Semester: I **Hours: 6**
Core I **Credits: 6**

Invertebrata – I (Protozoa - Nematoda)
INVERTEBRATA

UNIT – I

Introduction to Principles of Taxonomy

Phylum Protozoa : General characters and Classification up to class level giving examples.

Detailed study: *Amoeba* and *Paramecium* – General structure and Life cycle.

General Topics: Parasitic Protozoans of Man – *Entamoeba, Plasmodium, Trypanosoma, and Leishmania* – mode of infection and its control; Nutrition in Protozoans.

UNIT – II

Phylum Porifera: General characters and Classification up to class level giving examples.

Detailed study: Scypha - *Leucoslenia* – General structure and Life cycle

General Topics: Canal system in sponges, Skeleton in sponges.

UNIT – III

Phylum Coelenterata: General characters and Classification upto class level giving examples.

Detailed study: *Hydra* and *Obelia* – General structure and Life cycle

General Topics: Polymorphism in Coelenterata, Corals and Coral reefs.

UNIT – IV

Phylum Platyhelminthes: General characters and Classification up to class level with examples.

Detailed study: *Planaria* and *Fasciola hepatica* – General structure and Life cycle

General Topics: Parasitic adaptations in Platyhelminthes. Parasitic Platyhelminthes of man

UNIT – V

Phylum Aschelminthes: Detailed study: *Ascaris lumbricoides* and *Wuchereria bancrofti* – General structure and Life cycle.

General Topics: Nematode parasites: Pathogenicity and Control measures of *Ancylostoma, Enterobius* and *Dracanculus.*

Textbooks

1. Valli, S. K. and Rajasekaran, C.,(1990) Muthukelumbuatravai I,(Tamil) BARD, Trichy.
2. Ekambaranatha Iyar and T. N. Ananthakrishnan. 1992. A Manual of Zoology, Vol. I (Invertebrata). Part I and Part II. Viswanathan & Co.

References

1. Barrington, E. J. W. (1979). Invertebrates. Structure and Function 2nd edn. ELBS and Nelson.
2. Jordon, E.L.and P.S. Verma. (1995). Invertebrate Zoology. 12 th edn. Sultan Chand & Co.
3. Barnes, R. D.(1968) Invertebrate Zoology. W. B. Saunders Company, London.
4. Kotpal, R. L., (1978) (Invertebrate Series) – Rastogi Publications, Meerut, India.

Semester: I & II **Hours: 4**
Core II **Credits: 4**

Core Practical – I
INVERTEBRATA – I & II

Objectives: To impart training on the techniques of dissecting the invertebrate animals and to understand the various systems present in their body.
To demonstrate the techniques of *in silico* dissection of invertebrate animals.
To train the students to discriminate the various external body parts of invertebrates.
To observe the preserved invertebrate animals in the museum (Wet and Dry) and to study their characteristic feartures.

Major Dissections/Virtual dissection: Earthworm- digestive and nervous system Cocroach- digestive and nervous system. .

Minor Dissections
Mounting of body setae and penial setae of Earthworm.
Mounting of mouth parts of honey bee, cockroach, mosquito and house fly.

Spotters
Study of invertebrate forms which belong to different phyla with special reference to the following aspects:

A. Classify giving reasons: *Paramecium*, *Euglena, Sycon, Aurelia,*Sea anemone, *Aurelia, Neries,*Earthworm Leech, Cockroach, Prawn, House fly, *Lepas*, *Scolopendra*, Millepede, *Gryllotalpa, Pila, Sepia, Chiton*, *Murex*, *Xancus*, Star fish, Sea cucumber, Seaurchin
B. Biological significance: *Paramecium* – Conjugation and Binary fission; Sponge – Gemmule; *Obelia medusa*, *Ascaris*, Heteroneries, Trochophore larva, Limulus, Nauplius larva, Peripatus, Silk moth, Honey bees, Bipinnaria larva and Tornaria larva.Balanoglossus,Ctenophora, Rotifera
C. Ecological Adaptations: *Physalia, Porpita, Fasciola hepatica Aphrodite, Arenecola*Leech, Tape worm and *Teredo.*
D. Relate the Structure and Function: Sponge – Spicules; *Taenia solium* – Scolex; Neries – Parapodium; Sepia – Cuttle bone; *Pila* – Radula and Star fish – Pedicellaria.
E. Draw and Label the parts: T. S. of *Fasciola*, Tape worm, *Ascaris* – Male, *Ascaris* - Female . Earthworm and *Neries* .

