Study of the life cycle of Muga Silk worm.
3. Study of the mouth parts of both male and female Culex Mosquito.
4. Study of the larval forms of Crustacean.
5. To dissect and study the Salivary Apparatus of Cockroach.
6. To dissect and study the Urinogenital System of Leech.
7. To dissect and study the Statocyst of Prawn.
8. Mounting (Permanent) – Euglena, Hydra, Obelia colony, Crustacean larvae.
9. Submission of Practical Record Book.
10. Viva voce.

Course Code: BSZ-204 (Practical)
Course Title: Cell Biology (2 Credit)
Course Outcome:
CO1: To make aware and understand the different types of cells with the help of observing the different types of histological slides of liver, intestine, kidney, testis ovary and lungs.
CO2: To understand the mitotic stages with the help of onion root tip.
CO3: To make aware about the different types of instruments for the study of different types of cells. Example- Different types of Microscope, Autoclave, Centrifuge machine, Micropipette, etc.
CO4: To make aware in the laboratory about the Sex chromatin from buccal epithelium, basic fixatives and stains, culture of Protozoa, etc.

Contents:
1. Histological slides- Liver, Pancreas, Stomach, Intestine, Kidney, Testis, Ovary and Lungs.

2. Study of cell division stages-mitosis and meiosis.

3. Preparation and identification of mitotic stages in onion root tip.

4. Preparation and identification of meiotic stages in grasshopper testes.

5. Study of sex chromatin from buccal epithelium.

6. Preparation of basic fixatives and stains.

7. Study of protozoan cell culture.

8. Study of nucleated and non-nucleated RBC.

9. Instrumentation-Principle/function and laboratory use of microscope, autoclave, centrifuge and micropipette.

10. Submission of laboratory notebook.

11. Viva voice.

Course Code: BSZ-721 (Theory)
Course Title: Chordate Diversity, Comparative Anatomy & Evolution (4 Credits)
Course Outcome:

CO1: To understand the General Characteristics and Classification of different types of Chordates and to differentiate between Chordates and Non-chordates and to understand the affinities of Urochordata, Cephalochordata and Vertebrata.
CO2: To understand the Biological significance of Cyclostomata, Ostracodermi and Placodermi and To understand the significance of air bladder of Pisces and the migration pattern of Pisces.
CO2:Describe the evolutionary knowledge through the concepts of coloration and mimicry.
CO3: Identify the contributions of various evolutionists.
CO4: Identify different zoogeographical realms with fauna.
CO5: To understand the knowledge of eras and evolution of species.

Contents:

UNIT I: Diversity of Animal Kingdom (Chordates)

1. **Protochordata:** General features of Herdmania, Retrogressive metamorphosis.
2. **Pisces:** Classification up to order; Air bladder and its signification and migration.
3. **Amphibia:** Classification up to order; parental care.
4. **Reptilia:** Classification up to order; skull types, Biting mechanism of poisonous snakes.
5. **Aves:** Classification up to order; Flight adaptation and mechanism of flight and perching in birds.
6. **Mammalia:** Classification up to order; dentition, general features of egg laying mammals, pouched-mammals.

UNIT II: Comparative anatomy of vertebrates

7. Integument and its derivatives, lateral line sense organ (in fish and amphibian), heart and aortic arches.

UNIT III: Concept of evolution

8. **Theories of evolution:** Darwinism and neo-darwinism, role of mutations in evolution, evolutionary patterns, Natural selection in action (industrial melanism, antibiotic and DDT resistance)
9. Adaptation biology- xeric adaptation in camel, aquatic adaptation in whale, aerial adaptation in vertebrates, Animal colouration and mimicry and their adaptive significance

Course Code: BSZ-722 (Practical)
Course Title: Chordate Diversity, Comparative Anatomy & Evolution (2 Credit)
Course Outcome:

CO1: To understand the mounting procedure of various tissue like blood film, epithelial tissue.
CO2: To make student capable of making permanent slides and studying the internal structure.
CO3: To understand the taxonomic classification through museum specimens of vertebrates.
CO4: To understand the different evolutionary process of human with the help of chart and PPT.
CO5: To understand the Palaentology with the demonstration of different fossil record with the help of PPT.

Contents:

1. **Mounting:** Blood film of Frog and mammal, scales of fish, pigmentation (skin) in fish and amphibia, Squamous and ciliated epithelium, striated and non-striated muscle.

2. Identification of Permanent slide & bones:

a) Salpa, Doliolum, T.S. through pharyngeal region of Amphioxus, T.S. of skin, stomach, intestine, liver pancreas, kidney, testis, ovary of mammals.
b) Axial and appendicular skeleton of fowl, Guineapig/Rat. Different types of skull in birds.

3. Study of Museum Specimens (Identification and classification upto order):

Balanoglossus, Petromyzon, Myxine, Trygon (Common stingray), *Hippocampus* (Sea horse), *Monopterus* (Kuchia), *Cyprinus* (Common carp), *Hypopthalmichthys* (Silver carp), *Clarias* (Magur), *Chanda, Botia, Ichthyophis, Necturus*, Axolotl larva, *Duttaphrynus*, *Frejervarya, Polypedates, Hoplobatrachus* (Indian Bull frog), *Calotes, Kachuga, Draco, Naja, Bungarus, Amphiesma, Echis, Lonchura* (Spotted mayna), *Alcedo* (King Fisher), *Pteropus, Funambulus*.

