COURSE CURRICULUM FOR B. Sc. (MAJOR) ZOOLOGY

NAME OF THE PROGRAMME: B. Sc. (MAJOR) ZOOLOGY

JAGANNATH BAROOAH COLLEGE, JORHAT (ASSAM)

SYLLABUS
UNDER NATIONAL EDUCATION POLICY, 2020

B. Sc. (MAJOR) ZOOLOGY

Objective of the Programme:

- To provide quality education and in-depth knowledge in the field of Biological sciences especially of animal sciences.
- To inculcate the spirit of conservation of resources, biodiversity and their interaction with environment and love for nature.
- To provide quality education offering skill-based programme and motivate the students for self-employment.
- To conduct field studies and different projects of local as well as global interests.
- To enhance academic standards and quality of higher education system of our country.

Expected Outcome of the Course:

- More and more students will get admission in PG programs in higher institutes of learning.
- Interested students may take up entrepreneurship in biological sciences
- Successful students will have a broad knowledge on anatomy, physiology, ecology & biodiversity, genetics, biochemistry etc. which will be useful in their day-to-day life.

Course Structure- ZOOLOGY

Major Course (MJ)									
Sem	**Course No.**	**Course Code**	**Course Title**	**Course Type**	**Marks Distribution**				
					TH		**PR**	**IA**	**Total**
1st	MJ-01	ZOOMJ-011	Animal diversity and Systematics (CR-04)	TH+ PR	50		20	30	100
2nd	MJ-02	ZOOMJ- 021	Fundamentals of Biochemistry (CR-04)	TH+ PR	50		20	30	100
3rd	MJ-03	ZOOMJ- 031	Cell Biology (CR-04)	TH+ PR	50		20	30	100
	MJ-04	ZOOMJ- 032	Physiology, Histology & Histochemistry (CR-04)	TH+ PR	50		20	30	100
	MJ-05	ZOOMJ- 033	Comparative Anatomy of Vertebrates (CR-04)	TH+ PR	50		20	30	100
4th	MJ-06	ZOOMJ- 041	Principles of Ecology (CR-04)	TH+ PR	50		20	30	100
	MJ-07	ZOOMJ- 042	Animal Physiology: Physiology of life Sustaining System (CR-04)	TH+ PR	50		20	30	100
	MJ-08	ZOOMJ- 043	Biochemistry of metabolic Process (CR-04)	TH+ PR	50		20	30	100
	MJ-09	ZOOMJ- 044	Environment and Public Heath (CR-04)	TH+ PR	50		20	30	100
	MJ-10	ZOOIN- 041	Internship (CR-02)	PR	-		40	10	50
5th	MJ-11	ZOOMJ- 051	Molecular Biology (CR-04)	TH+ PR	50		20	30	100
	MJ-12	ZOOMJ- 052	Principles of Genetics (CR-04)	TH+ PR	50		20	30	100
	MJ-13	ZOOMJ- 053	Immunology (CR-04)	TH+ PR	50		20	30	100
	MJ-14	ZOOMJ- 054	Biotechnology & Bioinformatics (CR-04)	TH+ PR	50		20	30	100
	MJ-15	ZOOIN- 051	Internship (CR-02)	PR	-		40	10	50
6th	MJ-16	ZOOMJ- 061	Developmental Biology (CR-04)	TH+ PR	50		20	30	100
	MJ-17	ZOOMJ- 062	Evolutionary Biology (CR-04)	TH+ PR	50		20	30	100
	MJ-18	ZOOMJ- 063	Wildlife Conservation & Management (CR-04)	TH+ PR	50		20	30	100
	MJ-19	ZOOMJ- 064	Animal Behaviour & Chronobiology (CR-04)	TH+ PR	50		20	30	100
	MJ-20	ZOOMJ-065	Field Trip/ Project (CR-02)	PR	-		40	10	50
7th	MJ-21	ZOOMJ- 071	Fish and Fisheries Biology (CR-04)	TH+ PR	50		20	30	100
	MJ-22	ZOOMJ- 072	Biostatistics (CR-04)	TH+ PR	50		20	30	100
	MJ-23	ZOOMJ- 073	Research Methodology (CR-02)	TH	40		-	10	50
	MJ-24	ZOOMJ- 074	Economic Zoology (CR-04)	TH+ PR	50		20	30	100
	MJ-25	ZOOMJ- 075	Toxicology (CR-04)	TH+ PR	50		20	30	100

Sem	Course No.	Course Code	Course Title	Course Type	Marks Distribution				
					TH		PR	IA	Total
8th	MJ-26	ZOOMJ- 081	Biophysics and Bioinstrumentations (CR-04)	TH+ PR	50	-	20	30	100
	MJ-27	ZOOMJ- 082	Computational Biology (CR-04)	TH+ PR	50	-	20	30	100
	MJ-28	ZOOMJ- 083	Dissertation (CR-10)	PR	-	-	200	50	250
Skill Enhancement Course (SK)									
1st	SK-01	ZOOSK-011	Aquarium Fish keeping (CR-03)	-	-	-	50	25	75
2nd	SK-02	ZOOSK-021	Aquarium Fish keeping (CR-03)	-	-	-	50	25	75
3rd	SK-03	ZOOSK-031	Aquarium Fish keeping (CR-03)	-	-	-	50	25	75
Value Added Course (VAC)									
1st (Sc, Com)		EVEVA-011/ 021	Environmental Education (CR-02)	-	35	-	-	15	50
2nd (Arts)		EVEVA-011/ 021	Environmental Education (CR-02)	-	35	-	-	15	50
Minor Course (MI)									
1st	MI- 01	ZOOMI- 011	Animal diversity and systematics (CR-04)	TH+ PR	50		20	30	100
2nd	MI- 02	ZOOMI- 021	Fundamentals of Biochemistry (CR-04)	TH+ PR	50		20	30	100
3rd	MI- 03	ZOOMI- 031	Animal Physiology (CR-04)	TH+ PR	50		20	30	100
4th	MI- 04	ZOOMI- 041	Environment and Public Heath (CR-04)	TH+ PR	50		20	30	100
5th	MI- 05	ZOOMI- 051	Biotechnology & Bioinformatics (CR-04)	TH+ PR	50		20	30	100
6th	MI- 06	ZOOMI- 061	Animal Behaviour & Chronobiology (CR-04)	TH+ PR	50		20	30	100
7th	MI- 07	ZOOMI- 071	Fish and Fisheries (CR-04)	TH+ PR	50		20	30	100
8th	MI- 08	ZOOMI- 081	Economic Zoology (CR-04)	TH+ PR	50		20	30	100

All the courses will have at least 10 hours of tutorial classes.

CR: Credit **TH:** Theory **PR:** Practical

Detailed Syllabus for Major Course

B.Sc. Zoology

Course Title: ANIMAL DIVERSITY & SYSTEMATICS

Semester- I

Course Title: ANIMAL DIVERSITY & SYSTEMATICS

Course Code: ZOOMJ– 011		**Course No: MJ- 01**
Credits: 04 (03 Theory, 01 Practical)		**Total Marks- 100**
Theory Marks: 50	**Practical Marks: 20**	**In Semester: 30**

Course objective: Students will learn the systematics and classification of Non-Chordates, and Chordates. They will also learn the life cycles of selected species.

