VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN ZOOLOGY

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes (CCFUP), 2023& NEP, 2020

// Amended on 22.12.2025 //

Vidyasagar University

4-Year Bachelor Degree Programme B.Sc. (Hons.)

Major in Zoology

(Draft Syllabus)

YEAR	SEMESTER	Code	Name of the Subject	Credit	Remark
I	**SEMESTER I**	MJ-1	***Systematics and Diversity of Life- Protists to Chordates***	3(T)+1(P) = 4	Major
		MI-1	***Animal diversity***	3(T)+1(P) = 4	Minor (Disc.-I) ***(To be taken by students of other Disciplines)***
		SEC -1	***Apiculture***	3(P)	Skill Enhancement course
	SEMESTER II	MJ-2	***Cell Biology***	3(T)+1(P) = 4	Major
		MI-2	***Insect vector & disease***	3(T)+1(P) = 4	Minor (Disc.-II) ***(To be taken by students of other Disciplines)***
		SEC -2	***Aquarium fish keeping***	3(P)	Skill Enhancement course

Programme Outcome

A student having Zoology as a major subject will be able to understand the vastness of the diversity of animals. Although, it is not possible to know each and every species, they will understand the utility of classification through study of systematics. They will be able to understand the origin & evolution of life and can identify and classify different chordate and non-chordate animals. The different cell types of different animals with basic knowledge of physiology will enhance the understanding level of adaptation. They will be more concerned about the recent environmental problems, and can understand the importance of biotechnology as an applied field from the study of genetics and developmental biology. The scope of the subject through research and applied field will also open to them.

SEMESTER-I

Course objective

The course guides Bachelor's applicants through the incredible diversity of living forms, from simple to complex. It explains how each group of organisms originated and how they established themselves in the environment with their unique traits. In addition, it addresses the differences and similarities between organisms based on their morphology and anatomy, which led to their classification into taxa and clades.

Major-1 (MJ-1)
Systematics and Diversity of Life- Protists to Chordates

About the course

The course compares various non-chordate taxa in great detail. It also highlights how the complexity of structure and function increases along the taxonomic hierarchy. Thus, the course provides an overview of the complex life processes and adaptive radiations of non-chordates.

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 plane.
- 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.
- In addition to improving their writing skills, the project assignment will provide them with a taste of research. So they can discover the process involved in studying biodiversity and taxonomy. Students will be able to think and interpret independently due to the selection of various animal species.

MJ1T: Systematics and Diversity of Life-Protists to Chordates **Credits 03**

Course Contents:	**Hours**
Unit 1: Products of evolutionary process and basics of systematics & classification Complexity of Life: Cellularity from unicellular grade to multicellularity; Origin of metazoans; Body symmetry; Concept of mesozoa, parazoa & eumetazoa; Concept of evolution of germinal layer - diploblastic and triploblastic organization; Concept of coelenteron & transition of third germ layer; Concept of evolution of body cavity – acoelomate, blastocoelomate & eucoelomate; Types of coelom; Concept of protostome & deuterostome; Concept of anamniote & amniote with structural features of amniotic egg; Concept of major & minor phyla. Systematics & classification- Definition, relationship & utility of Systematics, Taxonomy, Evolution, Classification & Nomenclature. **Unit 2: Diversity in Protists** General characteristics and classification of subkingdom Protozoa up to phyla (Levine *et.al*, 1981). The Protist bauplan: Body structure, support, nutrition, gas exchange, excretion, locomotion & reproduction – basic organization (detail type study or related theory not to be discussed). **Unit 3: Diversity in Acoelomate Metazoa** General characteristics and classification up to classes: Porifera, Cnidaria, Ctenophora, & Platyhelminthes (Rupert & Barnes, 1994). Special features & structural diversity in sponges with special reference to cell types. Special features of cnidarians with reference to polymorphism and division of labour. Coral reefs with diversity, formation, function & conservation. Affinity of Ctenophora. Basic organizations with reference to parasitic adaptation & adaptive radiation in flatworm.	7hrs 5hrs 8hrs

