KAZI NAZRUL UNIVERSITY

[Kalla Bypass More, North, P.O, C H Kalla, Asansol, West Bengal 713340]

SYLLABUS

B.Sc. HONOURS IN ZOOLOGY

(With effect from the academic session: 2020-21)

SCHEME AND SYLLABUS

(As per Learning Outcomes based Curriculum Framework)

SEMESTER	Core Course (14)	Ability Enhancement Compulsory Courses AEC (2)	Generic Elective Courses GE(4)	Skill Enhancement Courses SEC (2)	Discipline Specific Elective DSE (4)
I	CC 1: Systematics & Diversity of Life - Protists to Chordates CC 2: Ecology	Environmental Science	GE 1		
II	CC 3: Comparative Anatomy & Physiology of Nonchordates CC 4: Cell Biology and Histology	English Communication	GE 2		
III	CC 5: Comparative Anatomy & Physiology of Chordates CC 6: Genetics CC 7: Biochemistry		GE 3	SEC-I Beekeeping / Public Health and Hygiene / Toxicology	
IV	CC 8: Behaviour and Chronobiology CC 9: Developmental Biology & Evolution CC 10: Molecular Biology		GE 4	SEC-II Sericulture/ Insect Pest, Vector Biology and Management /Biofertilizers	
V	CC 11: Biotechniques CC 12: Microbiology, Parasitology & Immunology				DSE 1: Genetic Engineering and Biotechnology DSE 2: Livestock Management and Animal Husbandry
VI	CC 13: Biostatistics & Bioinformatics CC 14: Applied Zoology				DSE 3: Wild Life Conservation and Management DSE 4: Human Reproductive Biology

SEMESTER-I

Course Name: Systematics and Diversity of Life Protists to Chordates

Course Code: BSCHZOOC101

Course Type: **Core**	Course Details: **CC-1**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

About the course

The course is a walk for the Bachelor's entrant through the amazing diversity of living forms from simple to complex one. It enlightens how each group of organisms arose and how did they establish themselves in the environment with their special characteristics. It also deals with the differences and similarities between organisms on the basis of their morphology and anatomy which led to their grouping into taxa and clades.

Learning outcomes

After successfully completing this course, the students will be able to:

- Develop understanding on the diversity of life with regard to protists, non chordates and chordates.
- Group animals on the basis of their morphological characteristics/ structures.
- Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
- Understand how morphological change due to change in environment helps drive evolution over a long period of time.

• The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. It will further enable the students to think and interpret individually due to different animal species chosen

THEORY

Unit I: Origin of Life on Earth, Products of evolutionary process (13 Lectures)

Origin of life on Earth: Arrival of simple form from primordial chemicals. Multicellularity: from simple collections of poorly differentiated cells to complex body plans. Biological diversity. Systematics and taxonomy. Species concept, clades. Nomenclature and utility of scientific names. Classification: morphological and evolutionary (molecular). Relationship of taxa: phylogenetics and cladistics with special reference to paraphyly, monophyly, apomorphy, plesiomorphy and phenoplasticity.

Unit II: Diversity in Protists and acoelomate Metazoa (13 Lectures)

Structure and diversity in Protists (classification up to Phylum). Origin of Metazoans: diploblastic and triploblastic organization; symmetries; body cavities; protostomes and deuterostomes. Special features and structural diversity (skeletal organization) in sponges (classification up to classes). Cnidarians: Special features; transition of third germ layer; polymorphism and division of labour; coral reef forming cnidarians, types & significance; classification up to classes. The Bilateria: Basic characteristics. The acoelomates: Basic organization and adaptive radiations in flatworms, classification of Platyhelminthes up to classes.