4. Study of Evolutionary Evidences (through model):

Analogy – Leg of grasshopper and leg of mammal; Wing of insect and wing of bird
Homology – Fore limb of amphibian/a reptilian, and wing of bird/bat.
Adaptive modifications in feet of birds (through model/chart) and mouth parts of insects (from slides)
Embryological evidence of evolution (through charts)

5. Submission: 10 Specimens, Charts of evolution and Skeleton of fowl/rat
6. Viva
7. Practical record book

Course Code: BSZ-301 (Theory)
Course Title: Diversity of Chordates (4 credits)
Course Outcome:
CO1: To understand the General Characteristics and Classification of different types of Chordates and to differentiate between Chordates and Non-chordates and to understand the affinities of Urochordata, Cephalochordata and Vertebrata.
CO2: To understand the Biological significance of Cyclostomata, Ostracodermi and Placodermi and To understand the significance of air bladder of Pisces and the migration pattern of Pisces.
CO3: To understand the skull types of Reptiles and biting mechanism of poisonous snakes.
CO4: To understand the Flight adaptation, Mechanism of flights and the migration of Birds.
CO5: To understand about the egg laying mammals, pouched mammals and primates.

Contents:
UNIT I:

1. An introduction to the Phylum Chordata, Three fundamental Chordate characteristics, Comparison between Chordates and Non-Chordates

2. Protochordata: General features, Classification.
3. Subphyllum-I: Hemichordata, Systematic position, Phylogeny and Affinities of *Blanoglossus*.

UNIT II:

1. Subphyllum-II: Urochordata, Affinities and Systematic position of *Herdmania*.
2. Subphullum-III: Cephalochordata, Primitive, Degenerate and Specialized characters of *Branchiostoma* (*=Amphioxus*)
3. Subphyllum-IV: Vertebrata, General Characteristics, Chordates versus Vertebrates.

UNIT III:

1. Biological significance of Ostracodermi, Affinities of Cyclostomata, Biological significance of Placodermi.
2. Pisces: Classification up to order; Air bladder and its signification and migration.
3. Amphibia: Classification up to order; respiration, parental care.

UNIT IV:

1. Reptilia: Classification up to order; skull types, status of Sphenodon, Biting mechanism of poisonous snakes.
2. Aves: Classification up to order; Flight adaptation and mechanism of flight and perching in birds, migration in birds.
3. Mammalia: Classification up to order; dentition, general features of egg laying mammals, pouched-mammals, aquatic mammals and primates.

SUGGESTED BOOKS:

1. V. K. Agarwal: Zoology for Degree students, S Chand, 2016
2. R.L.Kotpal, 2014. Modern textbook of zoology, Vertebrates. (Rastogi Publ., Meerut). 632 pages.
3. E. L. Jordon & P. S. Verma: Chordate Zoology, S Chand, 2009
4. A.J. Marshall, 1995. Textbook of zoology, Vertebrates. (The McMillan Press Ltd., UK). 852 pages. (Revised edition of Parker & Haswell, 1961
5. A.K. Sinha, S. Adhikari & B.B. Ganguly, 1978. Biology of animals. Vol. II. Chordates. (New Central Book Agency, Calcutta). 560 pages.

Course Code: BSZ-302 (Theory)
Course Title: Physiology: Controlling and Coordinating Systems (4 credits)
Course Outcome:
CO1: Understand the Importance of physiology and branches of it.
CO2: To understand the General characteristics of Endocrine system and classification of Hormones.
CO3: To understand the structure of different endocrine glands like pituitary gland, Thyroid gland, pancreas, Adrenal and the functions of their different hormones.
CO4: To understand the different functions of steroid and peptide hormones.
CO5: To understand the structure and function of Testis and Ovary.

Contents:
UNIT I:

1. Nutritional Requirements, Digestion and absorption of dietary Components (Carbohydrates, fats, proteins, vitamins and minerals).
2. Types of respiration: Anaerobic and aerobic, Properties and function of respiratory pigments, Exchange of gases, breathing, Oxygen dissociation curve, control of breathing.

UNIT II:

3. Type of body fluids, Composition and function of different body fluids, Haemopoiesis, Buffer system in blood, Chloride shift, Blood groups and blood clotting mechanism.
4. Types of Heart- Myogenic & Neurogenic, Origin, conduction and regulation of heart beat, Cardiac cycle, Blood pressure.

UNIT III:

5. Types of Nitrogenous wastes- ammonotelic, urotelic and uricotelic, Physiology of urine formation, Regulation of Urine formation.
6. Initiation and conduction of nerve impulse, Synapse and synaptic transmission ytrough myelinated and non-myelinated nerve fibres, Neuro-mascular coordination.

UNIT IV:

7. Types of Muscle tissue, Muscle protein, Chemistry of muscle contraction.
8. Osmoregulation in Vertebrates.

SUGGESTED BOOKS:

1. S. C. Rastogi: Essentials of Animal Physiology, New Age International Publication, 2016
2. P. S. Verma, B. S. Tyagi & V. K. Agarwal: Animal Physiology, S Chand, 2014
3. A. K. Berry: Text book on Animal Physiology (11th Ed.), Emkay Publications, 2008
4. C. C. Chatterjee: Human Physiology (11th Ed.), Vol.:1 & 2, Medical Allied Agency, 2005

Course Code: BSZ-303 (Theory)
Course Title: Fundamentals of Biochemistry (4 credits)
Course Outcome:
CO1: To understand the Chemical foundation of Biology, i.e., pH, Buffers, pK, Isomeristaion, etc.
CO2: To understand the Classification and Biological Significance of amino acids, carbohydrates, peptides, protein, lipids and nucleic acid.
CO3: To understand the metabolism of carbohydrates, protein and Lipids.
CO4:. Understand about the agencies responsible for Production of various products using biochemistry.
CO5: To understand the mechanism of Oxidation with special reference to mitochondrial electron transport system.