List of Text/ Refernce Books:

K.Vijayaraman and K. Palanivel (2003) Seimurai Vilangial. Chimeera publication, Trichy,TN
Verma, P. S. 2 S.;(2013.) A Manual of Practical Zoology of Invertebrates, S. Chand and Company Ltd. Ram Nagar, New Delhi.
Amsath, A. (2013). Seimurai vilangiyal (tamil), Practical manual in Zoology. MMA Publications, Adirampattinam.
Lal, S.S.(1980). Practical Zoology- Invertebrate, Rastogi Publications,Meerut, India.

Semester: I **Hours : 4**

Allied I **Credits :4**

BIOLOGY OF INVERTEBRATES AND CHORDATES

Unit I

General characteristics and outline classification of Invertebrata upto class..

Phylum: Protozoa- Type study -Paramecium.
Phylum: Platyhelminthes-Type study - *Fasciola hepatica*-.
Locomotion and reproduction in Protozoa -Parasitic Adaptations in Helminthes

Unit II

Phylum: Annelida - Type study- Earthworm.
Phylum: Arthropoda- Type study- Cockroach-Mouth parts of insects.

Unit III

Phylum: Echinodermata- Type study – *Asterias rubens.* Echinoderm larvae and their significance, Water vascular system in Echinodermata

Unit IV

General Characters and outline classification of Chordata.
Class: Pisces : Type study- *Scolidonsorrokowah* (Shark), (except Endoskeleton). Types of Scales and types of Fins.
Class: Amphibia : Type study - *Ranahexadactyla* (Frog), (except Endoskeleton).Parental care in amphibian;

Unit V

Class: Aves - Type study - *Columba livia* (Pigeon), (except Endoskeleton).
Migration in Birds,
Class: Mammalia - Type study -*Oryctolaguscuniculus* (Rabbit), (except Endoskeleton).Dentition in mammals.\. \

References

1. Manual of Zoology (Invertebrata), EkambaranathaAyyar and T.N. Aranatha Krishnan (1992) Part-I & II VishwanathanPvt.Ltd.
2. Jordon EL and Verma P.S. (1995), Invertebrate Zoology, S Chand and Co, Delhi.
3. Kotpal, R.L, S.K. Agarwal, R.P.R. Khetarpal 1989 Modem text Book of Zoology Rastogi Publication
4. Anderson, D. T. (Ed.) (2001). Invertebrate Zoology. 2Ed. Oxford University Press.
5. N. Arumugam, Invertebrata, Saras Publication, Nagercoil.

SEMESTER: I & II **Hours: 4**

Allied Practical **Credits: 2**

BIOLOGY OF INVERTEBRATES & CHORDATES AND ECONOMIC ZOOLOGY

Major Dissections / Virtual dissection:

Cockroach: Digestive system and Nervous system

Earth worm: Digestive system and Nervous system

Mountings / Slide:

Honey bee, House fly, Mosquitoes and cockroaches – mouth parts - Slides. Identification of Cycloid, Placoid and Ctenoid Scales - slides.

Earth worm –Body setae and Pineal setae slide.

Spotters:

Specimens: Paramecium, Euglena, Liver fluke, Tapeworm, Neries, Earthworm, Leech, Crab-Scolopendra, Honey bee, Scorpion, Star fish, Sea cucumber, Shark, Frog, Chameleon, Pigeon and Rabbit.

Products
Honey bee, Cod Liver oil, Pearl, silk.

Economic Importance:

Harmful animals: *Entamoeba, Plasmodium,* **Housefly**, Mosquito, Termite queen, *Orycytes rhinoceros.*

Beneficial animals: *Bombyx mori,* Cocoon, Pearl oyster, *Penaeus monodon* and *Macrobranchium malcomsonii.* Honey bee

SEMESTER: I **Hours: 2**
SBE I **Credits: 2**

APPLIED ZOOLOGY

Unit – I

Scope of Apiculture- Honey bee species- Biology of *Apis indica* – Social organization of honey bees- Communication in bees – Methods of Bee keeping : Newton's beehive - Description-Accessories used in apiculture - Extraction of honey - Properties-Composition and uses of honey. By-Products of Bee keeping -Bee wax, bee venom, propolis, royal jelly.

Unit-II

Diseases of honey bees - Viral diseases: Thai Sac Brood Virus, Apis iridescent virus – Bacterial diseases: American Foul Brood, European Foul Brood – Enemies of Honey bee : Wax moths, ants, wasps, birds, rattle snake -Economics of Apiculture.