UNIT III: Diversity in pseudocoelomate and coelomate Non chordates (13 Lectures)

The Ecdysozoa: characteristics of the representative taxa. Pseudocoelomates; Basic organization and adaptive radiations in roundworms. Classification of Nematoda up to classes. The coelomates: Basic organization and adaptive radiations in Arthropods- Ancestors/fossil arthropods. Adaptive radiations in Crustaceans, Myriapods, Chelicerates, Insects, etc.,

classification of arthropods up to classes. Basic organization and diversity (classification up to classes) in Annelids. Basic organization and diversity (classification up to classes) in Molluscs. Disruption of bilateral symmetry and its significance. Basic organization and classification (up to classes) of Echinoderms; their affinity to Chordates.

Note: Classification to be followed from Ruppert and Barnes Invertebrate Zoology VI edition, except for Protozoa (American Association of Protozoologist ref: Levine 1980) and Porifera (Brusca and Brusca 2002; IV edition. Invertebrate Zoology)

UNIT IV: Diversity in Protochordates and Chordates (13 Lectures)

Chordates– Primitive Chordates and their affinities. Hemichordates, Urochordates and Cephalochordates. Advent of vertebrates: Cyclostomes, their evolutionary status and affinities. Basic organization and diversity (classification up to order) of fishes, their evolutionary transitions from Water to Land invasion- Early Tetrapodes. Amphibians diversity (classification up to order) and adaptability to dual mode of life. adaptive radiations in reptiles, classification of reptiles up to order; the avian ancestors. Birds: Adaptation from terrestrial to aerial mode of life. Origin of Mammals- Special features of Monotremes and Marsupials. Characteristics and classification of mammalian groups (up to orders) with special reference to primates.

Note: Classification from Young, J. Z. (1981) to be followed except for classification fishes. For Pisces classification scheme to be followed from Nelson, J. S. (2006).

PRACTICAL

1. Study of animals through slides and museum specimens/photographs in the laboratory with their classification, biogeography and diagnostic features (record book). Animals to be included for the study are as follows:

   Euglena, Amoeba, Paramecium, Obelia, Physalia, Porpita, Euspongia, Scypha, Aurelia, Tubipora, Sea Anemone, *Pennatula, Fungia, Fasciola hepatica, Taenia solium, Ascaris, Aphrodite, Sabella, Chaetopterus, Pheretima, Carcinoscorpius, Macrobrachium, Balanus, Julus, Periplaneta, Peripatus, Chiton, Pila, Pinctada, Sepia, Astropecten, Cucumaria* and *Antedon.*

   Balanoglossus, Branchiostoma, Ascidia, Scoliodon, Torpedo, Mystus vitattatus, Catla, Exocoetus, Hippocampus, Ichthyophis, Necturus, Bufo, Rachophorous, Chelone, Calotes, Chamaeleon, Draco, Bungarus, Vipera, Naja, Psittacula, Pycnonotus, Sorex, Pteropus, Funambulus.

2. Study of animals in nature during a survey of a National Park or Forest area or any local biodiversity rich area.
3. Collection of five species or presentation through photographic plates (preferably invertebrates, insects) belonging to a clade. A project work on their generic identification, description and illustration with a note on their locality. Also the assessment of their relationship by constructing a cladogram using characters and character states.
4. Comparison of two species of birds belonging to same genus (Interspecific difference).
5. Comparison and weighting of characters of two birds belonging to same family but dissimilar genera.
6. Group discussion or Seminar presentation on one or two related topics.

Recommended readings

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VII Edition. Thompson Brooks Cole (International Edition)

2. Barnes, R.S.K., Callow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition.
4. Young, J. Z. (1981). The Life of Vertebrates. III Edition. Oxford university press.
5. Pough H. Vertebrate life, VIII Edition, Pearson International.
6. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
7. Hall B.K. and Hallgrimsson B. (2008).
8. Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
9. Nelson, J. S. (2006). Fishes of the World, Wily.
10. Lomolino, M. V. et al (2010) Biogeography, 4th Edition, Sinauer Associates

Course Name: Ecology

Course Code: BSCHZOOC102

Course Type: **Core**	Course Details: **CC-2**		L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

About the course

This course will take students on a journey through the physical workings of the Earth, the interactions between species and their environments. The course highlights on some of the important aspects *viz*. growth and survival of populations and communities in different habitats, energy flow in the ecosystems, interactions between the communities, exclusion of niches and consequences of changing environment on the biodiversity.

Learning outcomes

After successfully completing this course, the students will be able to:

- Know the evolutionary and functional basis of animal ecology.
- Understand what makes the scientific study of animal ecology a crucial and exciting endeavour.
- Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field.
- Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice.
- Solve the environmental problems involving interaction of humans and natural systems at local or global level.

THEORY

UNIT I: An overview of Ecology, Ecosystems and Biomes (13 Lectures)

Introduction and scope of Ecology. Multidisciplinary relevance in current perspective. Structure and function of ecosystem; Abiotic factors affecting survival and sustenance of organisms e.g., water, temperature, light, pH and salinity. Role of limiting factors in survival of biotic components. Major ecosystems of the world: Ecological features, limiting factors, zonation and classification of organisms of fresh water and marine ecosystems. Introduction to Biome: Ecological features of Tundra, Desert, Savannah and Tropical Rain forest Biomes. Energy flow in ecosystem, food chain and food web. Productivity. Mineralization and recycling of nutrients: C, N, P & S.

UNIT II: Population ecology (13 Lectures)

Ecology of populations: Unitary and Modular populations. Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves. Unique and group attributes of population: mortality, age ratio, sex ratio, dispersal. Factors regulating population dispersal and growth: Exponential and logistic growth. Population regulation: density-dependent and independent factors; r and K strategies.

UNIT III: Biotic community, characteristics and attributes (13 Lectures)

Community characteristics: stratification; Dominance, diversity, species richness, abundance, Evenness, Similarity. Diversity and food-web indices. Ecotone and edge effect; Types of interaction: Positive interactions: commensalism, proto-cooperation, and mutualism. Negative interactions: parasitism and allelopathy; predation and predator-prey dynamics; herbivory. Interspecific competition and coexistence, Inter and intra-specific; abundance. Niche overlap and segregation. Gause's Principle with laboratory and field examples. Ecological succession: Definition, Process, types, theories of succession.

UNIT IV: Environmental degradation; Environmental movement etc. (13 Lectures)

Environmental ethics; Pollution: Air, water and noise pollution and their control; Natural resources: Mineral, water and forest, their significance and conservation; Types of biodiversity, Hotspots, benefit and threat of conservation strategies; Biodiversity: status, monitoring and documentation; major drivers of biodiversity change; Biodiversity mapping using GPS, GIS and remote sensing. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Application of ecology in management and Conservation programmes. Role of gender and cultures in environmental conservation. Environmental movements: Bishnois. Chipko, Silent valley, Big dam movements. Environmental education and public awareness.

PRACTICAL

1. To measure microclimatic variables *viz*., temperature, humidity and light conditions in a microhabitat.
2. Making an ecosystem in a wide-mouthed bottle.
3. Constructing a food web by observing organisms from a given area.
4. Preparing and clearly present an essay based on the evaluation of 4-7 publications.
5. Studying the impact of herbivore on plant species (planted in pots under specific conditions).
6. Constructing distribution map of species of a genus through GPS by estimating the coordinates (virtual demonstration).
7. Estimation of the ratio of the producers and consumers.
8. Determination of pH, and Dissolved oxygen (Winkler's Method) and Free CO_2 contents.
9. Preparation of nested quadrate and estimation of effective quadrate size.
10. Study of an aquatic ecosystem: Major Phytoplankton (Up to Family) and zooplankton (Up to Genus).