Contents:
UNIT-I:

1. Chemical foundation of biology- pH, pK, acids, bases, buffers free energy, isomerisation
2. Classification & biological significance of carbohydrate, amino acids and peptides, protein, lipids and nucleic acids

UNIT-II:

3. Enzymes- Nature and classification, Mechanism of enzyme action, Enzyme kinetics, Enzyme inhibition.
4. Metabolism- Underlying theoretical Principles: Thermodynamics, Redox reactions, ATP and its role in Bioenergetics

UNIT-III:

5. Carbohydrate Metabolism: Glycolysis, fate of pyruvate
6. The Citric acid cycle: Energetics and regulation of Citric Acid Cycle

UNIT-IV:

7. Lipid Metabolism: Lipid digestion, oxidation of Fatty acids, fate of Acetyl-CoA
8. Oxidation- reduction potential with special reference to mitochondrial electron transport system. ATP in metabolism and in free energy production

SUGGESTED BOOKS:

1. Murray et al: Harper's Illustrated Biochemistry (26th Ed.), Appleton & Lange, 2003
2. Satyanarayana & Chakrapani: Biochemistry, Elseiver, 2017
3. J. L. Jain and Sunjay Jain: Fundamentals of Biochemistry, S. Chand, 2016
4. Naik Pankaja: Essentials of Biochemistry, 2nd Ed., 2017
5. Ambika Sanmugam: Fundamentals of Biochemistry, 7th Ed., 2012

Course Code: BSZ-304 (Practical)
Course Title: Vertebrate (2 Credit)
Course Outcome:
CO1: To understand the mounting procedure of various tissue like blood film, epithelial tissue.
CO2: To make student capable of making permanent slides and studying the internal structure.
CO3: Study of skeletal system of vertebrate
CO4: To understand the taxonomic classification through museum specimens of vertebrates.

Contents:
1. Mounting: Blood film of Frog and mammal, scales of fish, pigmentation (skin) in fish and amphibia, Squamous and ciliated epithelium, striated and non-straiated muscle, Pecten and filoplume of bird.

2. Identification of Permanent slide & bones:
   c) Salpa, Doliolum, T.S. through pharyngeal region of Amphioxus, T.S. of skin, stomach, intestine, liver pancreas, kidney, testis, ovary of mammals.
   d) Axial and appendicular skeleton of fowl, Guineapig/Rat. Different types of skull in birds.

3. Study of Museum Specimens (Identification and classification upto order):
   Balanoglossus, Herdmania, Amphioxus, Petromyzon, Myxine, Trygon (Common stingray), *Torpedo* (Electric Ray), *Hippocampus* (Sea horse), *Monopterus* (Kuchia), *Cyprinus* (Common carp), *Hypopthalmichthys* (Silver carp), *Clarias* (Magur), *Chanda, Botia, Ichthyophis, Necturus,* Axolotl larva, *Duttaphrynus, Frejervarya, Polypedates, Hoplobatrachus* (Indian Bull frog), *Calotes, Kachuga, Draco,* Chemeleon, *Naja, Hydrophis, Bungarus, Amphiesma, Echis, Lonchura* (Spotted mayna), *Alcedo* (King Fisher), *Pteropus, Funambulus*.
4. Submission: 10 Specimens, Charts
5. Practical Note book
6. Viva voce

Course Code: BSZ-305 (Practical)
Course Title: Physiology (2 Credits)
Course Outcome:
CO1: To aware the knowledge of different cellular structure of different endocrine glands (Pituitary, Thyroid, pancreas, adrenal, Ovary and Testis) with the help of permanent slides.
CO2: To understand the structure and position of pituitary gland with the help of dissecting the pituitary gland of fishes.
CO3: To understand the Quantative detection of Carbohydrates, Protein and Lipid.
CO4: To understand the Enzyme activities with the help of Salivary amylase.

Contents:

1. Human blood grouping, ABO and Rh factor
2. Total count of RBC and WBC
3. Differential count of WBC
4. Preparation of haemin crystals from blood
5. Haemoglobin estimation
6. Biochemical estimation of Glucose
7. Biochemical estimation of Protein
8. Detection of Enzyme activity- Salivary amylase
9. Estimation of ascorbic acid in lemon.
10. Detection of presence of Vitamin A in Oil
11. Laboratory Note book
12. Viva voce

Course Code: BSZ-306 (Theory)

Course Title: Skills Development –I: Basic Skills Development and Economic Zoology (2 Credit)

Course Outcome:

CO1: to understand the importance of skill development with status of skill development in India and opportunities related to Entrepreneurship in Zoology.

CO2: To understand the scope of Economic Zoology in the field of Sericulture, Apiculture and Lac culture.

CO3: To understand the aspect of fish culture and Induced breeding.

CO4: To study the ornamental fish of NE India with its prospect & trade.

Contents:

UNIT- I: Skills Development

1. Skill Development - Definition, Importance, aim and objectives. Skill development Status of India. Skill Development Programme and schemes in India.

2. Skill Development Vs Entrepreneurship Development. Role of extension education in enhancing skill development

3. An outline of Skill Development issues related to Zoology

UNIT – II: Economic Zoology

Sericulture

4. Different commercial species of silkworm and their Host plants, silkworm rearing and management practices (Muga&Eri); Enemies of silkworms.

Apiculture

5. Commercially important species of bees in India, bee products and their economic importance, Bee keeping and management.

Lac culture

6. Life cycle of the lac insects; Lac culture, properties and uses of lac.

Fisheries and aquaculture

7. Types of fishery: Marine, Inland. Prawn and pearl culture;

8. Composite fish culture, Induced breeding and Hybridization.

9. Ornamental fish of NE India, prospects of ornamental fish culture and trade

10. Integrated fish farming

SUGGESTD BOOKS

1. Text book on rural development and entrepreneurship and communication skills (2011) by Sagar Mandal, G.I. Roy, Kalyani Publisher, India.

Course Code: BSZ-731 (Theory)

Course Title: Biosystematics, Taxonomy & Biostatistics (4 Credits)

Course Outcome:

CO1: Thorough understanding in the principles and practice of systematics.

CO2.To understand development and application of statistical methods to a wide range of topics in biology.

CO3: To understand the data collection methods which is considered in research planning, because it highly influences the sample size and experimental design.

CO4: To understand the basic concept of qualitative and quantitative analysis of a given sample.

Contents:

UNIT I: Biosystematics & Taxonomy

1. Definition, basic concept and importance of Systematics and Taxonomy; applications of systematics in biology, Classification (Natural and cladistics only)
2. Taxonomic procedures- taxonomic collections, preservation, method of identification, taxonomic keys- different types of keys
3. Concept of species: Typological, Nominalistic, Biological, and Evolutionary
4. Biological species concept, subspecies other intraspecific categories
5. Type concept: names of Primary and Secondary types, their definitions and applications.
6. International Code of Zoological Nomenclature (ICZN): Basic Concepts
7. Zoological nomenclature: Binominal, Trinominal
8. Kinds of taxonomic characters: Morphological, Embryological, Cytogenetical, Biochemical

UNIT II: Biostatististics

1. Biostatistics - Mean, Mode, Median, Standard deviation, Standard error of mean, Probability.
2. Hypothesis testing (Chi-square, t-test),
3. Correlation and regression analysis, ANOVA (one way)
4. Sampling techniques- Random sampling, Stratified sampling, Quadrate sampling, Line-transect, Point-transect, Stream-transect

SUGGESTED BOOKS:

1. V.C. Kapoor: Theory and Practice of Animal Taxonomy and Biodiversity, 8th Ed., 2017
2. R. C. Dalela & R. S. Sharma: Animal Taxonomy & Museology, Jai Prakash Nath & Co., 2017
3. Ashok Verma: Principles of Animal Taxonomy, Narosa, 2014
4. G. G. Simpson, Principles of Animal Taxonomy, Scientific Publishers, 2014
5. Animesh K. Dutta: Basic Biostatistics and its Application, 2015
6. P. K. Banerjee: Introduction to Biostatistics, S Chand, 2016

Course Code: BSZ-732 (Practical)

Course Title: Biosystematics, Taxonomy & Biostatistics (2 Credits)

Course Outcome:

CO1: To understand the Measure of central tendency Mean (Definition & simple problems) Median, Quartiles (Definition, Graphical calculation) Box Plot Mode (Definition, graphical calculation) Situations where one is preferred over others.

CO2: To understand the Measures of dispersion: Variance (Definition, simple problems) Standard deviation Coefficient of variance.

CO3. To understand the ANOVA Test (Mathematical and graphical representation, no formula, and real life example).

CO4: To understand the Chi-Square Test (Field work, graphical representation and real life example) Testing of hypothesis (two tailed only) a) For mean (one population).

Contents:

1. Collection, preservation, curation and identification of non-chordate and chordate species
2. Preparation of Eri/Muga life cycle
3. Taxidermy of fish/pigeon/fowl
4. Identification with only diagnostic features (specimen or model/diagnostic photograph)
5. Preservation techniques- Dry & Wet Preservation
6. Survey and application of biodiversity indices of animal species (any one group)
7. Calculation of Pearson correlation coefficient,
8. T test (One sample t-test, Two sample t-test, Paired t-test);
9. Chi square test, ANOVA
10. Statistical application of Sampling techniques
11. Preparation of practical record and submission
12. Viva-voce.

Course Code: BSZ-401 (Theory)
Course Title: COMPARATIVE ANATOMY OF VERTEBRATES (4 Credits)
Course Outcome:
CO1: To understand the integumentary and skeletal system of different vertebrates.
CO2: To understand the Alimentary canal of different vertebrates and associated glands, dentition, etc.
CO3: To understand the Respiratory System of different terrestrial and aquatic animals and different structure of respiratory organs in different animals.
CO4: To understand the digestive system of lower to higher animals and their accessory organs.
CO5: To understand the General plan of circulation, evolution of heart and aortic arches.

Contents:
UNIT 1:
Integumentary system
Structure, function and derivatives of integument
Skeletal system
Overview of axial and appendicular skeleton, jaw suspension, 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
Comparative account of brain, Autonomic nervous system, spinal cord, cranial nerves in mammals

Sense organs
Classification of receptors, Brief account of visceral and auditory receptors in man

Course Code: BSZ-402 (Theory)

Course Title: ANIMAL PHYSIOLOGY (4 Credits)

Course Outcome:

CO1: Understand the function of various systems

CO2: Seeks to understand the mechanisms that work to keep the human body alive and functioning.

CO3: 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.

CO4: Students gain fundamental knowledge of physiology and endocrine systems

CO5: Students gain fundamental knowledge of physiology of homeostasis.

Contents:

UNIT-I: Physiology of Digestion

Digestive System, Mechanical and Chemical Digestion, Absorption of carbohydrates, lipids, proteins, water, minerals and vitamins.

UNIT-II: Physiology of Excretion

Nature of Excretory products; Ammonotelic, Uricotelic and Ureotelic animals;

Functional Architecture of Mammalian Kidney; Structure of Uriniferous tubule; Mechanism of formation of urine.

UNIT-III: Physiology of Respiration

Respiratory System; The mechanism of Respiration: Inspiration and Expiration; Transport of Oxygen and Carbon dioxide; The dissociation curve of Oxyhaemoglobin; Respiratory pigments.

UNIT-IV: Physiology of Circulation

Structure of mammalian heart; Types of circulation; Systematic and Pulmonary circulation; The origin of heart beat; Conduction of heart beat; The cardiac cycle; Blood pressure; Factors affecting blood pressure.

UNIT-V: Blood

The Structure and Functions of Blood; Blood Groups: The ABO System and Rh factors; The clotting of Blood: Mechanisms, Factors and Natural Inhibitors.

UNIT-VI: Nerve Physiology

Functional Architecture of a Neuron; Morphological Classification of Nerve Cells; Nerve Fibres: Myelinated and Non-Myelinated Nerve Fibre; Propagation of Nerve impulse; The Synapse and Synaptic transmission.

Course Code: BSZ-403 (Theory)
Course Title: BIOCHEMISTRY OF METABOLIC PROCESSES (4 Credit)
Course Outcome:

CO1: Interactions and interdependence of physiological and biochemical processes. Also understand the chemical nature of life and life process.
CO2: Get an idea on structure and functioning of biologically important molecules.
CO3: Help to explore new developments in biochemistry.
CO4: Enable the students to illustrate various Biochemical pathways.
CO5: Develop an interest in the debates and discussions associated with Lifestyle Diseases.