Unit-III

Scope of Vermiculture – Biology of composting earthworms – *Eudrilus eugeniae* and *Lampito mauritii* – Classification of earthworms: epigeic, endogeic, aneic, saprophages, geophages –Identification and characteristics of earthworms.

Unit-IV

Organic waste sources – Vermicomposting methods: Small and large scale production methods –Pit method, heap method, windrow method, indoor method – Vermiwash- Factors affecting vermicomposting: pH, moisture, temperature, nutrition.

Unit-V

Advantages of vermicomposting – Applications of vermicomposting – Economics of vermiculture, NABARD, Nationalized Banks and KVIC supports for vermiculture.

Textbooks:

1. Teenai valarpu-Thigarajan-TeeJay Publications, Thanjavur.
2. Cherian,R. and K.R Ramanathan, 1992. Bee keeping in India.
3. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition, Other India Press, Goa, India.

References:

1. Sharma,P. and Singh L. 1987-Hand book of bee Keeping, Controller Printing and Stationery, Chandigarh.
2. Mishra,R.C.,1985-Honey and their management in India, ICAR.
3. Nagaraja, N and, D. Rajagopal, 2009. Honey bee diseases, Parasites, Pest, Predators and their Management. MJP publishers, Chennai, Tamil Nadu, India.
4. Renganathan, L.S., Manpuzhum manpuzhu vuramum. Manivasagar Publications, Chennai.
5. Sathe,T.V., 2004. Vermiculture and Organic Farming. Daya Publications.

Semester: II **Hours: 6**
Core III **Credits: 6**

INVERTEBRATA II (Annelida - Echinodermata)

UNIT – I
Phylum Annelida : General characters and Classification up to class level with examples.
Detailed study: Earthworm – *Megascolex mouritii* and Leech – *Hirudinaria granulosa*.
General Topics: Metamerism among Annelida – Adaptive Radiation in Annelida.

UNIT – II
Phylum Arthropoda: General characters and Classification up to class level with examples.
Detailed study: Cockroach – *Periplaneta americana* and Marine prawn - *Penaeus monodon*
General Topics: Social life of insects - Mouth parts of insects.

UNIT – III
Phylum Mollusca: General characters and Classification upto class level with examples.
Detailed study: *Pila globosa* and *Sepia*
General Topics: Torsion in Mollusca, Economic importance of Molluscs.

UNIT – IV
Phylum Echinodermata: General characters and Classification up to class level with examples.
Detailed study: Starfish - *Asterias rubens* and Seaurchin - *Salmacis bicolor* – General structure and Life cycle
General Topics: Larval forms of Echinoderm, Water vascular system in echinoderms.

UNIT – V
Minor Phyla: General characters of minor phyla with examples.
Detailed study: Rotifera – *Brachiolus pelicatus* and Ctenophora
General Topic: Organisation and affinities of Chaetognatha and Sipunculida.
Prochordata: Hemichordata – Detailed study - *Balanoglossus* and its affinities.

Textbooks

3. Valli, S. K. and Rajasekaran, C.,(1990) Muthukelumbuatravai I,(Tamil) BARD, Trichy.
4. Ekambaranatha Iyar and T. N. Ananthakrishnan. 1992. A Manual of Zoology, Vol. I (Invertebrata). Part I and Part II. Viswanathan & Co.

References

5. Barrington, E. J. W. (1979). Invertebrates. Structure and Function 2nd edn. ELBS and Nelson.
6. Jordon, E. L.and P. S. Verma. (1995). Invertebrate Zoology. 12 th edn. Sultan Chand & Co.
7. Barnes, R. D.(1968) Invertebrate Zoology. W. B. Saunders Company, London.
8. Kotpal, R. L., (1978) (Invertebrate Series) – Rastogi Publications, Meerut, India.

Offering Department: Zoology **Receiving Department: Botany and Chemistry**
Semester II **Hours: 4**
Allied III **Credits: 4**

ECONOMIC ZOOLOGY

Unit - I

Aquaculture: Scope, site selection, pond construction and management of freshwater fish farming - Edible South Indian Fishes: Fresh water fishes-*Catla catla, Labeo rohita, Mirigal* - Marine water fishes- *Mugil cephalus, Sardinella longiceps, Rastrelliger kanagurta* - Fish by-products.

Unit - II

Aquarium fishes-marine (any two), fresh water (any two). Setting up and maintenance of aquarium - Economic importance of aquarium fishes.

Unit - III

Mulberry culture - Biology and life history of *Bombyx mori* - Rearing techniques – Harvesting- Bacterial diseases (Septicemia and Bacterial intoxication) and Viral diseases (Grasserie and Flacherie) of silk worm- Enemy of silkworm : Uzi fly-Economic importance.

Unit - IV

Vermiculture: Scope - Culture of *Eisenia foetida, Perionyx excavates* - Methods of vermicomposting- Economic importance of Vermiculture - Vermiwash.

Unit - V

Vector borne diseases: Malaria, Dengue, Filaria : Transmission and Prophylaxsis - Household pests: Mosquitoes, Cockroaches, House flies - Agricultural pests: Life cycle and control measures of *Scirpophaga incertuals* (paddy stem borer), *Amsacta albistriga* (red hairy caterpillar), *Oryctes rhinoceros* (rhinoceros beetle), *Pectinophora gossypiella* (Pink boll worm).

Text Books:

1. Vasantharaj David, 2001. Elements of Economic Entomology, Popular Book Depot., Chennai-600015.
2. Shukla Upadhyay, Economic Zoology. Rastogi Publication, Meerut.
3. Dr Jawaid Ahsan and Dr. Subhas Prasad Sinha, A Hand book on Economic Zoology. S,Chand Company Ltd, New Delhi.

References:

1. Sultan Ahamed Ismail, 2005. The Earthworm Book, IIEd., Mother India Press Goa.
2. Dr.N.Arumugam, Aquaculture. Saras Publication.
3. Ganga, S and Sulochana Chetty J. An Introduction to Sericulture (II Ed.,) Oxford and IBH Pub., Co. Pvt. Ltd., New Delhi.

Semester III **Hours: 4**
CC IV **Credits: 4**

BIOLOGY OF CHORDATES

Unit I

Prochordata : Detailed study – *Amphioxus lanceolatus*
General characters and classification of Pisces up to orders with example
Pisces: Detailed study – Scoliodon (Shark) (excluding endoskeleton)
General Topic: Migration in Fishes.

Unit II

General characters and classification of Amphibia up to orders with example
Amphibia: Detailed study – *Rana hexadactyla* (Frog including endoskeleton)
General Topic: Parental care in Amphibians

Unit III

General characters and classification of Amphibia up to orders with example
Reptiles: Detailed study –Calotes.
General Topic: Biological significance of *Sphenodon.*

Unit IV

General characters and classification of Aves up to orders with example
Aves: Detailed study – *Columba livia* (Pigeon) (excluding endoskeleton)
General Topic: Flight adaptations in birds.

Unit V

General characters and classification of Mammals up to orders with example
Mammals: Detailed study – *Oryctolagus cuniculus* (Rabbit) (excluding endoskeleton)
General Topic: Adaptation of aquatic Mammals.

Textbooks

1. Ekambaranath Ayyar and T.N. Ananthakrishan, 1995. "A Manual of Zoology" Vol 2 (Part I and 2). S.Viswanathan, Chennai.

References :

1. Jordan E.L and P.S.Verma, 2000 "Chordate Zoology" S. Chand, New Delhi.
2. Newman H.H.1939, the Phylum Chordata,"Mc Millan, New York.
3. Kotpal, R. L., (1978) (Invertebrate Series) – Rastogi Publications, Meerut, India.

Semester III & IV **Hours: 4**
Core Practical II* **Credits: 4**

Core Practical II

BIOLOGY OF CHORDATES, CELL BIOLOGY AND MOLECULAR BIOLOGY
***Running Paper from semester III to semester IV**

CHORDATA

Dissections / Virtual:

Virtual dissection of Frog/ Fish

Frog- Arterial system, Venous system, Dorsal and Ventral view of brain.

Fish- Digestive system, Circulatory systems.

Mounting of fish scales (Ctenoid, Placoid and Cycloid).

Fish measurement – any 3 fishes.

CELL BIOLOGY

Onion root tip – Chironomus larva – Grasshopper Testis squash – Buccal smear – Blood smear in man/ frog.

SPOTTERS:

With special reference to the following aspects:

A. **Classify giving reasons :** *Scoliodon, Narcine ,Pristis, Channa, Anabas, Clarius, Rand hexadactyla, Bufo, Hyla,Calotes, Varanus, Naja naja, Echis carinata, Columba livia,* Parrot, Rabbit, *Rattus.*
B. **Relate the structure and function :** *Echenis, Exocoetus, Hippocampus, Rhacophorus, Draco, Chelone,* Russell's viper, Feet modifications in birds, Beaks of birds, Bird feathers, Loris.
C. **Biological significance :** *Amphioxus,* Ascidian, *Arius ,Protopterus, Anguilla, Ambystoma, Axolotl* Iarva, *Chameleon, Hydrophis, