

B.Sc. (Zoology)
(Three years programme)

School of Applied Sciences

Centurion University of Technology & Management

2018

Course structure

Semester-I

Sl. No	Code	Subject Name	T-T-P	Credit
1	BSFL1101	English	2-0-0	2
	FCBS0101	Environmental Science		
2	BSZO1101	Non-Chordates I	3-1-3	6
3	BSZO1102	Principles of Ecology	3-1-3	6
4	GE-1 [@]	Inter Disciplinary Subject		6
Total				20

Semester-II

Sl. No	Code	Subject Name	T-T-P	Credit
1	BSFL1101	English	2-0-0	2
	FCBS0101	Environmental Science		
2	BSZO1201	Non-Chordates II	3-1-3	6
3	BSZO1202	Cell Biology	3-1-3	6
4	GE-2 [@]	Inter Disciplinary Subject		6
Total				20

Note: [@] Generic Elective Subjects to be chosen from discipline other than Zoology

Semester-III

Sl. No	Code	Subject Name	T-T-P	Credit
1	SEC-1 [#]	Skill Enhancement Course-1	0-0-3	2
2	BSZO2301	Diversity of Chordates	3-1-3	6
3	BSZO2302	Physiology: Controlling and Coordinating Systems	3-1-3	6
4	BSZO2303	Fundamentals of Biochemistry	3-1-3	6
5	GE-3 [@]	Inter Disciplinary Subject		6
Total				26

Semester-IV

Sl. No	Code	Subject Name	T-T-P	Credit
1	SEC -2 [#]	Skill Enhancement Course-2	0-0-3	2
2	BSZO2401	Comparative Anatomy of Vertebrates	3-1-3	6
3	BSZO2402	Physiology: Life Sustaining Systems	3-1-3	6
4	BSZO2403	Biochemistry of Metabolic Processes	3-1-3	6
5	GE-4 [@]	Inter Disciplinary Subject		6
Total				26

Note: [#] Any two Skill Enhancement Courses to be chosen from the list given below

Skill Enhancement Courses

Sl. No	Code	Subject Name	T-T-P	Credit
1	BSLS2001	Techniques in Biofertilizer (SEC-1)	0-0-3	2
2	BSLS2002	Skill in Apiculture (SEC-1)	0-0-3	2
3	BSLS2003	Herbal Technology(SEC-2)	0-0-3	2
4	BSLS2004	Techniques in Medical Diagnostics (SEC-2)	0-0-3	2
5	BSLS2005	Vermicomposting	0-0-3	2
6	BSLS2011	Pisciculture	0-0-3	2
7	BSLS2012	Sericulture	0-0-3	2
8	BSLS2013	Ecotourism	0-0-3	2
9	BSLS2014	Poultry Management	0-0-3	2
10	BSLS2015	Ornamental Fish Management	0-0-3	2

Semester- V

Sl. No	Code	Subject Name	T-T-P	Credit
1	BSZO3501	Molecular Biology	3-1-3	6
2	BSZO3502	Principle of Genetics	3-1-3	6
3	DSE*	Discipline Specific Elective-1		6
4	DSE*	Discipline Specific Elective-2		6
		Total		24

Semester- VI

Sl. No	Code	Subject Name	T-T-P	Credit
1	BSZO3601	Developmental Biology	3-1-3	6
2	BSZO3602	Evolutionary Biology	3-1-3	6
3	DSE*	Discipline Specific Elective-3		6
4	DSE*	Discipline Specific Elective-4		6
		Total		24

Note: * Any four discipline specific elective to be chosen from the list given below



Discipline Specific Elective Courses (Non Domain)

Subject Name	Code	Type of Course	T-T-P Credit	Prerequisite
Animal Biotechnology	BSZO3503	Theory + Practice	3-1-3(06)	Nil
Fish and Fisheries	BSZO3504	Theory + Practice	3-1-3(06)	Nil
Immunology	BSZO3603	Theory + Practice	3-1-3(06)	Nil
Parasitology	BSZO3604	Theory + Practice	3-1-3(06)	Nil

Discipline Specific Elective Courses (Domain: Reproductive Physiology)

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Basics of Neuroscience	BSRPDE01	Theory + Practice	3-1-3(06)	Nil
Exploring The Brain: Structure and Function	BSRPDE02	Theory + Practice	3-1-3(06)	Nil
Endocrinology	BSRPDE03	Theory + Practice	3-1-3(06)	Nil
Reproductive Biology	BSRPDE04	Theory + Practice	3-1-3(06)	Nil

Discipline Specific Elective Courses (Domain: Biodiversity Management)

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Biology of Insecta	BSBMDE01	Theory +Practice	3-1-3(6)	Nil
Animal Behaviour and Chronobiology	BSBMDE02	Theory + Practice	3-1-3(6)	Nil
Wild Life Conservation and Management	BSBMDE03	Theory + Practice	3-1-3(6)	Nil
Environment And Public Health	BSBMDE04	Theory + Practice	3-1-3(6)	Nil

**Semester-I****English**

Subject Name	Code	Type of course	T-T-P(Credit)
English	BSFL1101	Theory	2-0-0 (02)

1. Objective

- Control sentence-level error (grammar, punctuation, and spelling).
- Demonstrate the ability to approach writing as a recursive process that requires substantial revision of drafts for content, organization, and clarity (global revision), as well as editing and proofreading (local revision).

2. Learning outcome

- Demonstrate knowledge and comprehension of major texts and traditions of language and literature written in English as well as their social, cultural, theoretical, and historical contexts
- Write with proficiency in one or more creative literary form (poetry, fiction, creative non-fiction).

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Internal Test	30	Written examination
	Assignment	10	Report and Presentation
	Experiments	-	Lab work, report
	Project	-	Report and presentation
	Quiz	-	Surprise/preannounced ones
<i>External Examination</i>		60	Written examination
<i>Total</i>		100	

Module-I: Communication Skill

Communication: Definition, concept

Channels of Communication: Sender, receiver, channel, message, encoding, decoding, context, feedback

Verbal & Non-Verbal Communication: Spoken & written-advantages & disadvantages, Bias free

English, Formal & informal style.

Module-II: Communicative Grammar

Time, Tense & Aspect

Verbs of state & events

Modality

Active & Passive voice

Antonyms, Synonyms, Homonyms, one word substitutions & correction of errors



Module-III: Sounds of English

Length of vowels:

Long vowels as in the words feel, food, shoot, card etc.

Short vowels as in the words pen, sun, cut, shut, etc.

Consonants

Stress pattern

Intonation: Rising & Falling.

Text Books:

1. Effective technical communication by M.A.Rizvi

Reference Books:

1. Communicative English & Business Communication by R.K.Panda, J.Khuntia, M.Pati, Alok Publication.
2. Communicative Grammar of English Geoffrey Leech

Environmental Science

Subject Name	Code	Type of course	T-T-P(Credit)
Environmental Science	FCBS0101	Theory	2-0-0 (02)

1. Objective

- *To understand the concept of multi-disciplinary nature of Environmental Science where different aspects are dealt with a holistic approach.*
- *Students will develop a sense of community responsibility by becoming aware of environmental issues in the larger social context.*

2. Learning outcome

- *Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.*
- *Appreciate key concepts from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.*

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	30	Written examination
	Assignment	10	Report and Presentation
	Experiments	-	Lab work, report
	Project	-	Report and presentation
	Quiz	-	Surprise/preannounced ones
<i>External Examination</i>		60	Written examination
<i>Total</i>		100	



Module: I

Environment and its multidisciplinary nature; Need for public awareness; Renewable and non-renewable resources—forest, water, mineral, land, food and energy resources; Structure and function of ecosystems of forest, grass land, desert and aquatic types.

Module: II

Biodiversity and its conservation: Biodiversity at global, national and local levels; Threats to biodiversity - Habitat loss; wild life poaching and man - wildlife conflicts; Endangered and endemic species; conservation measures.

Causes, effects and control measures of pollution, air, water and noise pollution; Nuclear hazards; solid-waste management—Causes, effects and control measures; Management of disasters due to natural causes of floods, earthquakes, cyclones and landslides.