Contents:

UNIT I: Overview of Metabolism

Metabolic pathways, types of metabolic pathways, site of different metabolic pathways, anabolic, catabolic and amphibolic pathways, concepts of metabolic control.

UNIT II: Carbohydrate metabolism

Review of glycolysis and Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis

UNIT III: Lipid metabolism

Beta oxidation and omega oxidation of saturates fatty acids with even and odd number of carbon atoms, Biosynthesis of palmitic acid, Ketogenesis

UNIT IV: Protein metabolism

Biosynthesis of amino acid, Catabolism of amino acid, Fate of C-skeleton of Glucogenic and Ketogenic amino acid

UNIT V: Oxidative phosphorylation

Review of mitochondrial respiratory chain, inhibitors and uncouplers of Electron transport System

Course Code: BSZ-404 (Practical)
Course Title: COMPARATIVE ANATOMY OF VERTEBRATES (2 Credits)
Course Outcome:
CO1:Students would be able to know and compare the different anatomical aspect of various organisms.
CO2: Students will acquire the knowledge of functioning of different body parts.
CO3: To understand the position of gonads in fishes through dissection.
CO4: To make students capable to design assignments/models on skeletal system in vertebrates.

Contents:

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.
2. Study of disarticulated skeleton of frog/fowl.
3. Study of articulated skeleton of human and rabbit.
4. Preparation of temporary slides from the scales.
5. Dissection of fish to study the pituitary gland.
6. Dissection of fish to study the gonads.
7. Study of structure of any two organs –

   Heart, lung, kidney, eye, ear through video recording
8. Project on skeletal modification of vertebrates.
9. Submission of skeleton of vertebrates.

Course Code: BSZ-405 (Practical)
Course Title: BIOCHEMISTRY (2 Credit)
Course Outcome:
CO1: Demonstrate basic principles in physiology Objectives of the course.
CO2: Learn clinical procedures for blood & urine analysis.
CO3: Develop skill in simple biochemical laboratory procedures.
CO4: Recognise the importance of various databases

Contents:

1. Preparation of fixatives, stains and other reagents.
2. Preparation of haemin crystal of blood.
3. Detection of blood glucose by glucose meter.
4. Quantitative estimation of total protein in given solution by Lowry's method.
5. Quantitative estimation of total carbohydrate by Anthrone method.
6. Quantitative estimation of lipid by colorimetric method.
7. To study the enzymatic activity of Trypsin and Lipase.
8. Qualitative estimation of amino acid using Ninhydrin reagent.

Course Code: BSZ-406 (Theory)

Course Title: Skills Development –II: Fish and Poultry Farming, and Nature Photography (2 Credits)

Course Outcome:

CO1: To understand the definition of endemic fish species. Types of endemism, Endemic fish species of India Conservation measures with understanding the definition of exotic fish species, Rules of introduction of exotic species, Preventive measures, Exotic fish species of India.

CO2: To understand the types of commercial layers and broilers, Selection of commercial layers and understand the construction of poultry farm, Rearing of broilers and layers by visiting the commercial farms.

CO4: To understand the basics about the camera, types of still camera, components of the camera (lens, aperture and other accessories), Good framing of the nature and wildlife photography and basic role of nature photography.

Contents:

Unit – I: Fish and Poultry Farming

Fish Farming (Endemic and Exotic Species)

1. Definition of endemic species. Types of endemism, Endemic fish species of India Conservation measures.
2. Definition of exotic species, Rules of introduction of exotic species, Preventive measures, Exotic fish species of India.

Poultry farming

3. Types of commercial layers and broilers, Selection of commercial layers.
4. Construction of poultry farm.
5. Rearing of broilers and layers.
6. Poultry waste management.

Unit – II: Nature Photography

7. History and evolution of Photography
8. Basics about the camera, types of still camera, components of the camera (lens, aperture and other accessories)
9. Good framing of the nature and wildlife photography
10. Basic role of nature photography.

SUGGESTD BOOKS

1. Poultry Science Practice (2015) by Nilotpal Ghosh, CBS Publishers & Distributors Pvt. Ltd
2. Modern Poultry Farming (2003) by Louis M Hurd, CBS Publishers & Distributors Pvt. Ltd
3. Recirculating Aquaculture Systems: A Guide to Farm Design and Operations (2018) by Andy Davison, Kindle Edition
4. Photography for Beginners (2016) by James Clark, David Jones, Olivia Jones, Charles ANDERSON, Kindle Edition
5. Photography: Nikon DSLRs for Beginners 2ND EDITION by Crys Kirkland, Kindle Edition

Course Code: BSZ-501 (Theory)
Course Title: Molecular Biology (4 Credits)
Course Outcome:

CO1: Develop deeper understanding of what life is and how it functions at cellular level.
CO2: Describe cellular membrane structure and function, fine structure and function of cell organelles.
CO3: Perform a variety of molecular and cellular biology techniques.
CO4: To understand about the Knowledge of genetics, developmental biology and organogenesis.
CO5: To understand the Application of DNA technology and molecular biology for research

Contents:

UNIT I:

1. Introduction: Concept,significance and historical background of moleculer biology.
2. Identification of genetic material: Direct and indirect evidences of DNA and RNA as genetic material.

UNIT II:

3. Moleculer structure of genetic material DNA and RNA.
4. DNA replication- experimental evidence of semi conservative nature of DNA replication,unidirectional and bidirectional replication,mechanism of replication in prokaryotes,
   DNA replicative enzymes.