Recommended readings

1. Colinvaux, P. A. (1993) Ecology (2nd edition) Wiley, John and Sons, Inc.

2. Krebs, C. J. (2001) Ecology (6th edition) Benjamin Cummings.

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

4. Ricklefs, R.E. (2000) Ecology (5th edition) Chiron Press.

5. Southwood, T.R.E. and Henderson, P.A. (2000) Ecologial Methods (3rd edition) Blackwell Sci.

6. Kendeigh, F C. (1984) Ecology with Special Reference to Animal and Man. Prentice Hall Inc.

7. Stiling, P. D. (2012) Ecology Companion Site: Global Insights and Investigations. McGraw Hill Education.

Course Name: Basics of Systematics and Classification

Course Code: BSCHZOOGE101

Course Type: **Generic Elective**	Course Details: **GEC-1**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

THEORY

Unit I: Introduction to systematic and classification **13 Lectures**

Kinds and diversity of living forms. Biogeographical zones; Endemism. Importance of collections/ museum specimens of the world and India; Documentation of biodiversity. Systematics and taxonomy. Importance and basis of classification. Heirarchy of classification and classification systems. Types of classification-artificial, natural and phylogenetic.

Unit II: Taxonomic treatment and phylogenetics **14 Lectures**

Systematic data: kinds of data. Taxonomic treatment of allopatric variation, homology; Reproductive isolating mechanisms; Hybridization and introgression; Polyploidy; Modes of speciation. Principles and criteria of taxonomic treatment: Taxonomic evidence: Characters and character states. Taxonomic characters; OTUs, character weighting, cluster analysis; Phenetics, Evolutionary taxonomy, Cladistics. Constructing trees/ dendrograms: Phenogram, phylogram and cladogram and turning them into classifications.

Unit III: Molecular phylogenetics **12 Lectures**

Molecular phylogenetics: Gene structure, mutation and rates and patterns of nucleotide substitutions. Mitochondrial genome. Molecular "clock" hypothesis. Phylogeny estimation methods: Distance data, Maximum-parsimony, Maximum-likelihood etc. Cladogram reliabilities, Molecular characterization versus morphological characterization: Conflict or compromise?

Unit IV: International code of Nomenclature **13 Lectures**

Identification, Description, Naming of taxa. Keys: indented and racketed keys. Principles and rules of International Code of Nomenclature (ICN), binominal system, type material, author citation, criteria for publication, types of names, principle of priority and its limitations. curation of taxonomic collections. Taxonomic revision. Taxonomic literature. The relevance of systematics in conservation programmes. Outline classification of protists, major invertebrate phyla (up to classes) and vertebrates (up to subclasses).

Recommended readings

1. Mayr, E. and Ashlock, P.D. (1991). Principles of Systematic Zoology. (2nd edition) New York: McGraw Hill, Inc.

2. Quicke, D. L. J. (1993). Principles and Techniques of Contemporary Taxonomy. New York: Chapman and Hall

PRACTICAL

1. General discussion, distinguishing characters and classification of common animals.

   Amoeba, Paramecium, Scypha, Obelia, Aurelia, Sea Anemone, *Fasciola hepatica, Ascaris, Aphrodite, Hirudinaria, Carcinoscorpius, Macrobrachium, Periplaneta, Peripatus, Pila and Astropecten.*

   Balanoglossus, Branchiostoma, Ascidia, Scoliodon, Torpedo, Catla, Exocoetus, Hippocampus, Ichthyophis, Necturus, Bufo, Rachophorous, Chelone, Chamaeleon, Draco, Bungarus, Vipera, Naja, Psittacula, Pycnonotus, Pteropus, Funambulus.

2. Preparation of identification keys for select specimens of non chordate (e.g., insects) and chordates (e.g., birds)

3. Generation of a character-state matrix by selecting and scoring diagnostic taxonomic characters.

4. Interactive software for exploring phylogeny and analyzing character state to construct dendrogram (Theoretical basis and demonstration).

5. Distance-based methods of phylogenetic reconstruction using manual and computer methods (Theoretical basis and demonstration).

6. Molecular data analysis by aligning sequences and constructing trees using PAUP (Theoretical basis and demonstration).