THEORY (CREDITS 3) **Marks: 50**

Unit1: Systematics and classification 12

Forms and hierarchy of classification. Basic concept and importance of systematic and taxonomy, newer aspects of biosystematics.

Protista:

General characters and classification up to classes with examples; Life cycle of Plasmodium.

Porifera:

General characters and classification up to classes with examples; canal system in Porifera

Radiata:

General characters and classification of Cnidaria up to classes with examples; polymorphism in Cnidaria.

Unit 2: Aceolomates: 6

General characters and classification of Platyhelminthes up to classes with examples; Life cycle of *Taenia solium*

Pseudocoelomates:

General characters and classification of Nemathelminthes up to classes with examples; Parasitic adaptations of Nemathelminthes.

Unit 3: Coelomate Protostomes 10

Annelida:

General characters and classification of Annelida upto classes; Metamerism in Annelida.

Arthropoda:

General characters and classification up to classes. Social life in insects.

Mollusca:

General characters and classification of Mollusca upto classes with examples; Pearl Formation in Mollusca.

Coelomate Deuterostomes:

General characters and classification of Echinodermata up to classes with examples, Water Vascular system in Starfish.

Unit 4: Protochordata: 10

Classification with examples and Salient features

Pisces:

Classification & classification of Pisces, Osmoregulation and Migration of Fishes.

Amphibia:

General characters & classification of Amphibia, Adaptations for terrestrial life, Parental care in Amphibia.

Unit 5: Amniotes: 12

Reptiles:

General characters & classification of Reptiles, Terrestrial adaptations in reptiles.

Aves:

General characters of birds; Flight adaptations.

Mammalia:

General characters; Affinities of prototheria.

Total 50

PRACTICAL

Marks: 20

1. Study of following specimens:

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

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

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

3. Temporary mounts of Unstained mounts of Placoid, Cycloid and Ctenoid scales.

Scheme of the Practical: Time: 3 Hours

	Marks
Identification of bottle specimen:	6
Identification of microscopic slide:	2
Temporary mount:	5
Practical record book:	4
Viva-voce:	3

SUGGESTED READINGS

- Mayr, E (2014). *Principles of Systematic Zoology*. McGraw Hill Education. Indian edition.
- Kapoor, V C (2019). *Theory and Practice of Animal Taxonomy and Biodiversity*. Oxford & IBH Publishing.
- Ruppert, Fox and Barnes (2006). *Invertebrate Zoology. A functional Evolutionary Approach*. 7th Edition, Thomson Press (India) Ltd.
- Campbell & Reece (2005). *Biology*. Pearson Education, (Singapore) Pvt. Ltd.
- Kardong, K. V. (2018). *Vertebrates: Comparative Anatomy, Function and Evolution*. 8th Edition, Tata McGraw Hill Publishing Company. New Delhi.
- Raven, P. H., Johnson, G. B., Kenneth, A.M., Losos, J., and Singer, S (2017). *Biology*. 9th edition, Tata McGraw Hill Publications. New Delhi.

Detailed Syllabus for Major Course
B.Sc. Zoology

Semester-II

Course Title: FUNDAMENTALS OF BIOCHEMISTRY

Course Code: ZOOMJ – 021 **Course No: MJ-02**
Credits: 04 (03 Theory, 01 Practical) **Total Marks-100**

Theory Marks: 50 **Practical marks: 20** **In Semester: 30**

Course objective: Students will learn the structure, classification, and significance of biomolecules of living system. They will also learn about Enzymes- nomenclature, action, kinetics, inhibition, & regulation.

THEORY (CREDITS 3)	**Mark**
Unit 1: Carbohydrates	8
Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates	
Unit 2: Lipids	10
Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Triacylglycerols, Phospholipids, Glycolipids, Steroids	
Unit 3: Proteins	10
Amino acids: Structure, Classification and General properties of α-amino acids; Physiological importance of essential and non-essential α-amino acids	
Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins.	
Unit 4: Nucleic acids	10
Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves, Denaturation and Renaturation of DNA. Types of DNA and RNA.	
Unit 5: Enzymes, Vitamins & Minerals	12
Enzymes- Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics: Factors affecting rate of enzyme-catalysed reactions; Michaelis-Menten equation, Concept of Km and Vmax; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.	
Vitamins- Vitamins acting as coenzymes in brief	
Minerals- sources and physiological importance of micro (Zn, Fe, Cu, Se, Mn, I, Cr, Mo) and macro minerals (Ca, P, Mg, Na, K, Cl, S)	

PRACTICAL

(CREDITS 1) **Marks: 20**

1. p^H, buffer and preparation of solutions (normal and molar solutions).
2. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
3. Paper chromatography of amino acids.
4. Action of salivary amylase under optimum conditions.
5. Demonstration of time taken for the digestion of starch by salivary amylase.

Scheme of the Practical:	**Marks**
1. Qualitative test	7
2. Quantitative test	8
3. Practical Record book	2
4. Viva-voce	3

SUGGESTED READING

- Cox, M.M and Nelson, D.L. (2021). *Lehninger's Principles of Biochemistry*, VIII Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L., Gregory J. G., Jr., and Stryer, L. (2019). *Biochemistry*, IX Edition, W.H. Freeman and Co., New York.
- Voet, D., Voet, J.G., and Pratt, C.W. (2018). *Voet's Principles of Biochemistry*. 5th edition Wiley.
- Kennelly, P.J., Botham, K.M., Owen P.M., Rodwell, V.W., and Well, P.A. (2022). *Harper's Illustrated Biochemistry*, XXXII International Edition, The McGraw- Hill Companies Inc.
- Hames, B.D. and Hooper, N.M. (2015). Bios *Instant Notes in Biochemistry*, IV Edition, T&F India.
- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2017). *Molecular Biology of the Gene*, VII Edition, Pearson Education India.

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-III

Course Title: CELL BIOLOGY

Course Code: ZOOMJ-031 **Course No: MJ-03**
Credits: 04 (03-Theory, 01-Practical) **Total Marks-100**

Theory Marks: 75	**End Semester: 50**	**In Semester: 15**
Practical Marks: 25	**End Semester: 20**	**In Semester: 05**

Course Objectives: To provide undergraduate students with a comprehensive understanding of the fundamental principles governing cellular structure, function, and molecular processes, enabling them to analyze and interpret complex cellular phenomena and their significance in biological systems.

THEORY **Marks**

Unit 1: Overview of Cells 3

Prokaryotic and Eukaryotic cells, Virus, Viroid's, Mycoplasma, Prions.

Unit 2: Plasma Membrane 7

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

Unit 3: Endomembrane System 7

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

Unit 4: Mitochondria and Peroxisomes 9

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

Unit 5: Cytoskeleton 7

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments.