Module: III

Social issues and the environment; Sustainable environment, Water conservation measures; Rain water harvesting; Resettlement and rehabilitation of people; Climate change and global warming; Acid rain; Ozone layer depletion; water land reclamation; Consumerism and waste products; Features of Environment Protection Act, Air pollution and Control of Pollution Acts; Water Pollution and its Control Act. Effects of Pollution explosion on environment and public health; Need for value education to Protect environment and resources.

Text Books:

1. AnubhavKaushik& C.P. Kaushik: Environmental Studies-New age International Publishers.

Reference Books:

1. Benny Joseph: Environmental Studies-Tata Mac Graw Hill
2. E. Bharucha: Text book of Environmental Studies for under graduate courses—Universities Press. (Book prepared by UGC Committee.

Non-Chordates-I

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Core-I Non-Chordates I	BSZO1101	Theory & Practice	3-1-3(06)	NIL

1. Objective

- To have in depth knowledge about invertebrates of different phyla.

2. Learning outcome

- Students would be able to represent invertebrates of different categories which affect the ecosystem in various ways.
- Students will acquire knowledge of intricate relationship of man and environment.

**3. Evaluation System:**

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module- I (12Hrs) Protista, Parazoa and Metazoa : General characteristics and Classification up to classes, Study of *Euglena*, *Amoeba* and *Paramecium*, Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*,

Module- II

Locomotion and Reproduction in Protista, Evolution of symmetry and segmentation of Metazoa.

Module- III (5Hrs)

Porifera: General characteristics and Classification up to classes, Canal system and spicules in sponges

Module- IV (8Hrs)

Cnidaria: General characteristics and Classification up to classes, Metagenesis in *Obelia* Polymorphism in Cnidaria, Corals and coral reefs.

Module- V (9Hrs)

Ctenophora: General characteristics and Evolutionary significance, General characteristics and Evolutionary significance.

Module- VI (8Hrs)

Platyhelminthes: General characteristics and Classification up to classes, Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*

Module- VII (16Hrs)

Nemathelminthes: General characteristics and Classification up to classes, Life cycle, and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti*, Parasitic adaptations in helminthes

Non-Chordates I Lab**Experiments:**

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

Text Books:

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

Reference Books:



- International Edition. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson

Principles of Ecology

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Principles of Ecology	BSZO1102	Theory & Practice	3-1-3(06)	Nil

1. Objective

- Obtain knowledge about the Ecosystem and their functioning, so that they will be crusader of environmental sustainability.

2. Learning outcome

- Students will acquire knowledge of intricate relationship of main and environment.

3. Evaluation System

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module- I(10Hrs)

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

Module- II (7Hrs)

Population: Unitary and Modular populations Unique and group attributes of population: Density, nasality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion. Exponential and logistic growth, equation and patterns, r and K strategies .

Module-III (8Hrs)

Population regulation - density-dependent and independent factors Population interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical Responses.

Module-IV (8Hrs)

Community: Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one Example, Theories pertaining to climax community.

Module- V (5Hrs)

Ecosystem: Types of ecosystems with one example in detail, Food chain: Detritus and Grazing food chains, Linear and Y-shaped food chains, Food web.



Module- VI (5Hrs)

Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies

Module- VII (5Hrs)

Nutrient and biogeochemical cycle with one example of Nitrogen cycle, Human modified ecosystem

Applied Ecology: Ecology in Wildlife Conservation and Management

Principles of Ecology Lab

Experiments:

- Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
- Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
- Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO₂.
- Report on a visit to National Park/Biodiversity Park/Wild life sanctuary.

Text Books:

- Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole

Reference Books:

- Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
- Robert Leo Smith Ecology and field biology Harper and Row publisher Ricklefs, R.E., (2000). Ecology. V Edition. Chiron

Semester-II

Non-Chordate II

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Non-Chordates II	BSZO1201	Theory & Practice	3-1-3(06)	Nil

1. Objective

- To introduce the students about the higher phyla of invertebrates and to know about taxonomy.
- To aware about the cytology and to know about the functioning of cells and components.

2. Learning outcome

- Students would be able to represent the various aspect of higher invertebrates phyla for future research.
- Students will acquire knowledge about the cells and apply their ability to design research work

**3. Evaluation System:**

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module-I (7Hrs)**Introduction to Coelomates:** Evolution of coelom and metamerism**Module-II (7Hrs)****Annelida:** General characteristics and Classification up to classes, Excretion in Annelida**Module-III (7Hrs)****Arthropoda:** General characteristics and Classification up to classes, Vision and Respiration in Arthropoda, Metamorphosis in Insects, Social life in bees and termites**Module-IV (7Hrs)****Onychophora:** General characteristics and Evolutionary significance**Module-V (7Hrs)****Mollusca:** General characteristics and Classification up to classes, Respiration in Mollusca, Torsion and detorsion in Gastropoda, Pearl formation in bivalves, Evolutionary significance of trochophore larva.**Module- VI (6Hrs)****Echinodermata:** General characteristics and Classification up to classes, Water-vascular system in Asteroidea**Module-VII (5Hrs)**

Larval forms in Echinodermata, Affinities with Chordates.

Non-Chordate II Lab**Experiments:****Study of following specimens:**

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

- Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm
- T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
- Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta*
- To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

Text Books:

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

Reference Books:

- Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson

**Cell Biology**

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Cell Biology	BSZO1202	Theory & Practice	3-1-3(06)	Nil

1. Objective

- To aware about the cytology and to know about the functioning of cells and components.

2. Learning outcome

- Students will acquire knowledge about the cells and apply their ability to design research work.

3. Evaluation System

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module- I (7Hrs)**Overview of Cells:**

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions,

Module- II (7Hrs)

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

Module- III (7Hrs)

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

Module- IV (8Hrs)

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

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

Module- V (6Hrs)

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

Module- VI (7Hrs)

Cell Division: Mitosis, Meiosis, Cell cycle and its regulation

Module- VII (7Hrs)

Cell Signaling: GPCR and Role of second messenger (cAMP)

Cell Biology Lab

Experiments:

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

Text Books:

- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

Reference Books:

- Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell, V Edition*, Garland publishing Inc., New York and London

Semester-III

Diversity of Chordates

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Diversity Of Chordates	BSZO2301	Theory & Practice	3-1-3(06)	NIL

1. Objective

- To make students aware of higher organisms and their taxonomy to correlate the evolutionary trend in organisms.

2. Learning outcome

- An in depth study for better application of mind to further approach towards biology.
- Students will be able to conduct research work efficiently.

**3. Evaluation System**

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
External Examination		30	Written examination
Total		100	

Module-I (7Hrs)

Introduction to Chordates: General characteristics and outline classification

Module-II (7Hrs)

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

Module-III (7Hrs)

Origin of Chordata: Dipleurula concept and the Echinoderm theory of origin of chordates Advanced features of vertebrates over Protochordata

Module-IV (7Hrs)

Agnatha : General characteristics and classification of cyclostomes up to class

Module-V (7Hrs)

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

Module-V (7Hrs)**Amphibia:**

Origin of *Tetrapoda* (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians

Module-VI (10Hrs)**Reptilia:**

General characteristics and classification up to order; Affinities of *Sphenodon*; Poison apparatus and Biting mechanism in snakes

Aves:

General characteristics and classification up to order *Archaeopteryx*—a connecting link; Principles and aerodynamics of flight, Flight adaptations and Migration in birds

Module-VII (16Hrs)**Mammals:**

General characters and classification up to order; Affinities of Prototheria; Adaptive radiate: Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms.

Diversity of Chordates Lab**Experiments:****1. Protochordata**

Balanoglossus, Herdmania, Branchiostoma, Colonial Urochordata Sections of Balanoglossus through proboscis and branchiogenital regions, Sections of Amphioxus through pharyngeal, intestinal and caudal regions. Permanent slide of Herdmania spicules



2. Agnatha: Petromyzon, xine

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

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

5. Reptilia

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

6. Aves

Study of six common birds from different orders. Types of beaks and claws

7. Mammalia

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

Mount of weberian ossicles of *Mystus*, pecten from Fowl head Dissection of Fowl head (Dissections and mounts subject to permission) Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission) Classification from Young, J. Z. (2004) to be followed

Test Books:

- Kotpal.R.L, (2007)*Modern Text Book of Zoology*, Rastogi Publication

Reference Books:

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

Animal Physiology: Controlling and Coordinating Systems

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Animal Physiology: Controlling and Coordinating Systems	BSZO2302	Theory & Practice	3-1-3(06)	Nil

1. Objective

To obtain Knowledge about the functioning of various system of organisms and their interrelationship for well-coordinated function.