Unit 4: Diversity in Pseudocoelomate and Coelomate Non chordates Ecdysozoa: Characteristics of the representative taxa. Basic organizations with reference to parasitic adaptation & adaptive radiation in roundworm. General characteristics and classification of Annelida, Arthropoda, Mollusca & Echinodermata up to class (Rupert & Barnes, 1994). Basic organization & diversity in annelids with special reference to metamerism. Basic organization & diversity in arthropods with special reference to the concept of arthropodisation & appendage evolution; Adaptive radiations in Crustacea, Chelicerata & Insecta; Basic idea of fossil arthropods - Trilobita & Myriapoda (structural details and phylogeny not needed). Basic organization and diversity in Mollusca with reference to torsion in Mollusca with respect to disruption of bilateral symmetry & its significance. Affinity of Echinodermata. General characteristics, affinity & evolutionary significance of Onychophora.	9hrs
Unit 5: Diversity in Hemichordata & Lower Chordates Characteristics features of Phylum Hemichordata & Chordata; Concept of protochordates & vertebrates; Evolutionary status & affinities of Hemichordate & Cyclostomata.	5hrs
Unit 6: Diversity in Vertebrates: Anamniotes Basic organization & evolutionary transitions of fishes; Classification of Chondrichthyes & Osteichthyes up to subclasses (Romer 1959); Emergence of land vertebrates; Amphibian diversity and adaptability to dual mode of life; Classification of Amphibia up to order (Duellman & Trueb, 1986).	5hrs
Unit 7: Diversity in Vertebrates: Amniotes Classification of Reptilia up to living order, Aves up to subclasses & Mammalia up to living order (Young, 1981). Features of venomous & non venomous snake; Distribution & type of snake venom with antidote in India; Poison apparatus & biting mechanism in venomous snake. Origin of Birds; Features of flying birds & running birds. Origin of Mammals; Special features of Monotremes & Marsupials with evolutionary significance.	6hrs

MJ1P: Systematics and Diversity of Life-Protists to Chordates Credits 01

Practical

1. Basic requirements for laboratory work: Knowledge about the parts of microscope withtheir function.
2. Study of animals through identification of models, photographs, slides and museum specimens in the laboratory with details on their classification up to phylum/class/subclass/order as indicated in theory, along with biogeography, adaptive features, economic/medical/ecological importance and diagnostic features:
   a) Protozoa*: Amoeba, Euglena, Paramoecium, Giardia, Elphidium.*
   b) Porifera*: Sycon*, Neptune's cup.
   c) Cnidaria: *Obelia, Aurelia, Physalia, Corallium, Gorgonia, Pennatula.*
   d) Ctenophora: *Beroe.*
   e) Platyhelminthes: *Echincoccus, Schistosoma.*
   f) Aschelminthes: *Ascaris, Wuchereria, Ancylostoma.*
   g) Annelida: *Nereis, Chaetopterus, Hirudinaria, Tubifex.*
   h) Arthropoda: *Carcinoscorpius,* Scorpion, *Balanus, Squilla, Eupagurus, Scolopendra, Julus, Sitophilus, Lepisma, Daphnia, Cyclops, Argulus.*
   i) Onychophora: *Peripatus.*
   j) Mollusca: *Chiton, Aplysia, Dentalium,* Oyster, *Sepia, Loligo, Octopus.*
   k) Echinodermata: Sea star, Brittle star, *Antedon, Cucumaria, Echinus.*
   l) Hemichordata: *Balanoglossus.*
   m) Urochordata: *Doliolum, Ascidia.*
   n) Cephalochordata: *Branchiostoma.*
   o) Cyclostomata: *Myxine, Petromyzon.*
   p) Fishes: *Sphyrna, Torpedo, Labeo, Notopterus, Tenualosa.*
   q) Amphibia: *Ichthyophis, Necturus, Tylototriton, Hyla.*
   r) Reptilia: *Chelone, Calotes, Mabuia, Gekko, Chameleo, Bungurus, Naja, Hydrophis.*
   s) Aves: *Psistaculla, Passer, Alcedo.*
   t) Mammalia: *Bandicota, Pteropus, Cavia.*
3. Observation & records of different animals from college campus or nearby any terrestrial field (forest, grassland, hill or mountain area etc.) or water body (pond, river, lake, sea etc.) or zoological park or museum
4. Preparation of dichotomous key for identification of venomous and non-venomous snakes; Preparation of key on any group (preferably insects, fishes & birds of different feeding habit (planktivorous, detritivorous, frugivorous, carnivorous, omnivorous, insectivorous, piscivorous, graminivorous etc.)