Unit 6: Nucleus 7

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

Unit 7: Cell Division & Cell Signaling 10

Mitosis, Meiosis, Cell cycle and its regulation, normal and malignant cell growth, apoptosis, GPCR and Role of second messenger (cAMP).

Total= 50

CELL BIOLOGY

PRACTICAL **Marks: 20**

1. Preparation of temporary stained squash of onion root tip to studyvarious stages of mitosis.
2. Study of permanent chromosomal slides: polytene and lamp brush chromosome.
3. Study of various stages of meiosis.
4. Preparation of permanent slide to show the presence of Barr body in human female blood cells/ cheek cells.

SUGGESTED READINGS

- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VIEdition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*.VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World ofthe 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.

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-III

Course Title: PHYSIOLOGY, HISTOLOGY AND HISTOCHEMISTRY

Course Code: ZOOMJ-032 **Course No: MJ- 04**
Credits: 04 (03-Theory, 01- Practical) **Total Marks: 100**
End Semester: Theory- 50 Practical: 20 **In Semester: 30**

Course Objective: To provide basic knowledge about Anatomy and functions of bodily systems.

THEORY

Marks

Unit 1: Histological Methods **10**

Principles of fixation, dehydration, embedding, sectioning and spreading; types of staining; vital staining; classification and properties of dyes; metachromatic dyes and staining, Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue. Structure and types of bones, cartilages. Ossification, bone growth and resorption.

Unit 2: Nervous System **8**

Resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Neurotransmitters, Types of synapses, Synaptic transmission and, Neuromuscular junction; Reflex action and its types, Reflex arc; Physiology of hearing, vision and Olfaction.

Unit 3: Muscle **8**

Ultra structure of skeletal muscle; Molecular and chemical basis of skeletal muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus, Effects of exercise on skeletal muscle fibers.

Unit 4: Reproductive System **8**

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

Unit 5: Endocrine System **16**

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

PHYSIOLOGY, HISTOLOGY AND HISTOCHEMISTRY

PRACTICAL **Marks: 20**

1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres
3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.
4. Microtomy: Preparation and submission of permanent slide of any one vertebrate tissue.

Scheme of the Practical: **3 hours**

SUGGESTED BOOKS

1. Guyton, A.C. & Hall, J.E. (2006). *Textbook of Medical Physiology*. XI Edition. Hercourt Asia PTE Ltd. / W.B. Saunders Company
2. Tortora, G.J. & Grabowski, S. (2006). *Principles of Anatomy & Physiology*. XI Edition John Wiley & sons.
3. Victor P. Eroschenko. (2008). *diFiore's Atlas of Histology with Functional correlations*. XII Edition. Lippincott W. & Wilkins.
4. Arey, L.B. (1974). *Human Histology*. IV Edition. W.B. Saunders.

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-III

Course Title: Comparative anatomy of vertebrates

Course Code: ZOOMJ – 033 **Course No: MJ-05**
Credits: 04 (03-Theory, 01 Practical) **Total Marks-100**
Theory Marks: 50 **Practical Marks: 20** **In Semester: 30**

Course objective: Anatomical features of selected systems in vertebrates with special reference to mammals.

Theory

Unit 1: Integumentary System **7**

Structure, functions and derivatives of integument

Unit 2: Skeletal System **6**

Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches

Unit 3: Digestive System **6**

Alimentary canal and associated glands, dentition

Unit 4: Respiratory System **6**

Skin, gills, lungs and air sacs; Accessory respiratory organs

Unit 5: Circulatory System **7**

General plan of circulation, evolution of heart and aortic arches

Unit 6: Urino-genital System **6**

Succession of kidney, Evolution of urino-genital ducts, Types of mammalian uteri

Unit 7: Nervous System **6**

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

Unit8: Sense Organs **6**

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

COMPARATIVE ANATOMY OF VERTEBRATES

PRACTICAL

Marks: 20

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit
3. Carapace and plastron of turtle/tortoise
4. Mammalian skulls: One herbivorous and one carnivorous animal
5. Dissection of fish (carp) to study efferent and afferent branchial system (subject to permission)
6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)

Suggested Readings

- Kardong, K. V. (2005). *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw – Hill Higher Education.
- Kent, G. C. and Carr R. K. (2000). *Comparative Anatomy of 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.

Detailed Syllabus for Core Course

B.Sc. (Honours) Zoology
Semester-III

Course Title: PRINCIPLES OF ECOLOGY

Course Code: ZOOMJ – 041 **Course No: MJ-06**

Credits: 04 (03-Theory, 01-Practical) **Total Marks-100**

End semester: 50 **Practical Marks: 20** **In Semester: 30**

Theory

Course Objective: Introduction and knowledge about Structure and dynamics of population, Community characteristics, Ecosystem and Wildlife biology.

THEORY **Marks: 50**

Unit 1: Introduction to Ecology **8**

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors

Unit 2: Population **20**

Unitary and Modular populations, Unique and group attributes of population: Density, natality, mortality, life tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion. Exponential and logistic growth, equation and patterns, r- and K-Strategies. Population regulation - density-dependent and independent factors. Population interactions, Lotka-Voltera equation for competition and Predation, Gause's Principle with laboratory and field examples, functional and numerical responses.

Unit 3: Community **10**

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

Unit 4: Ecosystem **12**

Concept and types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies. Human modified ecosystem. Nutrient and biogeochemical cycle with one example of Nitrogen cycle.

PRINCIPLES OF ECOLOGY

PRACTICAL **Marks - 20**

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton,
4. Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method) and free CO_2
5. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary.

SUGGESTED READINGS

- Colinvaux, P.A. (1993). *Ecology*. II Edition. Wiley, John and Sons, Inc. Krebs, C.J. (2001). Ecology. VI Edition. Benjamin Cummings.
- Odum, E.P., (2008). *Fundamentals of Ecology*. Indian Edition.
- Brooks/Cole Robert Leo Smith. *Ecology and Field Biology*. Harper and Row publisher Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-IV

Course Title: ANIMAL PHYSIOLOGY: PHYSIOLOGY OF LIFE SUSTAINING SYSTEMS

Course Code: ZOOMJ – 042 **Course No: MJ- 07**
Credits: 04 (03-Theory, 01-Practical) **Total Marks-100**
End semester: 50 **Practical Marks: 20** **In Semester: 30**

Course Objective: To know about Anatomy and functions of bodily systems.

THEORY **Marks: 50**

Unit 1: **Physiology of Digestion** **12**

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.

Unit 2: **Physiology of Respiration** **10**

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

Unit 3: **Renal Physiology** **8**

Structure of kidney and its functional unit; Excretory products, Mechanism of urine formation; Regulation of water balance; Renal regulation of acid-base balance.

Unit 4: **Blood** **10**

Composition and Constituents of blood and their functions; Structure and types of haemoglobin; Haemostasis: Blood clotting system- Kallikrein-Kinninogen system, Complement system & Fibrinolytic system, Anticoagulants; Hemopoiesis, ABO Blood groups, Rh factor.

Unit 5: **Physiology of Heart** **10**

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

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

PRACTICALS **Marks: 20**

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

Scheme of the Practical: Time: 3 Hours

SUGGESTED READINGS

1. Guyton, A.C. & Hall, J.E. (2006). *Textbook of Medical Physiology*. XI Edition. Hercourt Asia PTE Ltd., W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). *Principles of Anatomy & Physiology*. XI Edition John Wiley & sons.
3. Vander A, Sherman J. and Luciano D. (2014). *Vander's Human Physiology*: The Mechanism of Body Function. XIII Edition, Mcgraw Hills
4. Victor P. Eroschenko. (2008). *diFiore's Atlas of Histology with Functional correlations*. XII Edition. Lippincott W. & Wilkins.
5. Arey, L.B. (1974). *Human Histology*. IV Edition. W.B. Saunders

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-IV

Course Title: BIOCHEMISTRY OF METABOLIC PROCESSES

Course Code: ZOOMJ – 043 **Course No: MJ-08**
Credits: 04 (03-Theory, 01 Practical) **Total Marks-100**

Theory Marks: 50 **Practical Marks: 20** **In Semester: 30**

Course Objective: Metabolic processes in Carbohydrate, Lipid and Proteins. ATP synthesis.

THEORY

Marks: 50

Unit 1: **Overview of Metabolism** **10**

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

Unit 2: **Carbohydrate Metabolism** **10**

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

Unit 3: **Lipid Metabolism** **10**

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

Unit 4: **Protein Metabolism** **10**

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

Unit 5: **Oxidative Phosphorylation** **10**

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

BIOCHEMISTRY OF METABOLIC PROCESSES

PRACTICAL **Marks: 20**

1. Estimation of total protein in given solutions by Lowry's method.
2. Extraction and determination of enzyme activity (urease) by titrimetric method.
3. Qualitative test of Uric acid, Creatinine and Glucose.

SUGGESTED READINGS

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

Detailed Syllabus for Major Courses

B.Sc. (Major) Zoology
Semester-IV

Course Title: ENVIRONMENT AND PUBLIC HEALTH

Course Code: ZOOMJ- 044		**Course No: MJ-09**
Credits: 04 (03-Theory, 01-Practical)		**Total Marks-100**
Theory Marks: 50	**Practical Marks: 20**	**In Semester: 30**

Course Objective: To provide basic insight on Factors affecting environment, environmental disasters and human diseases.

THEORY **Marks**

UNIT I: Introduction **10**

Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment.

UNIT II: Climate Change **8**

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

Unit III: Pollution **12**

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

Unit IV: Waste Management Technologies **12**

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

Unit V: Diseases **8**

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

Total: 50

PRACTICAL

Marks: 20

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

SUGGESTED BOOKS

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

Detailed Syllabus for Major Course

B.Sc. (Honours) Zoology
Semester-V

Course Title: MOLECULAR BIOLOGY
Course Code: ZOOMJ- 051 **Course No: MJ-11**
Credits: 04 (03-Theory, 01 Practical) **Total Marks: 100**
Theory Marks: 50 **Practical Marks: 20** **In Semester: 30**

Course objective: The objective of the course is to impart basic knowledge of the structure and function of the macromolecules, Protein synthesis, DNA repair mechanism, Gene regulation.

THEORY **Marks: 50**

Unit 1: Nucleic Acids **4**

Salient features of DNA and RNA; Watson and Crick model of DNA

Unit 2: DNA Replication **10**

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.

Unit 3: Transcription **7**

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

Unit 4: Translation **10**

Genetic code and its properties, Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, 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

Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA **6**

Structure of mRNA; Split genes: concept of introns and exons, basic concept of RNA splicing, and RNA editing, Processing of tRNA.

Unit 6: Gene Regulation and Regulatory RNAs **9**

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; Genetic imprinting, Ribo-switches, RNA interference, miRNA, siRNA.

Unit 7: DNA repair Mechanisms **4**

Pyrimidine dimerization and mismatch repair.

PRACTICAL **Marks: 20**

1. Study of Polytene chromosomes from Chironomous / Drosophila larvae
2. Preparation of liquid culture medium (LB) and raise culture of E. coli
3. Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking
4. Demonstration of antibiotic sensitivity/resistance of E. coli to antibiotic pressure and interpretation of results
5. Quantitative estimation of DNA using colorimeter (Diphenylamine reagent) or spectrophotometer(A260 measurement)/ Quantitative estimation of RNA using Orcinol reaction
6. Study and interpretation of electron micrographs/ photograph showing –

   (a) DNA replication (b) Transcription (c) Split genes (d) DNA double helix

   (e) RNA

SUGGESTED READINGS

- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VIIEdition. 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 Wileyand 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. Detailed Syllabus for Core Course.

Detailed Syllabus for Major Course
B.Sc. (Major) Zoology
Semester- V

Course Title: PRINCIPLES OF GENETICS

Course Code: ZOOMJ-052 **Course No: MJ- 12**
Credits: 04 (03-Theory + 01 Practical) **Total Marks: 100**
End Semester: Theory- 50 **Practical- 20** **In Semester: 30**

Course objective: To give knowledge to the target students about the Genetic inheritance and gene interaction in Mendelian and post-Mendelian perspective, Mutation, Linkage, Crossing over, Chromosome mapping.

THEORY **Marks: 50**

Unit 1: Mendelian Genetics and its Extensions **6**

Principles of inheritance, The Chromosomal theory of inheritance, Types of dominance (complete, Incomplete dominance, co- dominance and over dominance,), Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Phenocopy, Penetrance and Expressivity, Sex-linked, sex influenced and sex-limited characters inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping **10**

Linkage and crossing over, Lod score analysis for linkage testing. Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity, Interference and coincidence, Somatic cell hybridization.

Unit3: Mutations **8**

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.

Unit 4: Sex Determination: **4**

Chromosomal mechanisms of sex determination in Drosophila, Man. Dosage compensation, XX males and XY females showing sex reversal, SRY gene and male development.

Unit 5: Extra-chromosomal Inheritance **6**

Criteria for extra-chromosomal inheritance, Antibiotic resistance in Chlamydomonas, Mitochondrial mutations in Saccharomyces, Infective heredity in Paramecium. Concept of Maternal effects with the example of Limnaea Coiling.

Unit 6: Polygenic Inheritance: **4**

Inheritance patterns of Polygenic traits with suitable examples; Simple numericals based on it.

Unit 7: Recombination in Bacteria and Viruses **7**

Genetic transfer: Plasmids, Conjugation, Transformation, Transduction; Genetic Recombination: General recombination and site-specific recombination, Complementation test in Bacteriophage.

Unit 8: Transposable Genetic Elements: **5**

Concept of Transposable elements in maize with example in human.

PRACTICALS

Marks: 20

- Study of Mendelian inheritance of human disorders- Sickle cell anemia, Huntington's disease, Hemophilia, Fragile X syndrome through Pedigree analysis.
- Chi-square analyses based on Mendelian data.
- Linkage maps based on data from Drosophila crosses.
- Study of human karyotype- for normal and for common aneuploid conditions.