UNIT III:

5. RNA- mechanism of transcriptiion in prokaryotes .
6. Genetic code and its characteristics

UNIT IV:

7. Mechanism of protein synthesis.
8. Regulation of gene expression in prokaryotes.

BOOKS RECOMMENDED:

1. CELL AND MOLECULER BIOLOGY –LODISH

2. CELL AND MOLECULER BIOLGY-GERALD KARP.

Course Code: BSZ-502 (Theory)
Course Title: Principles of Genetics (4 Credits)
Course Outcome:
CO1:To understand the basic concept of genetics, laws of inheritance and central dogma of biology.
CO2:Would gain knowledge about gametogenesis, cleavage mechanisms, gastrulation and role of hormones in metamorphosis and regeneration.
CO3: Understand the theories of classical genetics and blood group inheritance in man.
CO4: To understand the genetic variation through linkage and crossing over, chromosomal aberrations and sex determination.
CO5: Understand the genetic defects and inborn errors of metabolism and genetic counselling and role of inbreeding and outbreeding.

Contents:
Unit-I:

1. Mendelian Laws of Inheritance, Back cross and Test cross
2. Varieties of gene expression- multiple alleles, lethal genes, pleiotropic genes, gene interactions, epitasis.
3. Linkage- its mechanism and significance, experiment of linkage, linkage map.

Unit-II:

1. Nucleic acids- DNA and RNA, chemical structure and function.
2. Structural changes in chromosomes (Chromosomal aberration), Numerical changes in chromosomes, Genetic consequences of changes in Chromosome.
3. Extra chromosomal Inheritance.

Unit-III:

1. Crossing-over: types and mechanism, synaptinemal complex and genetic recombination, significance of crossing over.
2. Genetic basis of sex determination.
3. Genetic diseases in man

Unit-IV:

1. Regulation of gene expression.
2. Mutation- Molecular basis of mutation. Consequences of mutation.
3. Recombination in Bacteria and Viruses: Conjugation, Transportation, Transduction, Complementation test in Bacteriophage. Transposable Genetic elements.

SUGGESTED BOOKS:

1. P. S. Verma and V. K. Agarwal: Cell Biology, Genetics, Molecular Biology, Evolution & Ecology, S. Chand, 2004
2. P. S. Verma and V. K. Agarwal: Genetics, S. Chand, 2010
3. B. D. Singh. Fundamentals of Genetics, 4th Ed., 2009
4. J. Deepali Trivedi & P. Shreemankar: Kapur & Suri'S Basic Human Genetics, 3rd Ed., 2016
5. K. B. Ahluwalia: Genetics, New Age International Publication, 2009

Course Code: BSZ-503 (Theory)
Course Title: Fish and Fishery (4 Credits)
Course Outcome:
CO1: To understand the fish and fishery industries.
CO2: Understand the various types and method of aquaculture practices.
CO3: Understands the physiology and reproductive mechanisms of important fishes.
CO4: Understands the modern techniques and methods of fishery industries.
CO5: Attained knowledge about important cultivable fin fishes, shell fishes and importance of value added fishery products.

Contents:
UNIT I:

General description of fish, Introduction and Classification, Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction.

UNIT II:

Morphology and Physiology: Types of fins and their modifications; Locomotion in fishes, 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, Osmoregulation in Elasmobranchs; Electric organs; Bioluminiscience; Migration in fishes.

UNIT III:

Inland Fisheries; Marine Fisheries. Non-piscian fisheries, Fishing crafts and Gears; Depletion of fishery resources; Fishery laws and regulations

UNIT IV:

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Composite fish culture; Induced breeding of fish; Preparation and maintenance of fish aquarium; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Fish Preservation, Fish by-products.

UNIT V:

Transgenic fish, application of Biotechnology in fishery

Course Code: BSZ-504 (Theory)
Course Title: Parasitology (4 Credits)
Course Outcome:

CO1: To understand the types of parasites, types of host, host-parasite relationship, zoonosis, source of Infections and mode of infections.
CO2: To understand the concept of Hemoflagelates taking the example of Leishmania and their prophylaxis.
CO3: To understand the insect vectors diseases, by taking example of Malaria disease: types of malaria, Life cycle.
CO4: To understand the general features of Helminthes and Platyhelminthes.
CO5: To study the different parasites like Tap worm, hook worm and liver flukes.

Contents:

UNIT-I:

1. Introduction to Parasitology: Types of Parasites, Types of Host, Zoonosis, Source of Infections and Mode of Infections.
2. General features and Classification of Protozoa.
3. *Entamoeba histolytica*: Morphology, Life cycle and pathogenesis.
4. *Giardia*: Morphology, Life cycle and Pathogenesis.

UNIT-II:

1. General Characteristic of Hemoflagellates.
2. *Trypanosoma gambiense*: Morphology, Life cycle and Pathogenesis.
3. *Leishmania donovani*: Morphology, Life cycle and pathogenesis.
4. Malarial parasites: Types of malarial parasites, Vectors, Life cycle and Pathogenesis.

UNIT-III:

1. Helminths: General Characteristics and Classification.
2. General Characteristics of Cestodes (Tapeworms)
3. *Taenia solium*: Morphology, Life cycle and Pathogenesis.
4. General Characteristics of Flukes; *Fasciola hepatica*: Morphology, Life cycle and pathogenesis.

UNIT-IV:

1. Nematodes: General characteristics and classification.
2. Hook Worm- *Ancyclostoma duodenale*: Morphology, Life cycle and pathogenesis.
3. Round Worm- *Ascaris lumbricoides*: Morphology, Life cycle and pathogenesis.
4. Filarial worms- *Wuchereria bancrofti*:Morphology, Life cycle and pathogenesis.

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Recommended Books:

1. Medical parasitology- C.K. Paniker and Sougata Ghosh, Jaypee Brothers Medical Publishers (P) Ltd.
2. General Parasitology, Cheng T. C., Academic Press.
3. 7. A Text book of Parasitology, Bombay Popular Prakashan – by S.S. Kelkar and Rohini S. Kelkar.
4. Parasitology – by Chandler and Chands, S. Chand & Company Ltd.
5. Parasitology – By Ramnik sood, C.B.S. Publisher, New Delhi – 1993.
6. A Handbook on Economic Zoology, S. Chand & Company Ltd.- Dr. Jawaid Ahsan and Dr. Subhas P. Sinha.