2. Learning outcome

- An in depth study for better application of mind to further approach towards biology.
- This course would make students well equipped with the process of body and its functioning.

**3. Evaluation System :**

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module-I (7Hrs)

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

Module-II (7Hrs)

Bone and Cartilage: Structure and types of bones and cartilages, Ossification, bone growth and resorption **Muscle:** Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of Muscle twitch; Motor unit, summation and tetanus.

Module-III (12Hrs)

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

Module-IV (5Hrs)**Endocrine System I:**

Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones

Module-V (16Hrs)**Endocrine System II:**

Regulation of their secretion; Mode of hormone action, Signal transduction pathways for steroidal and non-steroidal hormones

Module-VI (7Hrs)

Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones.

Module-VII (7Hrs)**Reproductive System:**

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

Animal Physiology: Controlling and Coordinating Systems Lab**Experiments:**

- Preparation of permanent slide of liver/skeletal muscle/any other tissue of given specimen.
- Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)



- Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
- Study of permanent slides of various Mammalian tissues
- Preparation of permanent slide of any five mammalian (Goat/chick) tissues by microtomy

Text Books:

- Agrawal, V.K, Textbook of Animal Physiology, S.Chand Publication
- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition.
- Hercourt Asia PTE Ltd. /W.B. Saunders Company.

Reference Books:

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

Fundamentals of Biochemistry

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Fundamentals Of Biochemistry	BSZO2303	Theory & Practice	3-1-3(06)	Nil

1. Objective

- This course will make students to know about the biochemical features in organisms and self.

2. Learning outcome

- An in depth study for better application of mind to further approach towards biology.
- This course would make students well equipped with the process of body and its functioning.

3. Evaluation System

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module-I (8Hrs)

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

Module-II (8Hrs)

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

Module-III (8Hrs)

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



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

Module-IV (3Hrs)

Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants

Module-V (5Hrs)

Nucleic Acids: Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves: Base pairing, Denaturation and Renaturation of DNA Types of DNA and RNA, Complementarity of DNA, Hypo-Hyperchromaticity of DNA.

Module-VI (12Hrs)

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

Module-VII (3Hrs)

Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action

Fundamentals of Biochemistry Lab

Experiments:

- Qualitative tests of functional groups in carbohydrates,
- Qualitative tests of functional groups in protein
- Qualitative tests of functional groups in lipids.
- Separation of amino acid using Paper. Chromatography .
- Action of salivary amylase under optimum conditions.
- Effect of different pH on salivary amylase activity.
- Effect of different Temperature on salivary amylase activity.
- Effect of inhibitor on salivary amylase activity.

Text Books:

- Das, Debajyoti, 2010, Biochemistry, Academic Publisher
- Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.

Reference Book:

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

Semester - IV

Comparative Anatomy of Vertebrates

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Comparative Anatomy of Vertebrates	BSZO2401	Theory & Practice	3-1-3(06)	Nil

1. Objective

- To make students to know the anatomical features of various organisms and their evolutionary trend.
- To know the functioning of various organs and their inter relationship.

2. Learning outcome

- Students would be able to know and compare the different anatomical aspect of various organisms.
- Students will acquire the knowledge of functioning of different body parts.
- The students can apply the acquired knowledge for higher study.

3. Evaluation System:

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module-I (7Hrs)

Integumentary System: Structure, functions and derivatives of integument

Module-II (7Hrs)

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

Module-III (7Hrs)

Digestive System: Alimentary canal and associated glands, dentition

Module- IV (17Hrs)

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

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

Module- VII (16Hrs)

Nervous System:



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

Sense Organs:

Classification of receptors, Brief account of visual and auditory receptors in man

Comparative Anatomy of Vertebrates Lab

Experiments:

- Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
- Study of disarticulated skeleton of Amphibia/Reptilia/Aves/Mammal
- Study of Mammalian skulls (Rabbit)
- Study of Mammalian skulls (Rat)
- Dissection / video demonstration of Chick to study arterial system (subject to permission)
- Dissection / video demonstration of Chick to study system (subject to permission)
- Study of different organs of Rat/other vertebrate from video recording.
- Mini Project as per course.

Text Books:

- Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education

Reference Books:

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

Animal Physiology: Life Sustaining Systems

Subject Name	Code	Type of course	T-P-P	Prerequisite
Animal physiology: life sustaining system	BSZO2402	Theory & Practice	3-1-3(06)	Nil

1. Objective

- To know the functioning of various organs and their inter relationship.
- To make students to know about the various metabolic processes

2. Learning outcome

- Students would be able to know and compare the different anatomical aspect of various organisms.
- Students will acquire the knowledge of functioning of different body parts.
- The students can apply the acquired knowledge for higher study.

**3. Evaluation System**

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module- I (8Hrs)

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

Module- II (8Hrs)

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

Module- III (7Hrs)

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

Module- IV (8Hrs)

Physiology of Heart: Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses

Module- V (8Hrs)

Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation

Module- VI (6Hrs)**Renal Physiology :**

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

Module-VII (8Hrs)

Adaptive physiology: adaptation of reptile, aves, other species to water, space, land

Animal Physiology: Life Sustaining Systems Lab**Experiments:**

- Study of blood cells from prepared blood smear
- Determination of ABO Blood group
- Enumeration of red blood cells using haemocytometer



- Enumeration of red blood cells using haemocytometer
- Estimation of haemoglobin using Sahli's haemoglobinometer
- Preparation of haemin and haemochromogen crystals
- Recording of blood pressure using a sphygmomanometer.
- Examination of sections of various mammalian organs

Text Books:

- Das, Debajyoti, 2010, Biochemistry, Academic Publisher

Reference Books:

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

Biochemistry of Metabolic Processes

Subject Name	Code	Type of course	T-P-P	Prerequisite
Biochemistry of Metabolic Processes	BSZO2403	Theory & Practice	3-1-3(06)	Nil

1. Objective

- To know the functioning of various organs and their inter relationship.
- To make students to know about the various metabolic processes

2. Learning outcome

- Students will acquire the knowledge of functioning of different body parts.
- The students can apply the acquired knowledge for higher study.

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
External Examination		30	Written examination
Total		100	

Module- I (8Hrs)

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

Module- II (8Hrs)



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

Module- III (7Hrs)

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

Module- IV (8Hrs)

Protein Metabolism: Catabolism of amino acids: Transamination, Deamination,

Module- V (8Hrs)

Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids.

Module- VI (6Hrs)

Oxidative Phosphorylation : Redox systems; Review of mitochondrial respiratory chain

Module- VII (8Hrs)

Inhibitors and un-couplers of Electron Transport System

Biochemistry of Metabolic Process Lab

Experiments:

- To estimate the protein content of supplied tissue by colorimeter method
- To estimate the glycogen content of supplied tissue by colorimeter method
- To extract & colorimetric estimation of nucleic acid.
- To demonstrate the effect of temperature on enzyme activity.
- Preparation of Standard Curve of Bovine serum Albumin.
- Detection of SGOT in given sample using available kit. (Chick/Goat Serum)
- Determination of SGPT in given sample by using available kit.(Chick/Goat Serum)
- Estimation of total protein content in the given sample by Lowry's Method.
- To study the enzymatic activity of Trypsin and Lipase.
- Dry Lab: To trace the labelled C atoms of Acetyl-CoA till in the TCA cycle

Text Books:

- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II edition, BIOS Scientific Publishers Ltd., U.K.

Reference books:

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

N.B-Students can choose Generic Elective Subjects from other Departments other than Zoology Dept.as specified by UGC.



Semester - V

Molecular Biology

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Molecular Biology	BSZO3501	Theory & Practice	3-1-3(06)	Nil

1. Objective

- This course would make students to know about internal mechanism of functioning of body parts at cellular level
- This course is so designed to have in depth knowledge of heredity.

Learning outcome

- *Students will get the knowledge of molecular functioning of body parts.*
- *Students will acquire knowledge of gene and its function.*

Module-I (7Hrs)

Salient features of DNA and RNA, Watson and Crick model of DNA DNA Replication DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear ds-DNA, replication of telomeres.

Module- II (8Hrs)

Transcription: RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors.

Module- III (3Hrs)

Translation: Genetic code, Degeneracy of the genetic code and Wobble Hypothesis.

Module-IV(8Hrs)

Process 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; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation.

Module- V (8Hrs)

Post Transcriptional Modifications and Processing of Eukaryotic RNA Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA.

Module-VI (8Hrs)

Gene Regulation: Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trp operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements;

Module-VII (8Hrs)

Gene silencing, Genetic imprinting DNA Repair Mechanisms: Pyrimidine dimerization and mismatch repair Regulatory RNAs, Ribo-switches, RNA interference, miRNA, siRNA.

Molecular Biology Lab

Experiments:

- Preparation of liquid culture medium (LB) and raise culture of E. coli
- Preparation of Standard Curve DNA by Diphenyl method.
- Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking
- Preparation of Standard Curve RNA using Orcinol reaction.
- Histochemical demonstration of DNA(Liver/Testis of Chick).
- Demonstration of DNA & RNA by MGP.
- Demonstration of Mucopolysaccharides by PAS reaction.
- Demonstration by Mercurbromophenol blue/Fast Green.

Text Books:

- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia

Reference Books:

- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell.VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: Molecular Biology of the Cell, IV Edition.
- Cooper G. M. and Robert E. Hausman R. E. The Cell: A Molecular Approach, V Edition, ASM Press and Sinauer Associates.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition.Lippincott Williams and Wilkins, Philadelphia.
- Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- Lewin B. (2008). Gene XI, Jones and Bartlett McLennan A., Bates A., Turner, P. and
- White M. (2015). Molecular Biology IV Edition. GS, Taylor and Francis Group, New York and London.

Principles of Genetics

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Principles Of Genetics	BSZO3502	Theory & Practice	3-1-3(06)	Nil

1. Objective

- This course is so designed to have in depth knowledge of heredity.

2. Learning outcome

- *Students will get the knowledge of molecular functioning of body parts.*
- *Students will acquire knowledge of gene and its function.*

**3. Evaluation System:**

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
External Examination		30	Written examination
Total		100	

Module-I (7Hrs)**Mendelian Genetics and its Extension:**

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

Module- II (8Hrs)

Linkage, Crossing Over and Chromosomal Mapping, Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination. Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

Module- III (8Hrs)**Types of gene mutations (Classification):**

Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method.

Module- IV (8Hrs)

Sex Determination, Chromosomal mechanisms of sex determination in *Drosophila* and Man Extra-chromosomal Inheritance. Criteria for extra-chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*, Mitochondrial mutations in *Saccharomyces*, Infective heredity in *Paramecium* and Maternal effects.

Module-V (3Hrs)**Polygenic Inheritance:**

Polygenic inheritance with suitable examples; simple numericals based on it.

Module- VI (8Hrs)

Recombination in Bacteria and Viruses, Conjugation, Transformation, Bacteriophage, Transduction, Complementation Test in Transposable Genetic Elements:

Module- VII (8Hrs)

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

Principles of Genetics Lab**Experiments:**

- To study the collection of *Drosophilla*.
- Study of *Drosophilla* under compound microscope.
- Chi-square analyses using seeds/beads/*Drosophila*.
- Linkage maps based on data from conjugation, transformation and transduction.
- Linkage maps based on data from *Drosophila* crosses.
- Study of karyotype (*Human or Drosophilla*).



- Pedigree analysis of some human inherited traits.

Text Books:

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of

Reference Books:

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings
- Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co
- Fletcher H. and Hickey I. (2015). Genetics. IV Edition. GS, Taylor and Francis Group, New York and London. CBCS Undergraduate Program in Zoology 2015

Semester - VI

BSZO3601 Developmental Biology

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Developmental Biology	BSZO3601	Theory & Practice	3-1-3(06)	Nil

1. Objective

- The course is so designed for acquiring knowledge to know the process of reproduction and the development of embryo.
- This course is designed for better understanding of evolutionary trends in development of organisms with time.

2. Learning outcome

- *Students will be benefited about their reproductive processes.*
- *Students will be equipped in evolutionary approach.*

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
External Examination		30	Written examination
Total		100	



Module-I (7Hrs)

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.

Module- II (4Hrs)

Early Embryonic Development Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes;

Module- III (4Hrs)

Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula.

Module-IV (6Hrs)

Fate maps (including Techniques); early development of frog and chick up to gastrulation; embryonic induction and organizers.

Module- V (8Hrs)

Late Embryonic Development: Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta) Post Embryonic Development. Metamorphosis: Changes, hormonal regulations in amphibians and insects;

Module VI (7Hrs)

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

Module- VII (8Hrs)

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

Developmental Biology Lab

Experiments:

- Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
- Study of whole mounts of developmental stages of chick 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)
- Study of the developmental stages and life cycle of Drosophila from stock culture
- Study of different sections of placenta (photomicrograph/ slides)
- Project report on Drosophila culture/chick embryo development

Text Books:

- Verma, Agrawal, 2007, Embryology, Rostogi Publication
- 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



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Evolutionary Biology

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Evolutionary Biology	BSZO3602	Theory & Practice	3-1-3(06)	Nil

1. Objective

- This course is designed for better understanding of evolutionary trends in development of organisms with time.

2. Learning outcome

- *Students will be benefited about their reproductive processes.*
- *Students will be equipped in evolutionary approach.*

3. Evaluation System

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module-I (7Hrs)

Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes, Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism
Evidences of Evolution: Fossil record (types of fossils, transitional forms,

Module- II (8Hrs)

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, Sources of variations: Heritable variations and their role in evolution.

Module-III (7Hrs)

Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-We 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.

Module- IV (4Hrs)

Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies. Product of evolution: Micro evolutionary changes (inter-population variations,



clines,races).

Module-V (5Hrs)

Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches Extinctions, Back ground and mass extinctions (causes and effects),

Module- VI (8Hrs)

detailed example of K-T extinction 2 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

Module-VII (5Hrs)

Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees .

Evolutionary Biology Lab

- Study of fossils from models/ pictures
- Study of homology and analogy from suitable specimens
- Study and verification of Hardy-Weinberg Law by chi square analysis
- Demonstration of role of natural selection and genetic drift in changing allele
- Frequencies using simulation studies
- Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
- Construction of phylogenetic trees with the help of bioinformatics tools (Clustal,X, Phylip, NJ) and its interpretation.

Text Books:

- Verma,Agrawal, 2007,Embryology,Rostogi Publication

Reference books:

- 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 Wiley-Blackwell

Discipline Elective (Non Domain)

Animal Biotechnology

Subject Name	Code	Type of course	T-P-P	Prerequisite
Animal Biotechnology	BSZO3503	Theory & Practice	3-1-3(06)	Nil

1. Objective

- The course is so designed for acquiring knowledge to know the process of molecular biology and biotechnology with its application
- This course is designed for better understanding of different technology relevant to biology

2. Learning outcome

- Provide current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic sciences

3. Evaluation System

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module-I (7Hrs)

Introduction: Concept and scope of biotechnology:

Molecular Techniques in Gene manipulation, Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics).

Module- II (5Hrs)

Restriction enzymes: Nomenclature, detailed study of Type II. **Transformation techniques I:** Calcium chloride method and electroporation.

Module- III (3Hrs)

Construction of genomic and cDNA libraries and screening by colony and plaque hybridization, Southern, Northern and Western blotting

Module-IV(7Hrs)

Transformation techniques II: DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing and DNA micro array.

Module- V (8Hrs)

Genetically Modified Organisms: Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection.

Module- VI (8Hrs)

Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knockout mice. Production of transgenic plants: Agrobacterium mediated transformation. Applications of transgenic plants: insect and herbicide resistant plants.

Module-VII (16Hrs)

Culture Techniques and Applications: Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia) Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy.

Animal Biotechnology Lab

Experiments:

1. Preparation of Standard Curve RNA using Orcinol reaction.
2. Histochemical demonstration of DNA (Liver/Testis of Chick).
3. Demonstration of DNA & RNA by MGP.
4. Demonstration of Mucopolysaccharides by PAS reaction
5. Genomic DNA isolation from E. coli
6. Study of restriction digestion of plasmid DNA.

7. Video/Lab demonstration of Construction of circular and linear restriction map from the data provided.

8. To study following techniques through photographs

- a. Southern Blotting
- b. Northern Blotting
- c. Western Blotting
- d. DNA Sequencing (Sanger's Method)
- e. PCR
- f. DNA fingerprinting

9. Small project report as per course animal cell culture

Text Books:

- Singh, B.D, 2006, Text book of Biotechnology, Kalyani Publisher

Reference Books:

- 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.
- Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.
- Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc.
- Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA- Genes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y., USA.
- Beauchamp, T.I. and Childress, J.F. (2008). Principles of Biomedical Ethics. VI Edition, Oxford University Press. CBCS Undergraduate Program in Zoology

Fish and Fisheries

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Fish and Fisheries	BSZO3504	Theory + Practice	3-1-3 (06)	Nil

1. Objective

- The course is so designed for acquiring knowledge to know the different fishes and fish management.

2. Learning outcome

- *Application of Fisheries* or related aquatic science disciplines.
- Be prepared to compete successfully for entry-level professional career positions in fisheries research or management in Alaska and elsewhere.

3. Evaluation System:

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	20	Written examination

	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
External Examination		30	Written examination
Total		100	

Module-I (7Hrs)

Introduction and Classification:

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

Module- II (5Hrs)

Morphology and Physiology-I:

Types of fins and their modifications; Locomotion in fishes; 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;

Module- III (5Hrs)

Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fishes); Electric organs; Bioluminescence; Mechanoreceptors; Schooling; Parental care; Migration

Module-IV(7Hrs)

Morphology and Physiology-II:

Reproductive strategies (special reference to Indian fishes); Electric organs; Bioluminescence; Mechanoreceptors; Schooling; Parental care; Migration.

Module- V (8Hrs)

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.

Module-VI (8Hrs)

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;

Module- VII (8Hrs)

Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products Fish in research: Transgenic fish, Zebra fish as a model organism in research.

Fish and Fisheries Lab

Experiments:

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, Total solids, Total dissolved solids
6. Study of air breathing organs in Channa, Heteropneustes, Anabas and Clarias
7. Demonstration of induced breeding in Fishes (video)
8. Demonstration of parental care in fishes (video)

9. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.

Test Books:

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

Reference Books:

- 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.

Immunology

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Immunology	BSZO3603	Theory + Practice	3-1-3 (06)	Nil

1. Objective

- The course is so designed for acquiring knowledge to know the process of immune system and their function

2. Learning outcome

- *Students will be benefited about their different techniques in immunology*

3. Evaluation System

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module-I (8Hrs)

Overview of Immune System: Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system, Innate and Adaptive Immunity, Anatomical barriers, Inflammation,

Module- II (8Hrs)

Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).

Module-III (6Hrs)

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

Module- IV (8Hrs)

Immunoglobulins : Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA)

Module- V (3Hrs)

Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis.

Module- VI (7Hrs)

Major Histocompatibility Complex:

Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation Cytokines: Properties and functions of cytokines, Therapeutics Cytokines Complement System: Components and pathways of complement activation.

Module- VII (8Hrs)

Hypersensitivity: Gell and Coombs' classification and brief description of various types of hypersensitivities, Vaccines: Various types of vaccines.

Immunology Lab

Experiments:

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. Ouchterlony's double immuno-diffusion method.
5. ABO blood group determination.
6. *. Cell counting and viability test from splenocytes of farm bred animals/celllines.
7. Demonstration of :
 - a. ELISA
 - b. Immunoelectrophoresis
8. The experiments can be performed depending upon usage of animals in UG courses.

Text Books:

□ Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company

Reference Books:

- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
- David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
- Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.

Parasitology

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Parasitology	BSZO3604	Theory + Practice	3-1-3 (06)	Nil

1. Objective

<ul style="list-style-type: none"> The course is so designed for acquiring knowledge to know of different types of insects and their management
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2. Learning outcome

<ul style="list-style-type: none"> Students will be benefited about their different pest managements and control of pest.
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3. Evaluation System

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Module-I (7Hrs)

Introduction to Parasitology: Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship.

Module- II (8Hrs)

Parasitic Protists :Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani, Plasmodium vivax.

Module-III (7Hrs)

Parasitic Platyhelminthes: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana.

Module- IV (8Hrs)

Parasitic Nematodes: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis.

Module- V (8Hrs)

Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylenchus (lesion nematode).

Module-VI (8Hrs)

Parasitic Arthropoda:

Biology, importance and control of ticks, mites, Pediculus humanus (head and body louse), Xenopsylla

cheopis and Cimex lectularius

Module- VII (8Hrs)

Parasitic Vertebrates:

A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat

Parasitology Lab

Experiments:

1. Study of life stages of Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani and Plasmodium vivax through permanent slides/micro photographs
2. Study of adult and life stages of Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana through permanent slides/micro photographs
3. Study of adult and life stages of Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis through permanent slides/micro photographs
4. Study of plant parasitic root knot nematode, Meloidogyne from the soil sample
5. Study of Pediculus humanus (Head louse and Body louse), 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]
8. Submission of a brief report on parasitic vertebrates

Text Books:

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

Reference Books:

- 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 & Distributors, 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 Publishers & Distributors (P) Ltd.
- *Developed by: (Faculty name),* *Email:* *Mobile:*
- *Developed on (Month and Year): March 2018*

Discipline Elective (Domain: Reproductive Physiology)

Basics of Neuroscience

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Basics of Neuroscience	BSRPDE01	Theory + Practice	3-1-3(06)	Nil

1. Objective

- Study of the nervous system, including mental health and neurological diseases as well as more general matters of neuroscience.
- To obtain an appreciation for the historical aspects of neuropsychology, from antiquity to the decade of the brain, in order to understand the progression of how scholars at various times have conceptualized brain functioning.

2. Learning outcome

- To understand the mechanisms related to neurotransmitter signaling and glial-neuronal interactions in health and disease.
- Obtain knowledge about overall organization of the vertebrate nervous system, including prevailing concepts on systems-level organization of the CNS

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Theory (Credits 4)

Module-1: Introduction to Neuroscience (12Hrs.)

Origins of Neuroscience; Neuroanatomy, Neurophysiology, and Systems Neurobiology. Structure and function of the nervous system: Cellular components: Neurons; Neuroglia; Neuron doctrine; The prototypical neuron – axons and dendrites as unique structural components of neurons.

Module- II (3Hrs)

The ionic bases of resting membrane potential; the action potential- its generation and properties; the action potential conduction.

Module-III: Cellular and Molecular Neurobiology (8Hrs.)

Molecular and cellular approaches used to study the CNS at the level of single molecules, Synapse: Synaptic transmission, Types of synapses; synaptic function; Principles of chemical synaptic transmission; Principles of synaptic integration; EPSPs and IPSPs. Ion channels, Neural transmission,

Module- IV (8Hrs)

Neurotransmitters : Different types of neurotransmitters—catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels; G-protein coupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.

Module V: Neurobiology and Neuropharmacology of Behaviour (6Hrs.)

The principles of signal transduction and information processing in the vertebrate central nervous system, and the relationship of functional properties of neural systems with perception and behavior; sensory systems,

Module- VI (8Hrs)

Molecular basis of behavior including learning and memory.

Module- VII (8Hrs)

Molecular pathogenesis of pain and neurodegenerative diseases such as Parkinson's, Alzheimer's, psychological disorders, addiction, etc.

Basics of neuroscience Laboratory (Credits 2)

1. Dissection and study of Drosophila nervous system using GFP reporter.
2. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.
3. Nerve Cell preparation from the spinal cord.
4. Study of neurons and/ or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
5. Study of olfaction in Drosophila.
6. Study of novelty, anxiety and spatial learning in mice.

REFERENCES

- Neuroscience: Exploring the brain by Mark F. Baer; Barry W. Connors. 2015
- From Molecules to Networks: An Introduction to Cellular and Molecular
- Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham
- Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates, Inc.-2004
- Principles of Neural Science-4th Edn-Eds. Kandel, Schwartz and Jessell- McGraw-Hill Companies-2000
- Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David Young-CUP-2003
- Essential Psychopharmacology- Neuroscientific Basis and Practical Applications-2nd Edn.- Stephan M. Stahl-CUP-2000
- Phantoms in the Brain - Vilayanur S. Ramachandran

Exploring the Brain: Structure and Function

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Exploring The Brain: Structure And Function	BSRPDE02	Theory + Practice	3-1-3(6)	Nil

1. Objective

- To obtain an appreciation for the historical aspects of neuropsychology, from antiquity to the decade of the brain, in order to understand the progression of how scholars at various times have conceptualized brain functioning.

2. Learning outcome

- To understand the mechanisms related to neurotransmitter signaling and glial-neuronal

interactions in health and disease.

- Obtain knowledge about overall organization of the vertebrate nervous system, including prevailing concepts on systems-level organization of the CNS

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Theory (Credits 4)

Module-1 Introduction: (7Hrs.)

Early and Nineteenth century views of the Brain; Neuroscience today; Evolution of brain in vertebrates Neurons and Glia: Neurons – Soma, Axon, Dendrite; Classification of Neurons; Glia – Astrocytes, Myelinating Glia, Non-neuronal cells.

Module- II (8Hrs)

Evolution and Adaptation of Brain: Brain evolution and behavioral adaptation; Theories of brain evolution – involving addition of structure or areas, involving new formation and reorganization of circuits.

Module-III Organization of the Brain: (7Hrs.)

Anatomical references, Cerebrum, cerebellum, brain stem, spinal cord; Cranial nerves, Meninges, ventricular system; CT and MRI imaging of the brain.

Module- IV (8Hrs)

Understanding Brain Structure through Development: Formation of neural tube, Primary brain vesicles; Differentiation of forebrain, midbrain and hindbrain. Cerebral cortex – neocortical evolution and structure-function relationship

Module-V: Chemical Control of Brain and Behaviour: (6Hrs.)

Structure and connection of the secretory hypothalamus; Diffuse modulatory systems of the brain – noradrenergic, serotonergic, dopaminergic and cholinergic system;

Module- VI (8Hrs)

Drugs and diffuse modulatory systems. Rhythms of the Brain: Electroencephalogram; Sleep – why do we sleep, Non-REM and REM sleep, neural mechanisms of sleep; Circadian rhythms.

Module-VII (8Hrs)

Mental illness and the Brain: Psychosocial and biological approaches to mental illness; Anxiety disorders; Mood disorders; Schizophrenia.

PRACTICAL (Credits 2)

1. Dissection and study of *Drosophila* nervous system using GFP reporter.
2. Observation and quantitation of *Drosophila* photoreceptor neurons in healthy and diseased condition.

REFERENCES

1. Neuroscience: Exploring the Brain by Mark F. Bear, Barry W. Connors and Michael A. Paradiso.
2. Comparative vertebrate Neuroanatomy by Ann B. Butler and William Hoods.

Endocrinology

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Endocrinology	BSRPDE03	Theory + Practice	3-1-3(6)	Nil

1. Objective

- To understand the roles of the endocrine system in maintaining homeostasis, integrating growth and development, responding to environmental insults and promoting Successful reproduction.
- To identify the glands, organs, tissues and cells that synthesize, secrete hormones, and associated compounds.

2. Learning outcome

- To learn the basic and advanced endocrine biochemistry, physiology and patho physiology which provide the basis for understanding endocrine disorders.
- To understand the spermatogenesis in the testis and oogenesis in the ovary are regulated during normal fertility as well as understand the various causes of infertility

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Theory (Credits 4)

Module1: Introduction to Endocrinology (8hrs.)

History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones. Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction.

Module- II (7Hrs)

Structure of hypothalamus, Hypothalamic nuclei and their functions, Regulation of neuroendocrine glands

Module- III (8Hrs)

Feedback mechanisms Structure of pituitary gland, Hormones and their functions, Hypothalamohypophysial portal system, Disorders of pituitary gland.

Module IV: Peripheral Endocrine Glands (8hrs.)

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas,

Module- V (8Hrs)

Ovary and Testis Hormones in homeostasis, Disorders of endocrine glands.

Module VI: Regulation of Hormone Action (12hrs.)

Hormone action at Cellular level: Hormone receptors, transduction and regulation
Hormone action at Molecular level:

Module- VII (3Hrs)

Molecular mediators, Genetic control of hormone action.

Endocrinology laboratory (Credits 2)

1. Dissect and display of Endocrine glands in laboratory bred rat*
2. Study of the permanent slides of all the endocrine glands
3. Compensatory ovarian/ adrenal hypertrophy *in vivo* bioassay in laboratory bred rat*
4. Demonstration of Castration/ ovariectomy in laboratory bred rat*
5. Estimation of plasma level of any hormone using ELISA

References

- General Endocrinology C. Donnell Turner Pub- Saunders Toppan
- Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.
- Oxford: BIOS Scientific Publishers; 2001.
- Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey.
- Vertebrate Endocrinology by David O. Norris,

Reproductive Biology

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Reproductive Biology	BSRPDE04	Theory + Practice	3-1-3(6)	Nil

1. Objective

- To identify the glands, organs, tissues and cells that synthesize, secrete hormones, and associated compounds.
- To understand the reproductive function and fertilization to methods for assisted reproductive technologies to circumvent infertility.

2. Learning outcome

- To understand the spermatogenesis in the testis and oogenesis in the ovary are regulated during normal fertility as well as understand the various causes of infertility

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Theory (Credits 4)

Module-1: Introduction (12Hrs.)

Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female;

Module- II (7Hrs)

Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

Module III: Functional anatomy of male reproduction (7 Hrs.)

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;

Module- IV (8Hrs)

Accessory glands functions; Sperm transportation in male tract. Reproductive Health: Infertility in male and female: causes, diagnosis and management;

Module-V (5Hrs)

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

Module VI: Functional anatomy of female reproduction (6 Hrs.)

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;

Module- VII (8Hrs)

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.

Reproductive Biology laboratory (Credits 2)

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. Ovariectomy, hysterectomy, 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

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

Developed by: (Faculty name),

Email:

Mobile:

Developed on (Month and Year): March 2018

Discipline Elective (Domain: Biodiversity Management)
Biology of Insecta

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Biology of Insecta	BSBMDE01	Theory + Practice	3-1-3(6)	Nil

1. Objective

- *To understand basic insect biology, as well as natural history and evolutionary relationships of insect orders and families.*

2. Learning outcome.

- The potential impact of different insect species on agriculture, human health, and society in general; to be knowledgeable about potential control strategies.
- Students will get knowledge for interpretation of behavior of organisms.

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Theory

(Credits 4)

Module- 1 (8hrs)

Introduction:General Features of Insects Distribution and Success of Insects on the Earth .Basis of insect classification; Classification of insects up to orders.

Module- II (8Hrs)

General Morphology of Insects:External Features; Head – Eyes, Types of antennae, Mouth parts with respect to feeding Habits Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat .Abdominal appendages and genitalia

Module-III: Physiology of Insects (18hrs)

Structure and physiology of Insect body systems - Integumentary, digestive,excretory, circulatory, respiratory,

Module- IV (8Hrs)

Endocrine, reproductive, and nervous system Sensory receptors Growth and metamorphosis

Module-V: Insect Plant Interaction (16hrs)

Group of social insects and their social life. Social organization and social behaviour.

Module- VI (8Hrs)

Insects as mechanical and Biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors

Module- VII (8Hrs)

Theory of co-evolution, role of allelochemicals in host plant mediation. Host-plant selection by phytophagous insects, Insects as plant pests.

Biology of insecta laboratory (Credits 2)

1. Study of one specimen from each insect order
2. Study of different kinds of antennae, legs and mouth parts of insects
3. Study of head and sclerites of any one insect
4. Study of insect wings and their venation.
5. Study of insect spiracles
6. Methodology of collection, preservation and identification of insects.
7. Morphological studies of various castes of *Apis*, *Camponotus* and *Odontotermes*
8. Study of any three insect pests and their damages
9. Study of any three beneficial insects and their products

Field study of insects and submission of a project report on the insect diversity

Suggested Readings:

1. A general text book of entomology, Imms , A. D., Chapman & Hall, UK
2. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
3. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
4. Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
5. The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
6. Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA
7. Physiological system in Insects, Klowden, M. J., Academic Press, USA
8. The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK
9. □ Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA

Animal Behaviour and Chronobiology

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Animal behaviour and chronobiology	BSBMDE02	Theory + Practice	3-1-3(6)	Nil

1. Objective

- Understanding and identify behaviors in a variety of taxa and the evolutionary origins of various animal behaviors.
- This course is so designed to make students to know about their surroundings and the inter-relationship of man and animals.

2. Learning outcome.

- The potential impact of different insect species on agriculture, human health, and society in general; to be knowledgeable about potential control strategies.
- Students will get knowledge for interpretation of behavior of organisms.

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Theory (Credits 4)

Module1: Introduction to Animal Behaviour (7Hrs.)

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.

Module- II (8Hrs)

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

Module III: Social and Sexual Behaviour (7Hrs.)

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.

Module- IV (8Hrs)

Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Module V: Introduction to Chronobiology (6Hrs.)

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

Module- VI (8Hrs)

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;

Module-VI I (8Hrs)

Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin. Relevance of biological clocks; Chronopharmacology, Chronomedicine, Chronotherapy.

Animal behaviour and Chronobiology laboratory (Credits 2)

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).

References

1. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
2. Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge, University Press, UK.
3. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
4. Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
5. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
6. Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rdEd) 2002 Baren's and Noble Inc. New York, USA
7. Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

Wild life Conservation and Management

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Wild life conservation and management	BSBMDE03	Theory + Practice	3-1-3(6)	Nil

1. Objective

- This course is so designed to make students to know about their surroundings and the inter-relationship of man and animals.
- Understand the current situation relating to population health (including environmental health) and disease do not depend uniquely on biological mechanisms, but include societal and culture influences as well.

2. Learning outcome.

- Students would approach for better management of wild life for sustainability.
- Familiarity with methodologies used to examine factors associated with the development and prevention of disease.

3 Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Theory

(CREDITS 4)

Module 1: Introduction to Wild Life (7Hrs.)

Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies. Evaluation and management of wild life Habitat analysis, Physical parameters: Topography, Geology, Soil and water;

Module- II (8Hrs)

Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS. Setting back succession; Grazing logging; Mechanical treatment;

Module- III (8Hrs)

Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats

Module-IV: Population estimation (7Hrs.)

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.

Module V: Management planning of wild life in protected areas (16Hrs.)

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

Module- VI (5Hrs)

Ecology of perturbation. Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal.

Module- VII (5Hrs)

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

Wild life conservation and management Laboratory (Credits 2)

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)

References

1. Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.
2. Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). *People and Wildlife, Conflict or Co-existence?* Cambridge University.
3. Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5 th edition. The Wildlife Society, Allen Press.
4. Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences.
5. 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.

Environment and Public health

Subject Name	Code	Type of course	T-P-P (Credit)	Prerequisite
Environment and Public health 3	BSBMDE04	Theory + Practice	3-1-3(6)	Nil

1. Objective

- This course is so designed to make students to know about their surroundings and the inter-relationship of man and animals.
- Understand the current situation relating to population health (including environmental health) and disease do not depend uniquely on biological mechanisms, but include societal and culture influences as well.

2. Learning outcome.

- Familiarity with methodologies used to examine factors associated with the development and prevention of disease.

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Midterm Test	20	Written examination
	Assignment	10	Report and Presentation
	Experiments	30	Lab work, report
	Project	5	Report and presentation
	Quiz	5	Surprise/pre announced ones
<i>External Examination</i>		30	Written examination
<i>Total</i>		100	

Theory (Credits 4)

Module-1 Introduction: (7Hrs.)

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

Module- II (5Hrs)

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

Module- III(5Hrs)

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

Module-IV Waste Management Technologies (7Hrs.)

Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal

Module- V (8Hrs)

Nuclear waste handling and disposal, Waste from thermal power plants,

Module- VI (8Hrs)

Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

Module-VII Diseases (12Hrs.)

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

ENVIRONMENT AND PUBLIC HEALTH

PRACTICAL (Credits 2)

1. To determine pH, Cl, SO₄, NO₃ in soil and water samples from different locations.

References

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

Techniques in Bio fertilizers

Subject Name	Code	Type of course	T-T-P(Credit)
Techniques in Bio fertilizer	BSLS2001	Practice	0-0-3 (02)

1. Objective

- *The main objective is to maintain the soil health by application of bio fertilizer for better plant growth.*

2. Learning outcome

- *The students will learn to improve the entire ecosystem and will serve the society in the best way by caring their health through natural products.*

3. Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Experiments	100	Lab work
Total		100	

Experiments:

1. Isolation of Rhizobium or Azotobacter from plant root nodules and rhizosphere.
2. Identification of soil cyanobacteria from different soil samples.
3. Preparation of culture media
4. Culture of cyanobacteria
 - a. Growth media
 - b. Media preparation and Strater culture
 - c. Sterilization of medium in autoclave
 - d. Prepare slants and Plates
 - e. Inoculation & Growth of Cyanobacteria

5. Cyanobacterial inoculation to plants.
6. To study different types of Mycorrhizal association.
7. Isolation of VAM
8. Methods of Biocompost
9. Methods of vermicomposting
10. Field application of Vermicompost

Text Books:

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand and Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John JothiPrakash, E. 2004. Outlines of Plant Biotechnology.Emkay _Publication, New Delhi.

Reference Books:

1. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya Publishers.
2. SubhaRao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.

Skill in Apiculture

Subject Name	Code	Type of course	T-T-P(Credit)
Skill in Apiculture (SEC-1)	BSLS2002	Practice	0-0-3 (02)

1. Objective

- *The students will able to know about beekeeping, conservation and harvesting of honey.*
- *The students will understand the concept of pollination and will work towards bee security for the future.*

2. Learning outcome

- *Students can learn the role and value of honey bees along with honey harvesting.*
- *They will acquire skills for engaging themselves in self-employment.*

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Experiments	100	Lab work
<i>Total</i>		100	

Experiments:

1. Study of characteristics of Honey Bee (Queen, Worker and Drawn Bee).



2. Study of social organization of bee colony
3. Demonstration of bee keeping equipment.
4. Observation of pollination and work of Bee
5. Study of beehives
6. Impact of flowers of local areas on quality and medicinal properties of honey
7. Study of impact of season on honey quality
8. Cultivation of bees and honey harvesting techniques and entrepreneurship.

Text Books:

Singh S., Beekeeping in India, Indian council of Agricultural Research, NewDelhi

Reference Books:

Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.

Bisht D.S., Apiculture, ICAR Publication.

Herbal Technology

Subject Name	Code	Type of course	T-T-P(Credit)
Herbal Technology(SEC-2)	BSLS2003	Practice	0-0-3 (02)

1. Objective

- *To aware the students to different types of instruments used for processing of herbal drugs*

2. Learning outcome

- *Students can learn the method of collection of medicinal plants.*
- *They will acquire the skill of extraction of phytochemicals and preservation of herbarium.*

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Experiments	100	Lab work
<i>Total</i>		100	

Experiments:

1. Collection of wild herbs and their herbarium preparation.
2. Study of different morphological structure and floral parts of the following plants of locally available



- medicinal herb.
3. Starch test
 4. Proteins and Lipid Test.
 5. Study of different types of instruments used in the extraction of phytochemicals.
 - a. Soxhlet Apparatus
 - b. Colorimeter
 - c. Thin Layer Chromatography
 - d. High Performance Layer Chromatography
 - e. UV –Spectrophotometer
 6. Extraction of an alkaloid

Text Books:

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R,New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.

Reference Books:

1. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
2. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH publishing Co.
4. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
5. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
6. Pharmacognosy, Dr.C.K.Kokate et al. 1999. NiraliPrakashan

Techniques in Medical Diagnostics

Subject Name	Code	Type of course	T-T-P(Credit)
Techniques in Medical Diagnostics	BSLS2004	Practice	0-0-3 (02)

1. Objective

- *The students will able to know about different tests for primary health care.*

2. Learning outcome

- *The students learn the basic clinical skills required to provide effective and efficient primary care.*

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Experiments	100	Lab work
Total		100	



Experiments:

1. Preparation of blood Smear.
2. Study of D.L.C (Differential Leucocyte Count) using Leishman's stain.
3. Platelet count using haemocytometer.
4. Determination of ABO Blood group
5. Estimation of haemoglobin using Sahli's haemoglobinometer
6. Preparation of haemin and haemochromogen crystals
7. Recording of blood pressure using a sphygmomanometer.
8. Study of various Medical imaging.

Text Books:

- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers

Reference Books:

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

Vermicomposting

Subject Name	Code	Type of course	T-T-P(Credit)
Vermicomposting	BSLS2005	Practice	0-0-3 (02)

1. Objective

- *The objective is to learn to compost organic wastes o to produce superior quality manure to improve soil quality.*
- *They will learn recycling of organic waste.*

2. Learning outcome

- *The students will learn the methods of production of organic fertilizers, reduced use of chemical fertilizers and production of best quality of food.*



- *This will provide a source of income.*

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Experiments	100	Lab work
Total		100	

Experiments

1. Collection and identification of different species of earthworms used for vermicomposting.
2. Study of different compostable waste for the production of vermicompost.
3. The growth of cereals in the soil applied with cow dung compost, chemical fertilizer and vermicomposting.
4. The growth of different vegetable plants in the soil applied with cow dung compost, chemical fertilizer and vermicompost.
5. The growth of **different pulse** crops in the soil applied with cow dung compost, chemical fertilizer and vermicompost.
6. Study about high Level of beneficial soil micro-organisms promoting plant growth.
7. Role of vermiculture in bio-accumulation of toxic chemicals and detoxification of the medium in which it lives.

Text Books:

Keshav Singh, (2014)Textbook of Vermicompost: Vermiwash and Biopesticides, Biotech Books

Reference Books:

The complete Technology Book on Vermiculture and Vermicompost,(2004) NPCS Board of Consultants and Engineers

Pisciculture

Subject Name	Code	Type of course	T-T-P(Credit)
Pisciculture	BSLS2011	Practice	0-0-3(2)

1. Objective

- *The students will learn about fish farming.*

2. Learning outcome

- *This will built young entrepreneurs.*

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>



	Experiments	100	Lab work
Total		100	

Experiments

1. Fish farming, types of fish farms and aquatic ecosystem
2. Site selection, pond layout, design, construction, pond facilities and maintenance for pisciculture.
3. Selection of fish breeds to be used in pisciculture for aquarium.
4. Collection of minor and major carp from hatchery
5. Feeding, fertilization, care and management for fish growth
6. Diseases in fish and their management
7. Methods of harvesting and post harvesting technology for marketing.
8. Advantages of fish farming business as food
9. Integrated fish farming
10. Nutritional importance of fish.

Text Books:

H.S. Mukherjee, S. N. Garad, V.K. Jagtap (2009) A Text Book of Pisciculture and Aquarium Keeping, Daya Publishing House

Reference Books:

N.W. Clark (2017), Pisciculture: An Address on the Artificial Breeding of Fish, Their Habits, Forgotten Books

Sericulture

Subject Name	Code	Course Type	T-T-P (Credit)
Sericulture	BSLS2012	Practice	0-0-3(2)

1. Objective

- The students will learn about rearing of silk worm and its application.

2. Learning outcome

- This will build young entrepreneur and sustainable management.

3. Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Experiments	100	Lab work



Total		<i>100</i>	
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1. Sericulture: **Introduction**, Types of silkworms.
2. Distribution and Races, Exotic and indigenous races, Mulberry and non-mulberry Sericulture. Biology of silkworm.
3. Selection of mulberry variety and establishment of mulberry garden, Rearing house and rearing appliances,
4. **Diseases of silkworm.** Disinfectants: Formalin, bleaching powder, RKO.
5. Silkworm rearing technology: Early age and Late age rearing, Types of mountages, Spinning, harvesting and storage of cocoons
6. Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture.
7. Visit to various sericulture centres.
 - Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
 - Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
 - Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
 - Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
 - Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan 1972.
 - Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
 - A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
 - Improved Method of Rearing Young age silkworm; S. Kr

Ecotourism

Subject Name	Code	Course Type	T-T-P (Credit)
Ecotourism	BSLS2013	Practice	0-0-3(2)

1. Objectives:

- This module will introduce students to the concept of ecotourism and its economic, cultural and environmental impacts at different scales. With reference to specific locations and activities, students will be aware of the methods through which ecotourism can be marketed and managed, together with its potential adverse impacts

2. Learning outcome

- This will help students to understand ecotourism as a significant aspect of tourism.

3. Evaluation Systems



<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Experiments	100	Lab work
Total		100	

Practices

1. History of ecotourism and its definitions
2. Ecotourism as a growth sector within the tourism industry
3. Environmental, socio-cultural and economic impacts of ecotourism
4. Ecotourism and development issues ,ecotourism and protected areas
5. Marketing ecotourism
6. Ecotourism and competing resource users
7. Case studies of ecotourism with field visit.

Reference

Mowforth, M., & Munt, I. (2009). Tourism and sustainability (3rd Edition). London, UK: Routledge.
 Newsome, D., Moore, S.A., & Dowling, R.K. (2002). Natural area tourism. Bristol, UK: Channel View Publications.
 Weaver, D. (2008). Ecotourism (2nd Edition). Hoboken, NJ: JS Wiley. Staff : Dr Julian Clifton

Poultry Management

Subject Name	Code	Course Type	T-T-P (Credit)
Poultry Management	BSLS2014	Practice	0-0-3(2)

1. Objective

- *The students will learn about poultry farming and its management*

2. Learning outcome

- *This will built young entrepreneur and sustainable livelihood management.*

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Experiments	100	Lab work
Total		100	

1. Hatching of eggs-selection and handling of eggs, testing of eggs, management of incubator, handling of chicks at hatching level, maintenance of hatchery hygiene.
2. Preparation of poultry houses and rearing of chicks, growers, layers/broilers.



3. Culling and selection of birds. Preparation of ration. Feeding of poultry.
4. Maintenance and sanitation of the farm. Vaccination and deworming.
5. Grading and preservation of table eggs, Marketing of poultry products.
6. Economics of poultry farming, preparation of schemes for large and small unit broiler and layer farming, record keeping, analysis of profitability of poultry farms.
7. Visit to different commercial poultry farms.

Practical:

Visit to livestock, fish and poultry production units. Economic analysis of poultry, fishery and dairy enterprises. Collection and interpretation of data on allied agricultural products export. Study on international organizations for quality standards. Study on marketing channels of allied agricultural products. Market survey for livestock, fish and poultry products.

Webster J (2011). Management and Welfare of Farm Animals. (5th Edition). Wiley-Blackwell, England.

Ornamental fish Management

Subject Name	Code	Course Type	T-T-P (Credit)
Ornamental fish Management	BSLS2015	Practice	0-0-3(2)

1. Objective

- *The students will learn about aquarium maintenance and fish keeping*

2. Learning outcome

- *This will built young entrepreneur.*

3. Evaluation Systems

<i>Internal Examination</i>	<i>Component</i>	<i>% of Marks</i>	<i>Method of Assessment</i>
	Experiments	100	Lab work
Total		100	

1. The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes
2. 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
3. Use of live fish feed organisms. Preparation and composition of formulated fish feeds
4. Live fish transport - Fish handling, packing and forwarding techniques.
5. General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage industry.
6. Visit to aquaculture centres.

Jhingran V G (2009) Fish and Fisheries of India. 2nd Edition. Hindustan Publishing Corporation



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(India).

Khanna SS and Singh HR (2014) A Text Book of Fish Biology and Fisheries. 3rd Edition. Narendra Publishing House, India.