Scheme of Examination: 3 hours

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India
- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings 4. 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.

Detailed Syllabus for Major Course
B.Sc. (Major) Zoology
Semester-V

Course Title: IMMUNOLOGY

Course Code: ZOOMJ -053 **Course No: MJ- 13**
Credits: 04 (03 Theory, 01 Practical) **Total Marks- 100**
End Semester: 50 **Practical Marks: 20** **In Semester: 30**

Course Objective: The course deals with various types of immunity, antibodies, antigens, Complement system, Vaccines etc.

THEORY **Marks– 50**

Unit 1: Overview of Immune System **7**

Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system.

Unit 2: Innate and Adaptive Immunity **8**

Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity.

Unit 3: Antigens **8**

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

Unit 4: Immunoglobulins **8**

Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis

Unit 5: Major Histocompatibility Complex **5**

Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation.

Unit 6: Cytokines **4**

Properties and functions of cytokines, Therapeutics Cytokines

Unit 7: Complement System **4**

Components and pathways of complement activation.

Unit 8: Hypersensitivity **3**

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

Unit 9: Vaccines **3**

Various types of vaccines.

IMMUNOLOGY

PRACTICAL **Marks: 20**

- Demonstration of lymphoid organs through Photograph
- Histological study of spleen, thymus and lymph nodes through slides/photographs
- Preparation of stained blood film to study various types of blood cells.
- Demonstration of ELISA

SUGGESTED READINGS

- 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.

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-V

Course Title: BIOTECHNOLOGY & BIOINFORMATICS

Course Code: ZOOMJ- 054 **Course No: MJ-14**
Credits: 04 (03- Theory, 01- Practical) **Total Marks-100**
Theory Marks: 50 **Practical Marks: 20** **In Semester: 30**

Course Objective: The objective of the course is to give the students the knowledge of modern biological techniques

THEORY

Marks- 50

Unit 1: Introduction **4**

Concept and scope of biotechnology

Unit 2: **Molecular Techniques in Gene manipulation** **18**

Cloning Principle

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, BAC, YAC, and Expression vectors (characteristics only)

Restriction enzymes: Type II – Blunt end cutter and sticky end cutter Transformation techniques: Calcium chloride method and electroporation.

Construction of genomic and cDNA libraries and screening by blue white colony selection method Blotting techniques- Southern, Northern and Western blotting;

DNA sequencing: Sanger dideoxy sequencing method Polymerase Chain Reaction, DNA Finger Printing

Unit 3: Genetically Modified Organisms **10**

Production of transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection, Applications of transgenic animals.

Production of transgenic plants: Agrobacterium mediated transformation. Applications of transgenic plants.

Unit 4: **Fundamentals of Bioinformatics** **8**

Concept and scope of bioinformatics, Introduction to biological databases; Primary, secondary and composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL); Protein databases (PIR, SWISSPROT, TrEMBL, PDB); Metabolic pathway database (KEGG); Small molecule databases (PubChem). Data mining and data mining tools (ENTREZ)

Unit 5: Basic concept of sequencing alignment **10**

Concept of sequence alignment: pairwise and multiple sequence alignments, Local and global alignment; Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming), BLAST and FASTA; Similarity, identity and homology of sequences. Phylogenetic analysis: Basic concept, Steps in evaluating and constructing phylogenetic tree.

PRACTICAL

Marks: 20

1. Genomic DNA isolation from E.coli/Animal tissue/Plant leaves.
2. To study following techniques through photographs:
    a) Southern Blotting
    b) DNA Sequencing (Sanger's Method)
    c) PCR
    d) DNA fingerprinting
3. Accessing biological database
4. Retrieval of nucleotide and protein sequences from databases
5. To perform pair-wise alignment of sequences (BLAST) and interpret the outcome
6. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequence
7. To learn graphical representation of statistical data with the help of computers (e.g., MS Excel)

SUGGESTED READINGS

- 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 Analysi*s. 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.

Detailed Syllabus for Major Course B.Sc.

B.Sc (Major) Zoology
Semester-VI

Course Title: DEVELOPMENTAL BIOLOGY
Course Code: ZOOMJ- 061 **Course No: MJ-16**
Credits: 04 (03-Theory, 01-Practical) **Total Marks-100**
Theory Marks: 50 **Practical Marks: 20** **In Semester: 30**

Course objective: To provide knowledge about the gradual emergence of form and structure of embryo. The essence of embryonic development is changing transition from one stage to another.

THEORY

Marks: 50

Unit1: Introduction **6**

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

Unit2: Early Embryonic Development **20**

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

Unit3: Late Embryonic Development **8**

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

Unit4: Post Embryonic Development **8**

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

Unit5: Implications of Developmental Biology **8**

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

DEVELOPMENTAL BIOLOGY

PRACTICALS

Marks: 20

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of different sections of placenta (photomicrograph/slides)
4. Project report on Drosophila culture/chick embryo development

SUGGESTED READINGS

- 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

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-VI

Course Title: EVOLUTIONARY BIOLOGY

Course Code: ZOOMJ-062 **Course No: MJ-17**

Credits: 04 (03-Theory, 01-Practical) **Total Marks-100**

Theory Marks: 50 **Practical Marks: 20** **In Semester: 30**

Course Objective: To provide basic concept about the present biodiversity and present geneticvariance on the earth.

THEORY

Marks: 50

Unit 1: **6**

Life's Beginnings: Chemogeny, RNA world, Biogeny.

Unit 2: **4**

Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism, Nature vs Nurture (meaning)

Unit 3: **8**

Evidences of Evolution: Homology- analogy, embryology, Fossil record (types of fossils, transitional forms); Geological time scale; Evolution of horse, Molecular evidences (universality of genetic code and protein synthesising machinery, three domains of life); Neutral theory of molecular evolution, Molecular clock, example of globin gene family, Cyt c.

Unit 4: **8**

Variations: Types, sources, examples of variation

Unit 5: **12**

Population genetics: Concept of population- gene pool and gene frequency, Hardy-Weinberg Law; Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient, genetic load), types of natural selection (Stabilizing selection, Directional selection, Disruptive selection), Kinselection, Adaptive resemblances (Crypsis, Mimicry); Sexual selection. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon); Role of Migration and Mutation in changing allele frequencies).

Unit 6: **5**

Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric and peripatric, parallel, divergent and convergent evolution; endemism and adaptive radiation radiation/ macroevolution (exemplified by Galapagos finches).

Unit 7: **2**

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

Unit 8: **5**

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.

Total: 50

PRACTICAL

Marks: 20

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

SUGGESTED READINGS

- 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

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-VI

Course Title: WILDLIFE CONSERVATION AND MANAGEMENT

Course Code: ZOOMJ-063 **Course No: MJ-18**
Credits: 04 (03-Theory, 01-Practical) **Total Marks-100**
Theory Marks: 50 **Practical Marks: 20** **In Semester:30**

Course Objective: The objective of the course is to know about various conservation strategies of wildlife and its management

THEORY **Marks: 50**

Unit 1: Evaluation and management of wildlife **12**

Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Sign survey and census method of wild life; Standard evaluation procedures: remote sensing and GIS.