Course Code: BSZ-505 (Practical)
Course Title: Molecular Biology (2 Credit)
Course Outcome:
CO1:Acquire knowledge of principles and working mechanisms of different microscopes.
CO2:Understands the mechanism of mitosis and meiosis.
CO3:Learn slide preparation to observe of giant chromosome, epithelial and blood cells.
CO4: Understand the concept of chromatography.

Contents:

1. Quantitative estimation of DNA using diphenylamine reagent.
2. Quantitative estimation of RNA using orcinol reagent.
3. Study of polytene chromosome from drosophila larvae.
4. Isolation of protein.
5. Preparation of agarose gel medium for gel electrophoresis.
6. Temporary squash preparation of onion root tip cells to study the stages of mitosis.
7. Study and interpretation of Electronmicrographs or photographs showing:
   (i) DNA replication
   (ii) Transcription
   (iii) Split genes
8. Paper based model submission
9. Practical Notebook
10. Viva voce

Course Code: BSZ-506 (Practical)
Course Title: Principles of Genetics (2 Credits)
Course Outcome:

CO1: Understand the inheritance of mendelian traits by direct observation among students.

CO2: Acquire knowledge, skill development, observation of blood group identification and pedigree chart preparations.

CO3: Understood of the mechanism of phenotypic expression in Drosophila.

CO4: Gained genetic knowledge on the observation of specimens and models.

Contents:

1. Staining techniques of nucleus and nucleolus
2. Study of different stages of mitosis through permanent slides
3. Study of different stages of meiosis through permanent slides
4. Preparation of temporary slides for mitosis in onion root tip
5. Staining of Barr body from buccal epithelium.
6. Study of giant chromosome from salivary gland of *Chironomous/Drosophila*
7. Pedigree chart analysis.
8. Laboratory Note book.
9. Viva voce

Course Code: BSZ-507 (Practical)
Course Title: Fish and Fishery (2 Credits)
Course Outcome:
CO1: To identify the different species of Indigenous Indian Major Carps and Exotic Carps.
CO2: To identify the commercial fish species in the lab and as well as in the field.
CO3: To understand the knowledge of fish industry by visiting the major fish market.
CO4: To understand the knowledge of fish farming by visiting the Fish farmers.

Contents:

1. (i) Identification of commercially important edible fishes : *Labeo rohita, Labeo gonius, Labeo bata, Cirrhinus reba , Catla catla, Puntius sophore, Wallago attu, Sperata seenghala, Mystus vittatus, Clarius batrachus, Heteropneustes fossilis, Channa marulius, Channa striatus, Notopterus notopterus, Hilsa ilisha, Anabus testudineus, Puntius javanicus, Cyprinus carpio, Hypothalmichthys molitrix.*

(ii) Identification of some important ornamental fishes

2. Fecundity and estimation of Gastrosomatic Index of any freshwater fish.
3. Study of different types of scales (through permanent slides/ photographs).
4. Study of fishing crafts and gears used in Fisheries
5. Determination of the amount of Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body.
6. Study of air breathing organs /Accessory respiratory organs in Channa, *Heteropneustes, Anabas* and Clarias spp.
7. Examination of stomach contents/gut content of fish in order to understand their feeding habits.
8. Project Report on a visit to any fish farm/ pisciculture unit/ Induced Breeding in Fishes

SUGGESTED READINGS

1. Lagler, K.F., J.E. Bardach, R.R. Miller & D.R.M. Passino. 1977. Ichthyology. John Willey & Sons, New York.
2. Nelson, J. 2006. Fishes of the World., 4th Edn., Willey Eastern Bk. Ltd.
3. Jayaram, K.C. 2008. Fishes of the Indian Region. Narendra Pub., New Delhi
4. Brown, M.E. 1957. The Physiology of Fishes. Academic Press, New York Vol. 1 & 2.
5. Hoar, W. & Randall, Fish Physiology, Vol I-XV., Acad. Press.
6. Evans, D.H. Physiology of Fishes, II Edn.
7. Vishwanth, W., W. S. Lakra & U. K. Sarkar. 2007. *Fishes of north east India*. National Bureau of fish genetic resources, Lucknow, ICAR, India.

Course Code: BSZ-508 (Practical)
Course Title: Parasitology (2 Credits)
Course Outcome:
CO1: To identify the different species of parasites present in the Laboratory.
CO2: To identify the insect vectors causing the disease like malaria, filarial, etc.
CO3: To impart the knowledge of infection of parasites by visiting the slaughter house.
CO4: To study the different parasites like Tap worm, hook worm and liver flukes.

Contents:

1. Identification of parasites from permanent Slides: *Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani. Entamoeba histolytica, Ancyclostoma duodenale* and *Wuchereria bancrofti.*
2. Identification of parasites from Museum specimen: *Taeniasolium, Ascaris lumbricoides, Fasciola hepatica* and *Argas, Boophilus* (Tick).
3. Preparation of permanent slides and identification of mouth parts of Vectors of Insect born disease: *Anophelees, Culex* and *Aedes*.
4. Study of Parasites from the gills of fresh water fish.
5. Study of nematode/cestode parasites from the intestines of Poultry bird.
6. Study of Ecto-parasites & Endo-parasites of cattle, dog, chick & human.
7. Preparation of whole mounts for helminthes.
8. Practical Note Book
9. Viva Voce

Course Code: BSZ-601 (Theory)
Course Title: Developmental Biology (2 Credits)
Course Outcome:
CO1:Understand the process of organogenesis of selected organs, development of extra embryonic membrane and the nature and physiology of placenta.
CO2:Come to know the inducer and inductor role in embryogenesis and knowledge about metamorphosis and the process of regeneration.
CO3:Get familiar with various stages involved in the developing embryo and types of placenta.
CO4:Understand the initial developmental procedure involved in Amphioxus, frog and chick.
CO5: Familiarise with the principle of developmental biology and various Techniques and tools of Embryology.