SEMESTER-II

Course Name: Comparative Anatomy & Physiology of Nonchordates

Course Code: BSCHZOOC201

Course Type: **Core**	Course Details: **CC-3**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

About the course

The course makes a detailed comparison of the anatomy of the different taxa of non chordates. It also highlights how in the taxonomic hierarchy, there is an increase in the complexity of structure and function. The course thus gives an overview of the intricate life processes and adaptive radiations in non chordates.

Learning outcomes

After successfully completing this course, the students will be able to

- Develop an understanding of the characters used to classify besides being able to differentiate the organisms belonging to different taxa.
- Acquire knowledge of the coordinated functioning of complex human body machine.
- Have hands on experience of materials demonstrating the diversity of protists and non-chordates.
- Understand the relative position of individual organs and associated structures through dissection of the invertebrate representatives.
- Realize that very similar physiological mechanisms are used in very diverse organisms.
- Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.

- Undertake research in any aspect of animal physiology in future.

THEORY

UNIT I: Diversity of Tegument and Digestive system (13 Lectures)

Symmetry, Coelom development and diversity. Cell membrane in protists and its derivatives. Tegument in non-chordates and its derivatives. Nutrition and feeding modes in protists. Digestive system & feeding mechanism in non-chordates): Process of digestion from food vacuoles to complex digestive organs.

UNIT II: Diversity of Locomotory, Respiratory, Circulatory and Excretory systems (13 Lectures)

Locomotion and diversity of locomotory organs in protists and non-chordates, muscle and locomotion, Structure and diversity of skeletal elements in protists and non-chordates. Respiration: diversity of respiratory organs, modes of respiration. Respiratory pigments. Circulation and the diversity of circulatory system. Excretion (protists): endocytosis, exocytosis; Excretion and diversity of excretory organs in non chordates.

UNIT III: Diversity of Nervous and Reproductive systems (13 Lectures)

Nervous system with special reference to diversity in brain and nerve chord. Neuroendocrine systems, pheromones. Sense organs: Mechanoreceptors and their diversity in different taxa. Sense organs: photoreceptors, chemoreceptors, thigmoreceptors, rheoreceptors and proprioceptors in different taxa. olfaction and sound perception in insects, etc. Diversity of the reproductive organs and accessory sex organs; modes of reproduction- asexual and sexual reproduction. Metamorphosis. Diversity of larval forms in non-chordates.

UNIT IV: Evolution and characteristics of important Non Chordate taxa (13 Lectures)

Affinities of living fossils, *Limulus* and *Peripatus.* Polymorphism and colony formation. Parasitic adaptations and life cycle patterns in parasites belonging to different taxa. The parasites listed by World Health Organization under preventive programmes. Structure and diversity of the pest organisms. Invertebrate model organisms and their importance. Types of canal systems in sponges and their significance. Torsion and detorsion in Mollusca. Components of water vascular system in echinoderms.

Recommended readings

1. Barrington, E J W. (1967) Invertebrate structure and function, Nelson, London.

2. Barnes, R. D. (1968) Invertebrate Zoology, 2nd Ed. Saunders, Philadelphia.

3. Hyman, L H. (1940-67). The Invertebrates, Vol. I-VI. McGraw-Hill, New York.

4. 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.

5. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.

6. Marshall, A.J and Williams, W.D. (1995) Text book of Zoology-Invertebrates. VII Ed., Vol. I, A.L.T.B.S. Publishers.

7. http://abacus.bates.edu/acad/depts/biobook/AnimPhyl.pdf

PRACTICAL

1. Study of slides or models or photographs of specimens of

Protozoans of agricultural importance.

Coral-reef forming Cnidarians

Plant parasitic nematodes

Nematodes used as models in experimental biological research

2. Dissection of *Periplaneta* to expose the digestive system, nervous system and reproductive system.

3. Dissection of *Palaemon* to expose appendages and Statocyst.

4. Dissection of *Pila* to expose the digestive system and Statocyst.

5. Study of larval forms: *Ephyra*, *Planula*, *Trochophore*, *Pluteus*, *Velliger*, Zoea, Metazoea, Bipinnaria

6. Some videos to develop understanding on the animals of different taxa.

7. Group discussion or Seminar presentation on one or two related topics

Course Name: Cell Biology and Histology

Course Code: BSCHZOOC202

Course Type: **Core**	Course Details: **CC-4**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

About the course

The course provides a detailed insight into basic concepts of cellular structure and function. It also gives an account of the complex regulatory mechanisms that control cell function.

Learning outcomes

After successfully completing this course, the students will be able to

- Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.
- Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.
- Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.
- Get new avenues of joining research in areas such as genetic engineering of cells, cloning, vaccines development, human fertility programme, organ transplant, etc.
- Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.

THEORY

UNIT-I: The structure and organelles of prokaryotic and eukaryotic cells (13 Lectures)

Cell biology, its scope in modern perspective. Cell theory and its modern version and interpretation. General structure of prokaryotes, bacteria, archaea and eukaryotes. Extra nuclear cell organelles: Ultrastructure and functions of endoplasmic reticulum, ribosome, Golgi apparatus, lysosome, peroxisomes. Mitochondria: Origin, structure, composition, genome organization and function. Cytoskeleton: composition and functions; microtubules and microfilaments. MT *vs* Actin - their organization, association with membrane. Nucleus: size, shape, structure and functions of interphase nucleus. Ultrastructure of nuclear membrane and pore complex. Nucleolus: general organization.

UNIT-II: Cell membrane and transport mechanism (12 Lectures)

Cell membrane organization: cell membrane: origin, structure, composition, models and function. Fluid mosaic model. Lipid Composition, inner and outer leaflets. Structure and functions of membrane proteins: Integral, peripheral and lipid-anchored membrane proteins. Junctional complexes, microvilli, desmosomes and plasmodesmata. Transport across membrane: diffusion and osmosis. Active and passivetransport, endocytosis and exocytosis

UNIT-III: Cell cycle, cell signaling and cell culturing (14 Lectures)

Cell cycle, cell division- mitosis and meiosis. Cell division check points and their regulation. Role of growth factors. Mutations in the genes that regulate cell cycle and division and their role in causing cancer. Programmed cell death (Apoptosis). Cell regulation and Cell signaling through GPCR. Cell culture: Types of cell culture- monolayer and suspension culture. Types of culture media. Sterilization methods for culture wares and culture media. Maintenance of a cell line and storage of cells. Subcellular fractionation by differential centrifugation. Somatic cell hybridization. Basic characteristics of tissue culture media.

UNIT-IV: Structural and functional significance of animal tissues (13 Lectures)

Introduction to tissues. Epithelial tissue: types, structure and characteristics. Surface modifications. Basement membrane: structure and characteristics. Exocrine and endocrine

glands: types and structure. Connective tissue cells. Structure and function of loose, dense and adipose tissue. Cartilage and bone: classification, and fine structure. Blood: plasma, blood cells, lymph– their structural and functional. Structure and function of spleen. Muscular tissue: ultrastructure of smooth, skeletal and cardiac muscles. Muscle-tendon attachment. Structure and classification of neurons. Types of supporting (glial) cells and their function. Types of sensory nerve endings. Membranes of the brain and spinal cord.

Recommended readings

1. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5^{th} edition) ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M.; Kleinsmith, L.J.; Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. (7th edition) Pearson Benjamin Cummings Publishing, San Francisco.

PRACTICAL

1. Study of prokaryotic and eukaryotic cell types with the help of chart, slide and video.

2. Chromosome segregation in mitosis and meiosis.

3. Preparation of chromosome squashes from grasshopper/cockroach testes for the observation of stages of meiosis.

4. Study of types of tissue through permanent slides: epithelial, connective, muscular, nervous etc.

5. Study of histology of tissues (Liver, Kidney, Pancreas, Intestine, Spleen) by preparing permanent stained slides through microtomy.

6. Isolation and estimation of DNA.

7. Group discussion or Seminar presentation on one or two related topics

Course Name: Vectors, Diseases and Control

Course Code: BSCHZOOGE201

Course Type: **Generic Elective**	Course Details: **GEC-2**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

About the course

The course provides an insight into the common vector-borne diseases, their etiology, role of vectors in their spread, host- parasite relationship and finally the strategies to manage these vectors.

Learning outcomes

After successfully completing this course, the students will be able to:

- Develop awareness about the causative agents and control measures of many commonly occurring diseases.
- Develop understanding about the favourable breeding conditions for the vectors.
- Devise strategies to manage the vectors population below threshold levels, public health importance.
- Undertake measures or start awareness programmes for maintenance of hygienic conditions, avoidance of contact from vector, destruction of breeding spots in the vicinity of houses and cattle shed by public health education campaign.

THEORY

Unit I: Vector and vector bionomics (13 Lectures)

Brief introduction, types and morphological peculiarities of vectors such as mosquitoes, flies, fleas, lice, bugs, ticks and mites. Host-vector relationship. Primary and secondary vector concept. Vectorial capacity. Vector bionomics-larval habitats and host biting preferences human and animal biting indices. Evolution of vector bionomics and its effect on disease transmission. Vector incrimination. Human practices and the occurrence of pests

Unit II: Disease vectors and the causes of disease outbreaks (13 Lectures)

Salient features of the vectors belonging to Diptera, Siphonaptera, Siphunculata, Hemiptera, Arachnida, Blattaria, Acarina (families Ixodidae and Argasidae) etc. Role of non-blood sucking flies in myiasis; of blood sucking flies in transmission of plague and typhus; of lice (body, head, pubic) in transmission of typhus, relapsing and trench fevers, Vagabond's disease and Phthiriasis; of bugs in transmission of Chaga's disease of. Brief account of mites and the associated diseases. Population biology, Factors affecting abundance, Density dependence and independence, How do people cause outbreak?

Unit III: Vector management strategies (13 Lectures)

Control of vector flies by screening, fly traps, electrocution, poison baits and outdoor residual sprays; biological control by natural parasites and predators. Chemical control. Efficacy of synthetic pyrethroids, residual spray of insecticides, treated bed nets/curtains and fumigations. Biological control of mosquitoes by the use of viruses, bacteria, fungi, synthetic pyrethroids, residual spray of insecticides, treated bed nets/curtains and parasites, approaches, Pheromones/allelochemicals, Attract-and –kill, Mating disruptors, alarm pheromones and oviposition disruptors.

Unit IV: Emerging concepts and approaches to vector management (13 Lectures)

Legislation and regulation, Methods of sampling and monitoring, sampling plan, Allocation of sampling units. Exclusion and routes of entry. Controlled atmosphere, Risk assessment,

The integrated control/ IPM approach, Damage thresholds estimation, Forecasting, Increasing agroecosystem resistance, Pesticide selection, Eradication versus control, Up to what limits IPM should be adopted. Decision support.

Recommended readings

1. Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK.

2. Chapman, R.F. (1998). The Insects: Structure and Function.IV Edition, Cambridge University Press, UK.

3. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and other Insect Vector borne Diseass.Wiley-Blackwell.

4. Belding, D.L. (1942). Textbook of Clinical Parasitology. Appleton-Century Co., Inc., New York.

5. Roy, D.N. and Brown, A.W.A. (2004). Entomology. Biotech Books, Delhi

PRACTICAL

1. Study of mouth parts of different insects.

2. Study of permanent slides/photographs of the following insect vectors: *Aedes, Culex, Anopheles, Pediculus humanus corporis, Pediculus humanus capitis, Phithirus pubis, Xenopsylla cheopis, Musca domestica, Cimex lectularius, Phlebotomus argentipes*

3. State the diseases transmitted by above insect vectors.

4. Project report submission on any one of the insect vectors and the disease transmitted.

5. Group discussion or Seminar presentation on one or two related topics