Unit 2: Management of habitats **10**

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

Unit 3: Management planning of wildlife in protected areas **10**

Estimation of carrying capacity; Ecotourism in forests; Concept of climax persistence.

Unit 4: Management of excess population **8**

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

Unit 5: Protected areas **10**

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

WILDLIFE CONSERVATION AND MANAGEMENT

PRACTICALS

Marks: 20

1. Identification of threatened flora, mammalian fauna, avian fauna, herpeto-fauna (at least five sp. From each).
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 pugmarks, hoofmarks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna: PCQ, Circular/Square/ rectangular plot methods for ground cover (Tree/Shrub/Herb) assessment, Tree canopy cover assessment.
5. Trail/transect monitoring for abundance and diversity estimation of mammals/ bird (direct and indirect evidences)

SUGGESTED READINGS

- Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.
- Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). *People and Wildlife, Conflict or Coexistence?* Cambridge University.
- Bookhout, T.A. (1996). *Research and Management techniques for Wildlife and Habitats*, 5th edition. The Wildlife Society, Allen Press.
- Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences
- Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). *Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Blackwell Publishing

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-VI

Course Title: ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

Course Code: ZOOMJ- 064 **Course No: MJ-19**
Credits: 04 (03-Theory, 01 Practical) **Total Marks: 100**
Theory Marks: 50 **Practical Marks:20** **In Semester: 30**

Course Objective: The various types of behaviour or the responses to environment & stimuli of different organisms along with human being.

THEORY **Marks: 50**

Unit 1: Introduction to Animal Behaviour **8**

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

Unit 2: Patterns of Behaviour **8**

Innate Behaviours (Orientation, Reflexes, behavioural genetics); Learning Behaviours: Associative Learning (Classical and Operant conditioning); Non-Associative Learning (Imprinting, Habituation), Individual Behavioural Patterns.

Unit 3: Social and Sexual Behaviour **10**

Social Behaviour: Concept of Society; Biological Communication; Altruism; Insects' society with Honeybee as example; Foraging in honey bee and advantages of the waggle dance.

Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Sexual Selection: Intra-sexual selection (malerivalry); Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology **14**

Historical developments in chronobiology; Relevance of biological clocks; Adaptive significance of biological clocks; Chrono-pharmacology, Chrono-medicine, Chronotherapy.

Unit 5: Biological Rhythm **10**

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

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

PRACTICAL

Marks: 20

1. To study nests and nesting habits of the birds and social insects.
2. To study geotaxis behaviour in earthworm.
3. To study the photo taxis behaviour in insect larvae.
4. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

SUGGESTED READINGS

- David McFarland. *Animal Behaviour*. Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M. S, *An Introduction to Animal Behaviour*. Cambridge, University Press, UK.
- John Alcock, *Animal Behaviour*. Sinauer Associate Inc., USA.
- Paul W. Sherman and John Alcock, *Exploring Animal Behaviour*. Sinauer Associate Inc., Massachusetts,USA.
- *Chronobiology: Biological Timekeeping*: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
- *Insect Clocks*. D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R.D. Lewis. (3rd Ed) 2002 Barens and Noble Inc. New York, USA
- *The Clock that times us*. 1982. Moore Ed. et. al.
- *Biological Rhythms*. Vinod Kumar (2002), Narosa Publishing.

Detailed Syllabus for Minor Course

B.Sc. Zoology
Semester- I

Course Title: ANIMAL DIVERSITY & SYSTEMATICS

Course Code: ZOOMI – 011 **Course No: MI01**

Credits: 04 (03 Theory, 01 Practical) **Total Marks- 100**

Theory Marks: 50 **Practical Marks: 20** **In Semester: 30**

THEORY **Marks**

Unit1: 12

Systematics and classification

Forms and hierarchy of classification. Basic concept and importance of systematic and taxonomy, newer aspects of Biosystematics.

Protista:

General characters and classification up to classes with examples; Life cycle of Plasmodium.

Porifera:

General characters and classification up to classes with examples; canal system in Porifera.

Radiata:

General characters and classification of Cnidaria up to classes with examples; Polymorphism in Cnidaria.

Unit 2: 6

Aceolomates:

General characters and classification of Platyhelminthes up to classes with examples; Life cycle of *Taenia solium*.

Pseudocoelomates:

General characters and classification of Nemathelminthes up to classes with examples; Parasitic adaptations of Nemathelminthes.

Unit 3: 10

Coelomate Protostomes Annelida:

General characters and classification of Annelida upto classes;
Metamerism in Annelida. Arthropoda:
General characters and classification up to classes. Social life in insects.

Mollusca:

General characters and classification of Mollusca upto classes with examples; Pearl formation in Mollusca

Coelomate Deuterostomes:

General characters and classification of Echinodermata up to classes with examples, Water Vascular system in Starfish.

Unit 4: 10

Protochordata:

Classification with examples and Salient features.

Pisces:

Classification & classification of Pisces, Osmoregulation and Migration of Fishes.

Amphibia:

General characters & classification of Amphibia, Adaptations for terrestrial life, Parental care in Amphibia.

Unit 5: 12

Amniotes:

Reptiles - General characters & classification of Reptiles, Terrestrial adaptations in reptiles.

Aves:

General characters of Birds; Flight adaptations

Mammalia:

General characters; Affinities of prototheria.

Total 50

PRACTICAL

Marks: 20

1. Study of following specimens:

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

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

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

3. Temporary mounts of Unstained mounts of Placoid, cycloid and Ctenoid scales.

Scheme of the Practical: Time: 3 Hours

	Marks
Identification of bottle specimen:	6
Identification of microscopic slide:	2
Temporary mount:	5
Practical record book:	4
Viva-voce:	3

SUGGESTED READINGS

- Mayr, E (2014). *Principles of Systematic Zoology*. McGraw Hill Education. Indian edition.
- Kapoor, V C (2019). *Theory and Practice of Animal Taxonomy and Biodiversity*. Oxford & IBH Publishing.
- Ruppert, Fox and Barnes (2006). *Invertebrate Zoology. A functional Evolutionary Approach*. 7th Edition, Thomson Press (India) Ltd.
- Campbell & Reece (2005). *Biology*. Pearson Education, (Singapore) Pvt. Ltd.
- Kardong, K. V. (2018). *Vertebrates: Comparative Anatomy, Function and Evolution*. 8th Edition, Tata McGraw Hill Publishing Company. New Delhi.
- Raven, P. H., Johnson, G. B., Kenneth, A.M., Losos, J., and Singer, S (2017). *Biology*. 9th edition, Tata McGraw Hill Publications. New Delhi.

Detailed Syllabus for Minor Course

B.Sc. Zoology Semester-II

Course Title: FUNDAMENTALS OF BIOCHEMISTRY

Course Code: ZOOMI- 021		**Course No: MI-2**
Credits: 04 (03 Theory, 01 Practical)		**Total Marks-100**
Theory Marks: 50	**Practical marks: 20**	**In Semester: 30**

Course objective: Students will learn the structure, classification, and significance of biomolecules of living system. They will also learn about Enzymes- nomenclature, action, kinetics, inhibition, & regulation.