Contents:

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 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

Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories

UNIT 5:

Implications of Developmental Biology 8 Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis

SUGGESTED READINGS

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
2. 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.
3. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
4. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

Course Code: BSZ-602 (Theory)
Course Title: Evolutionay Biology (4 Credits)
Course Outcome:
CO1:Understand the theories of evolution and highlighted the role of evidences in support of evolution.
CO2:Describe the evolutionary knowledge through the concepts of coloration and mimicry.
CO3: Identify the contributions of various evolutionists.
CO4: Identify different zoogeographical realms with fauna.
CO5: To understand the knowledge of eras and evolution of species.

Contents:
UNIT 1: Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes

UNIT 2: Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism

UNIT 3: Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Molecular (universality of genetic code and protein synthesising machinery, three domains of life, neutral theory of molecular evolution, molecular clock ,example of globin gene family, rRNA/cyt c

UNIT 4: Sources of variations: Heritable variations and their role in evolution

UNIT 5: Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium. Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies

UNIT 6: Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, 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: Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, molecular analysis of human origin

Course Code: BSZ-603 (Theory)
Course Title: Reproductive Biology (4 Credit)
Course Outcome:
CO1: To understand the fundamentals of the structure and function of the male and female reproductive tracts, gametogenesis, fertilization, early embryogenesis, fetal development and preparation for birth, and maternal adaptations to pregnanc.
CO2: To understand the male and female reproductive hormones and their functions.
CO3: To impart the knowledge of IVF and GIFT and to understand the important foundation to consider sexual differentiation and development, contraception, infertility and current reproductive technologies.
CO4:To understand the process of human implantation and decidualization of the endometrium.
CO5: Understand the major hormonal signals controlling breast development and lactation.

Contents:
UNIT I: Reproductive Endocrinology: Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

UNIT II: Functional anatomy of male reproduction: Outline and histological of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract

UNIT III: Functional anatomy of female reproduction: Outline and histological of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

UNIT IV: Reproductive Health: Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning

Course Code: BSZ-604 (Theory)
Course Title: Wildlife Conservation and Management (4 Credits)
Course Outcome:
CO1: To understand the different types of Threatened species or Endangered species specially to North East India.
CO2: To impart the knowledge of Indian Wildlife protection Act and Indian Forest Act.
CO3: To impart the knowledge of different National Park and Wildlife Sanctuaries of North east.
CO4:Students will have a greater knowledge of how wildlife conservation and management relates to the economy and environment, both currently and in the future.
CO5: Students will be able to critically evaluate current events and public information related to wildlife conservation and management as being scientifically-based or opinion-based and contribute to the knowledge base of information.

Contents:
UNIT I: Introduction to Wild Life
Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.
UNIT II: 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 III: Management of habitats
Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity.
UNIT IV: Population estimation
Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

UNIT V: 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 perturbence.
UNIT VI: Management of excess population
Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal
UNIT VII: 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.

Course Code: BSZ-605 (Practical)
Course Title: Developmental Biology (2 Credits)
Course Outcome:
CO1: Demonstrate various types of Eggs
CO2: To impart the knowledge of difference between the male and female reproductive system by dissecting cockroach.
CO3: To understand the different developmental stages of animal by collecting the eggs of Frog from the field and rearing in the laboratory and then identify the different stages.
CO4: Expose to concepts and process in developmental biology.

Contents:
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)

2. 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)

3. Study of the developmental stages and life cycle of Drosophila from stock culture

4. Study of different sections of placenta (photomicropgraph/ slides)

5. Project report on Drosophila culture/chick embryo development

6. Submission of Practical Record Book.

7. Viva voce.

SUGGESTED READINGS (*for BSZ 601 & BSZ 605*)

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

Course Code: BSZ-606 (Practical)
Course Title: Evolutionary Biology (2 Credits)
Course Outcome:
CO1: To understand the different evolutionary process of human with the help of chart and PPT.
CO2: To understand the Palaentology with the demonstration of different fossil record with the help of PPT.
CO3: To make aware about the different types of era with the help of demonstration through PPT.
CO4: Student will learn about the sedimentation by visiting the national museum.

Contents:
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. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies

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

6. Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation.

7. Submission of Practical Record Book.

8. Viva voce

SUGGESTED READINGS (*for BSZ 602 & BSZ 606*)

Ridley,M (2004) Evolution III Edition Blackwell publishing

Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.

Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.

Douglas, J. Futuyma (1997).Evolutionary Biology. Sinauer Associates. Snustad. S Principles of Genetics.

Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition WileyBlackwell

Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley

Course Code: BSZ-607 (Practical)
Course Title: Reproductive Biology (2 Credits)
Course Outcome:
CO1: To impart the knowledge of difference between the male and female reproductive system by dissecting cockroach.
CO2: To understand the different types of oestrous cycle with help of laboratory work in mice.
CO: 3 Student will learn the Reproductive cycle in the laboratory by observing the mice.
CO4: Study of modern contraceptive devices through picture, models.

Contents:
1. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
2. Examination of vaginal smear rats from live animals.

3. Surgical techniques: principles of surgery in endocrinology. Ovarectomy, hysterectorny, castration and vasectomy in rats.

4. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.

5. Human vaginal exfoliate cytology.

6. Sperm count and sperm motility in rat

7. Study of modern contraceptive devices

8. Submission of Practical Record Book.

9. Viva voce

SUGGESTED READINGS (*for BSZ 603 & BSZ 607*)

Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.

Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.

Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.

Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.

Course Code: BSZ-608

Course Title: Practical: Wildlife conservation and management (2 Credits)

Course Outcome:

CO1: To understand the insitu and exsitu conservation, student visit Wildlife Sanctuary or National Park and any Wild ConservationCentre (eg., Pigmy Hog Conservation Centre).

CO2: Student learn the Forest management system by visiting Wildlife Sanctuary or National Park.

CO3: To understand the different species of different animals, field survey is guided.

CO4: To understand the species diversity, diversity index is applied at different field level.

Contents:

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)
7. Submission of Practical Record Book
8. Viva voce

SUGGESTED READINGS (*for BSZ 604 & BSZ 608*)

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 Coexistence? Cambridge University.

Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th 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.