Recommended readings

- Barnes, R. S. K.; Calow, P.; Olive, P. J. W.; Golding, D. W.; Spicer, J. I. (2002) The Invertebrates: a Synthesis, Blackwell Publishing.
- Hickman, C.; Roberts, L.S.; Keen, S.L.; Larson, A. and Eisenhour, D. (2018) Animal Diversity, McGraw-Hill.
- Holland, P. (2011) The Animal Kingdom: A Very Short Introduction, Oxford University Press.
- Kardong, K.V. (2006) Vertebrates: Comparative Anatomy, Function, Evolution (4th edition), McGraw- Hill.
- Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
- Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
- Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.
- Brusca R.C. and Brusca G.J. (2003). Invertebrates, 2nd Edn. Sinauer Associates
- Ruppert & Burnes (1994). Invertebrates Zoology, 6th Edn. Seengage
- Young J.Z. (2004). The Life of Vertebrates, 3rd Edn. Oxford University Press.

Minor-1 (MI-1)

Animal Diversity

About the course:

The course has been framed for the Bachelor's entrant through the amazing diversity of animal world with a journey towards living form's complexity. It enlightens how each group of organisms evolved and how did they establish themselves in the environment with their special characteristic features. It also deals with the similarities and dissimilarities between organisms on the basis of their morphology and anatomy which led to their proper placement 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.
- In addition to improving their writing skills, the project assignment will provide them with a taste of research so they can discover the process involved in studying biodiversity and taxonomy. Students will be able to think and interpret independently due to the selection of various animal species.

MI1T: Animal diversity **Credits 03**

Course Contents:	Hours
Unit 1. Products of evolutionary process Origin of life on Earth Symmetry;Cellularity; Types & evolution of Germinal layer& Body cavity;Concept with special reference to types of coeloms, protostome &deuterostome	7hrs
Unit 2. Basics of systematics & classification Definition, relationship &utility of Systematics, Taxonomy &Classification; Taxonomic hierarchy; Zoological Nomenclature – utility, principles & codes; Six kingdom classification; Concept of major & minor phyla	7hrs
Unit 3. Diversity in Protists General characteristics and classification of subkingdom Protozoa upto phyla (Levine et.al, 1981),	5hrs
Unit 4. Diversity in acoelomate Metazoa General characteristics and classification upto classes: Porifera, Cnidaria, Ctenophora, & Platyhelminthes (Rupert & Barnes, 1994) Coelenterata – comparison between cnidarian and Ctenophora Basic organizations with reference to adaptive radiation in flatworm	7hrs
Unit 5. Diversity in pseudocoelomate and coelomate Non chordates Basic organizations with reference to adaptive radiation in roundworm General characteristics and classification of Annelida, Arthropoda, Mollusca & Echinodermata upto class (Ruppert & Barnes, 1994) Basic organization & diversity in arthropods with special reference concept of appendage evolution; Adaptive radiations in Crustacea, Chelicerata&Insecta Basic organization and diversity in Mollusca with reference to torsion in mollusca with respect to disruption of bilateral symmetry & its significance General characteristics & evolutionary significance of Onychophora	9hrs

Unit 6. Diversity in Hemichordata & lower Chordates Characteristics features of Phylum Hemichordata & Chordata; Concept of protochordates& vertebrates; Evolutionary status & affinities of Hemichordata	7hrs
Unit 7. Diversity in vertebrates: Anamniotes Basic organization and diversity of fishes with reference to aquatic adaptation Classification of Chondrichthyes & Osteichthyesupto subclasses (Romer 1959) Emergence of land vertebrates. Classification of Amphibia upto Order (Duellman &Trueb, 1986)	7hrs
Unit 8. Diversity in vertebrates: Amniotes Classification of Reptiliaupto living Order, Aves upto subclasses & Mammalia upto living Order (Young, 1981). Concept of volant, arboreal & secondary aquatics adaptations. Features of venomous & non venomous snake, distribution & type of snake venom in India. Features of flying birds & running birds.	7hrs

Recommended readings

1. Brusca R.C and Brusca G.J. (2003). Invertebrates, 2nded. Sinauer Associates
2. Chaki K.K., Kundu G. and Sarkar S. (2011). General Zoology, 4thed. New Central Book agency
3. Ganguly B., Sinha, A.K., Adhikari S. (2011). Biology of Animals, Vol. I. NCBA
4. Ghosh K.C. and Manna B. (2007). Practical Zoology. New Central Book agency
5. Hyman, L.H. (1940). Invertebrates
6. Kapoor V.C. (2008). Theory & practice of animal taxonomy. Oxford & IBH.
7. Marshall, A.J and Williams, W.D. (1995) Text book of Zoology-Invertebrates. VIIEd., Vol. I, A.L.T.B.S. Publishers.
8. Mayr, E. (2020). Principles of systematic Zoology. United book prints
9. Meglitsch, P. and Schram, S.R. (2020). Invertebrate Zoology. 3rded. OXFORD UNIVERSITY PRESS
10. Romer, A.S. and Parsons, T.S. (1986)The vertebrate body. 6th edition. Saunders.
11. Ruppert and Barnes (1994). Invertebrate Zoology. 6th ed. Seengage
12. Ruppert, Fox and Barnes (2006). Invertebrate Zoology. 7thed.
13. Sinha, Chatterjee and Chattopadhyay. (2014). 3rd ed. Books & Allied (P) Ltd.
14. Verma and Srivstava. (2015). Advanced practical Zoology. S. Chund
15. Young, J.Z. (2004). The life of vertebrates, 3rd edition, Oxford University Press

MI-1P: Animal diversity **Credits 01**

Practical

1. Basic requirements for laboratory work: Knowledge about the parts of microscope with their function & setting of microscopes.
2. Study of animals through identification of models, photographs, slides and museum specimens in the laboratory with details on their classification upto phylum/class/subclass/order as indicated in theory, with importance and diagnostic features:
   - ✓ *Amoeba, Euglena, Paramoecium, Plasmodium vivax*
   - ✓ *Sycon,* Neptune's cup
   - ✓ *Obelia, Hydra, Aurelia, C*oral*,* Sea anemone, Sea pen*,Beroe*
   - ✓ *Fasciola, Teania, Ascaris*
   - ✓ *Nereis, Aphrodite,* Leech*, Tubifex*
   - ✓ *Carcinoscorpius,* Scorpion*, Balanus,* Crab*, Macrobrachium, Penaeus, Squilla, Eupagurus, Scolopendra, Julus,* Termite queen,Silkmoth*,* Honey bee (three casts)*,* Locust, Grasshopper, Stick insect, *Lepisma*, *Daphnia, Cyclops, Peripatus*
   - ✓ *Chiton, Achatina, Aplysia,* Oyster, Mussel*, Sepia, Loligo, Octopus*
   - ✓ Sea star, Brittle star*, Antedon,* Sea cucumber*, Echinus*
   - ✓ *Balanoglossus, Ascidia, Branchiostoma, Myxine, Petromyzon*
   - ✓ *Scoliodon, Sphyrna, Trigon, Torpedo, Labeorohita, Catlacatla, Heteropneustes, Clarias, Tenualosa, Exocoetus, Anabas,* Sucker fish, Flat fish, *Hippocampus*
   - ✓ *Uraeotyphlus, Ichthyophis, Tylototriton, Hyla, Rhachophorus*
   - ✓ *Chelone, Trionyx, Hemidactylus, Varanus, Calotes, Gekko, Chameleo, Draco, Bungurus, Naja,Daboia, Ahatulla, Chrysopelea,Hydrophis, Crocodylus, Gavialis*
   - ✓ *Pistaculla, Spilopelia (*spotted dove*), Milvus(kite)*
   - ✓ *Bandicota, Pteropus, Cavia*
3. Observation & records of different animals from college campus or nearby any terrestrial field (forest, grassland, hill or mountain area etc.) or water body (pond, river, lake, sea etc.) or zoological park or museum
4. Comparison & weighting of characters of any two species of animal belonging to same genera or different genera but same family
5. Preparation of key for identification of venomous and non-venomous snakes

SKILL ENHANCEMENT COURSES (SEC 1)

Apiculture

Credit – 3

About the course:

Honey bees are now looked upon for production of honey, bee wax and other valuable products which have a remarkable market demand. So, beekeeping would provide an adequate knowledge to establish a sustainable beekeeping cottage industry and development of entrepreneurship in this sector.