THEORY	**Marks**
Unit 1: Carbohydrates Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates.	8
Unit 2: Lipids Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Triacylglycerols, Phospholipids, Glycolipids, Steroids.	8
Unit 3: Proteins Amino acids: Structure, Classification and General properties of α-amino acids; Physiological importance of essential and non-essential α-amino acids. Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins.	10
Unit 4: Nucleic acids Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves, Denaturation and Renaturation of DNA. Types of DNA and RNA.	10
Unit 5: Enzymes, Vitamins & Minerals **Enzymes-** Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics: Factors affecting rate of enzyme-catalysed reactions; Michaelis Menten equation, Concept of Km and Vmax; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action. **Vitamins-** Vitamins acting as coenzymes in brief. **Minerals-** sources and physiological importance of micro (Zn, Fe, Cu, Se, Mn, I, Cr, Mo) and macro minerals (Ca, P, Mg, Na, K, Cl, S)	14

PRACTICAL **Marks: 20**

1. pH, buffer and preparation of solutions (normal and molar solutions).
2. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
3. Paper chromatography of amino acids.
4. Action of salivary amylase under optimum conditions.
5. Demonstration of time taken for the digestion of starch by salivary amylase.

Scheme of the Practical:	**Marks**
1. Qualitative test	7
2. Quantitative test	8
3. Practical Record book	2
4. Viva-voce	3

SUGGESTED READING

- Cox, M.M and Nelson, D.L. (2021). *Lehninger's Principles of Biochemistry*, VIII Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L., Gregory J. G., Jr., and Stryer, L. (2019). *Biochemistry*, IX Edition, W.H. Freeman and Co., New York.
- Voet, D., Voet, J.G., and Pratt, C.W. (2018). *Voet's Principles of Biochemistry*. 5th edition Wiley.
- Kennelly, P.J., Botham, K.M., Owen P.M., Rodwell, V.W., and Well, P.A. (2022). *Harper's Illustrated Biochemistry*, XXXII International Edition, The McGraw- Hill Companies Inc.
- Hames, B.D. and Hooper, N.M. (2015). Bios *Instant Notes in Biochemistry*, IV Edition, T&F India.
- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2017). *Molecular Biology of the Gene*, VII Edition, Pearson Education India.

Detailed Syllabus for Minor Course

B.Sc. Zoology Semester-III

Course Title: ANIMAL PHYSIOLOGY

Course Code: ZOOMI- 031 **Course No: MI-03**
Credits: 04 (03-Theory, 01-Practical) **Total Marks: 100**
End Semester: Theory-50 Practical: 20 **In Semester: 30**

Course Objective: To provide basics about Anatomy and functions of bodily systems.

THEORY

Marks

Unit 1: Tissues **10**

Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue. Structure and types of bones, cartilages. Ossification, bone growth and resorption.

Unit 2: Nervous System **8**

Resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapses, Synaptic transmission and Neuromuscular junction; Reflex action and its types, Reflex arc; Physiology of hearing and vision.

Unit 3: Muscle **8**

Ultra-structure of skeletal muscle; Molecular and chemical basis of skeletal muscle contraction; Characteristics of muscle twitch; Motor unit, Summation and tetanus.

Unit 4: Reproductive System **8**

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

Unit 5: Endocrine System **16**

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

ANIMAL PHYSIOLOGY

PRACTICALS **Marks: 20**

1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres.
3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.

Scheme of the Practical: 3 hours

SUGGESTED 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.
- Arey, L.B. (1974). *Human Histology*. IV Edition. W.B. Saunders.

Detailed Syllabus for Minor Course

B.Sc. Zoology Semester-IV

Course Title: ENVIRONMENT AND PUBLIC HEALTH

Course Code: ZOOMI- 041 **Course No: MI-04**
Credits: 04 (03-Theory, 01 Practical) **Total Marks-100**
End semester: 50 **Practical Marks: 20** **In Semester: 30**

Course Objective: To provide basic insight on Factors affecting environment, environmentaldisasters and human diseases.

THEORY

Marks: 50

UNIT I: Introduction **10**

Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistentsubstances in the environment.

UNIT II: Climate Change **8**

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

Unit III Pollution

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

Unit IV: Waste Management Technologies **12**

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

Unit V: Diseases **8**

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

Total: 50

PRACTICAL **Marks: 20**

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

2. Detection of Cl, SO_4, NO_3 in soil and water samples from different locations.

SUGGESTED BOOKS

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

Detailed Syllabus for Minor Course

B.Sc. Zoology Semester-V

Course Title: BIOTECHNOLOGY & BIOINFORMATICS

Course Code: ZOOMI- 051 **Course No: MI-05**
Credits: 04 (03-Theory, 01-Practical) **Total Marks-100**
Theory Marks: 50 **Practical Marks: 20** **In Semester: 30**

Course Objective: The objective of the course is to give the students the knowledge of modern Biological techniques.

THEORY

Marks- 50

Unit 1: Introduction **4**

Concept and scope of Biotechnology

Unit 2: **Molecular Techniques in Gene manipulation** **18**

Cloning Principle

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, BAC, YAC, and Expression vectors (characteristics only) Restriction enzymes: Type II – Blunt end cutter and sticky end cutter, Transformation techniques: Calcium chloride method and electroporation.
Construction of genomic and cDNA libraries and screening by blue white colony selection method Blotting techniques- Southern, Northern and Western blotting;
DNA sequencing: Sanger dideoxy sequencing method, Polymerase Chain Reaction, DNA Finger Printing.

Unit 3: Genetically Modified Organisms **10**

Production of transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection, Applications of transgenic animals

Production of transgenic plants: Agrobacterium mediated transformation. Applications of transgenic plants.

Unit 4: **Fundamentals of Bioinformatics** **8**

Concept and scope of bioinformatics, Introduction to biological databases; Primary, Secondary and Composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL); Protein databases (PIR, SWISSPROT, TrEMBL, PDB); Metabolic pathway database (KEGG); Small molecule databases (PubChem). Data mining and data mining tools (ENTREZ).

Unit 5: Basic concept of sequencing alignment **10**

Concept of sequence alignment: pairwise and multiple sequence alignments, Local and global alignment; Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming), BLAST and FASTA; Similarity, identity and homology of sequences. Phylogenetic analysis: Basic concept, Steps in evaluating and Constructing Phylogenetic tree.

PRACTICAL

Marks: 20

1. Genomic DNA isolation from E. coli/Animal tissue/Plant leaves.
2. To study following techniques through photographs:
    a) Southern Blotting
    b) DNA Sequencing (Sanger's Method)
    c) PCR
    d) DNA fingerprinting
3. Accessing Biological database.
4. Retrieval of nucleotide and protein sequences from databases.
5. To perform pair-wise alignment of sequences (BLAST) and interpret the outcome.
6. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequence.
7. To learn graphical representation of statistical data with the help of computers (e.g., MS Excel)

SUGGESTED READINGS

- 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.

Detailed Syllabus for Minor Course

B.Sc. Zoology Semester-VI

Course Title: ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

Course Code: ZOOMI- 061 **Course No: MI-06**

Credits: 04 (03-Theory, 01-Practical) **Total Marks: 100**

Theory Marks: 50 **Practical Marks: 20** **In Semester: 30**

Course Objective: The various types of behaviour or the responses to environment & stimuli of different organisms along with human being.

THEORY **Marks: 50**

Unit 1: Introduction to Animal Behaviour **8**

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

Unit 2: Patterns of Behaviour **8**

Innate Behaviours (Orientation, Reflexes); Learning Behaviours: Associative Learning (Classical and Operant conditioning); Non-Associative Learning (Imprinting, Habituation), Individual Behavioural Patterns.

Unit 3: Social and Sexual Behaviour **10**

Social Behaviour: Concept of Society; Biological Communication; Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.

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

Unit 4: Introduction to Chronobiology **14**

Historical developments in chronobiology; Relevance of Biological clocks; Adaptive significance of biological clocks; Chrono-pharmacology, Chrono-medicine, Chronotherapy.

Unit 5: Biological Rhythm **10**

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

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

PRACTICAL

Marks: 20

1. To study nests and nesting habits of the birds and social insects.
2. To study geotaxis behaviour in earthworm.
3. To study the phototaxis behaviour in insect larvae.
4. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

SUGGESTED READINGS

- David McFarland, *Animal Behaviour*, Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M.S, *An Introduction to Animal Behaviour*, Cambridge, University Press, UK. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
- Paul W. Sherman and John Alcock, *Exploring Animal Behaviour*, Sinauer Associate Inc., Massachusetts, USA.
- *Chronobiology Biological Timekeeping*: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. De Coursey(ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
- *Insect Clocks* D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R.D. Lewis. (3rdEd) 2002 Barens and Noble Inc. New York, USA
- *The Clock that times us*. 1982. Moore Ed et.al.
- *Biological Rhythms*, Vinod Kumar (2002) Narosa Publishing.

Detailed Syllabus for Value Added Course (VAC) for UG Programme Environmental Education

(Syllabus of environmental education as part of value-added courses under NEP framework with effect from 2023-24 programme: four-year UG honours programme)

A Mandatory Course for BA/ BCom/ BSc, etc.
Semester–I

Course Title: ENVIRONMENTAL EDUCATION

Course Code: EVE VA– 011

Credits: 02 **Total Marks: 50**
End Semester: 35 **Project Marks/IA:15**

Course objective: Course intended to create awareness that the life of human beings is an integral part of environment and to inculcate the skills required to protect environment from all sides.

Learning outcomes: On completion of this course the students will be able to…..

1. Understand the concept, objective, nature, components of an ecosystem and that humans are an integral part of nature.
2. Realize the importance of environment, the goods and services of a healthy biodiversity, dependence of humans on environment.
3. Evaluate the ways and ill effects of destruction of environment, population explosion on ecosystems and global problems consequent to anthropogenic activities.
4. Discuss the laws/ acts made by government to prevent pollution, to protect biodiversity and environment as a whole.
5. Acquaint with international agreements and National movements, and realize citizen's role in protecting environment and nature.

	Marks
Unit 1: Concept of Environmental Education	5
Meaning, objective and importance, Evolution and development of environmental education. Need for public awareness. Stockholm Conference, Earth summit.	
Unit 2: Environment and Natural Resources	11
Multidisciplinary nature of environmental science; scope and importance. Concept of ecosystem; Natural resources – types and their importance.	
Biodiversity: Definition; levels, importance and threats to Biodiversity.	

Marks

Unit 3: Environmental degradation and its impacts 10

Human population growth and its impacts on environment; land use change, deforestation, habitat fragmentation land degradation, soil erosion and desertification.

Concept of environmental hazards.

A brief account of air, water, soil and noise pollutions- causes, effect and control measures;

Concept of climate change: Green-house effect, global warming; ozone layer depletion, acid rains and their impacts on human communities and agriculture.

Unit 4: Conservation of Environment 9

Concept of sustainability and sustainable development with judicious use of land, water and forest resources; afforestation. Conservation of nature and natural resources, man- animal conflict.

Environment Laws: Environment Protection Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols;

Environmental movements: Bishnois of Rajasthan, Chipko, Silent valley.

Suggested activities to learner: **15**

1. Visit to an area to document environmental assets: river/forest/flora/fauna
2. Visit to a local polluted site- Urban/Rural/Industrial/Agricultural site.
3. Study of common plants, insects, birds and basic principles of identification.
4. Study of simple ecosystems- forest, pond, lake etc.
5. Case study of a Forest ecosystem or a pond ecosystem.
6. Assignment/ Group discussion/ project

Suggested text books:

- Erach Barucha (2004). *Text book of Environmental Studies for Undergraduate courses* (Prepared for University Grants Commission) Universities Press.
- Dani, H.M. (1996). *Environmental Education*. Chandigarh: Punjab University Publication Bureau.
- Pankaj Shrivastava & D.P. Singh (2002). *Environment Education*. Anmol Publication Pvt. Ltd.
- Purnima Smarath (2018). *Environmental studies*. Kalyani Publishers, Ludhiana.

Detailed Syllabus for Major Course

B.Sc. (Major) Zoology
Semester-I/II/III

Course Title: AQUARIUM FISHKEEPING

Course Code: ZOOSK-011/021/031 **Course No:SK01/02/03**
Credits: 03 **Total Marks: 75**
End Semester: 50 **In Semester: 25**

Course objective: Students will be able to construct Aquarium and they will also be able to maintain it with aquarium fishes. Skill so developed may be used in entrepreneurship.

Marks

Unit 1: Introduction to Aquarium Fish Keeping 10

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

Unit 2: Biology of Aquarium Fishes 10

Common characters and sexual dimorphism of Fresh water aquarium fishes such as *Puntius*, *Channa*, *Botia*, *Mystus*, *Clarius*, *Wallago*, *Notopterus*, *Tetradon*, *Nandus sp.*; Fish diseases, Fish compatibility, Aquarium fish behaviour.

Unit 3: Food and feeding of Aquarium fishes 10

Use of live fish feed organisms. Preparation and composition of formulated fish feeds.

Unit 4: Fish Transportation 10

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

Unit 5: Maintenance of Aquarium 10

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

PRACTICAL

Project report on field visit to a fish market to identify aquarium fishes and submission of the field study report. 25

SUGGESTED READINGS

- Jhingran, V.G. (1997), *Fish and Fisheries of India*, Hindustan Publishing Corporation.
- Gupta, S.K., Gupta, P.C.(2006), *General and applied ichthyology (fish and fisheries)*, S. Chand Limited, New Delhi.
- Jayaram, K.C. (2012), *The Freshwater Fishes of the Indian Region*, Narendra Publishing House.
- Jeremy Gay, J (2005), *The Perfect Aquarium: The Complete Guide to Setting Up and Maintaining an Aquarium*, Hamlyn publishers.