Learning outcome:

Upon successful completion of this course the student should able to –

- Gain knowledge about importance of beekeeping.
- Knowledge regarding perquisite of beekeeping industry.
- Advance knowledge of bee-farm management and disease control of bee worm.
- Knowledge regarding different use of honey, honey related food products, medicinal uses of honey, bee venom and other products.

Syllabus details:

1. Identification of different species of honeybees. Identification of different working groups of honey bees. Study the morphology and sexual dimorphism of honey bees.
2. Studies on pollen basket, mouth parts, sting apparatus, wax gland of worker honey bees.
3. Studies on the special structure of bee hives and beekeeping equipments.
4. Studies on various diseases of adult Honeybees.
5. Studies on the physical and chemical nature of Honey.
6. Preparation of Honey based products.
7. Visit to an apiculture farm and preparation a project report on apiculture.

Recommended readings:

1. Abrol, D. P. (1997) Bees and Beekeeping. Kalyani Publisher, New Delhi. 173

2. Abrol, D. P. (2010) A Comprehensive guide to Bees and Beekeeping. Scientific Publisher, New Delhi.

3. Withhead, S. B. (2010) Honey bees and their management Axis books Publisher, Jodhpur.

4. Nagaraja, N. and Rajagopal, D. (2013) Honey bees: Diseases, Parasites, Pests, Predator and their management. M.J.P Publisher, Chennai.

5. Dharamsing and Singh, D. P. A Handbook of Beekeeping, Agrobios India (Publisher), Jodhpur.

SEMESTER-II

MJ-2 CELL BIOLOGY

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 signalling 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.

MJ2T: Cell Biology **Credits 03**

Course Contents	**Hours**
Unit 1: Cell theory and its modern version and interpretation; General structure of prokaryotes, bacteria, archaea and eukaryotes.	2hrs
Unit 2: Plasma Membrane (Structure and Function) Concept of Lipid Bilayer Fluid Mosaic Model; Composition: Lipids (Phospholipids and Cholesterol); Peripheral and integral membrane proteins; Glycolipids & glycoproteins; Membrane receptor modifications: microvilli, desmosomes and plasmodesmata; Mobility of membrane lipids and membrane proteins; Lipid rafts; Cell-cell junctions; Transport through plasma membrane: Active and passive transport, endocytosis and exocytosis.	8hrs
Unit 3: Cytoplasmic Organelles I Basic concepts of ER, Golgi and Lysosome; Ultrastructure of ER; Overview of Protein Sorting, Protein folding and processing in ER; Export of proteins and lipids from ER; Morphology and ultrastructure of Golgi Apparatus; Protein glycosylation within Golgi;	5hrs

Protein sorting and export from Golgi apparatus; Polymorphism and lysosome formation.	
Unit 4: Cytoplasmic Organelles II	6hrs
Mitochondria: Endosymbiotic hypothesis; Structure, Mitochondrial DNA, Mitochondrial Respiratory Chain; Centrosome: Structure and function; Peroxisomes: Structure and Functions.	5hrs
Unit 5: Cytoskeletal Structures	
Structure, and function: Microtubules, Actin filaments, and Intermediate filaments; Basic composition and function of ECM; Cell-matrix Interactions.	5hrs
Unit 6: Nucleus	
Structure and functions of interphase nucleus; Ultrastructure of nuclear membrane and pore complex (basic concept). Nucleolus: General organization, chemical composition and functions, nuclear sap/ nuclear matrix, nucleo-cytoplasmic interactions.	8hrs
Unit 7: Cell Cycle	
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); Cancer: Basic concept of cancer; Protooncogene & tumor suppressor genes; Activation of a protooncogene to oncogene.	6hrs
Unit 8: Cell Signalling	
Modes of cell-cell communication; Types of signalling molecules and receptors: GPCR and G-protein mediated signalling (Adenyl cyclase-cAMP); Enzyme linked Receptors: RTK (ras-raf).	

MJ2P: Cell Biology **Credits 01**

Practical

1. Cell viability study by Trypan Blue Exclusion method.
2. Preparation of chromosome squashes from grasshopper/cockroach testes for the observation of stages of meiosis.

3. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
4. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
5. Identification of mitochondria by Janus Green B stain.

Suggested Reading:

1. Lodish, H. et al (2021) Molecular Cell Biology (9th edition) W.H. Freeman & Company.
2. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5th edition) ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
5. 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.

MI-2 INSECT VECTOR AND DISEASES

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.

MI 2T: Insect Vectors and Diseases **Credits 03**

Course Contents:	**Hours**
Unit 1: Introduction to Insects General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth Parts	5hrs
Unit 2: Vector and vector bionomics Brief introduction, Types of vectors, Morphological peculiarities of different vectors Host-vector relationship, Adaptations as vectors, Host specificity, Vectorial capacity	7hrs
Unit 3: Insects as Vectors Detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera	7hrs
Unit 4: Dipteran as Disease Vectors Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies	9hrs

Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis Control of mosquitoes Study of sand fly-borne diseases –Leishmaniasis; Control of Sand fly Study of house fly as important mechanical vector, Myiasis, Control of house fly **Unit 5: Siphonaptera as Disease Vectors** Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas **Unit 6: Siphunculata as Disease Vectors** Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse **Unit 7: Hempitera as Disease Vectors** Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures **Unit 8: Vector management:** Control of vector by screening, traps, electrocution, poison baits, outdoor residual sprays; Biological control, Chemical control, Sterile insect technique, Pheromones/ allelochemicals.	7hrs 7hrs 7hrs 7hrs

MI 2P: Insect Vectors and Diseases **Credits 01**

Practical

1. Study of mouth parts of different insects
2. Study of following insect vectors through permanent slides/ photographs: *Aedes*, *Culex*, *Anopheles*, *Pediculushumanuscapitis*, *Phithirus pubis*, *Xenopsyllacheopis*, *Cimexlectularius*, *Phlebotomusargentipes*, *Muscadomestica*through permanent slides/ photographs
3. Study of different diseases transmitted by above insect vectors
4. Submission of a project report on any one of the insect vectors and disease transmitted

Suggested 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. Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication
4. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell
5. Mosquito (2000) Chandra G, Sribhumi Publication Co. Kolkata
6. Medical Entomology, Hati A. K Allied Book Agency, Kolkata

SKILL ENHANCEMENT COURSES (SEC 2)

Aquarium fish keeping

Credit – 3

About the course:

The course provides practical knowledge for sustainable ornamental fish farming and will guide them to establish a large-scale aquarium fish farm as a cottage industry and to develop entrepreneurship in fish sector.

Learning outcome:

Upon successful completion of this course the student should able to –

- Provide knowledge about indigenous and exotic ornamental fishes.
- Explain the prerequisite in aquarium keeping.
- Describe the laws around aquarium keeping.
- Provide knowledge regarding ornamental fish health management practice.
- Provide field exposure.
- Develop entrepreneurship in aquarium keeping.

Syllabus details:

1. Identification of fresh water indigenous and exotic ornamental fishes. Identification of marine indigenous and exotic aquarium fishes.
2. Construction and installation of modern age aquahome.
3. Studies on Aquarium plants.
4. Feed formation and preparation of pelleted diet for aquarium fishes. Live fish food organism for ornamental fishes.
5. Ornamental fish breeding practice.
6. Studies on different disease of ornamental fishes.
7. Field visit to an ornamental fish farm and preparation of a field report.

Recommended readings:

1. K. Shillewar& D. V. Totawar (2021), A Text Book of Fishery Science (3rd Edition), LAMBERT Academic Publishing.

2. Mary Bailey & Gina Sandford (2015), The Ultimate Encyclopedia of Aquarium Fish & Fish Care (1st Edition), Southwater.

3. Vincent B Hargreaves (2007), The Complete Book of the FRESHWATER AQUARIUM: A Comprehensive Reference Guide to More Than 600 Freshwater Fish & Plants, Thunder Bay Pr.

4. David Alderton (2003), Freshwater Aquariums: Basic Aquarium Setup and Maintenance (1st Edition), Companion House Books.

5. H. S. Jagtap, S.N. Mukherjee & V. K. Garad (2009), A Textbook of PISCICULTURE & AQUARIUM KEEPING, Daya Publishing House, Delhi, India.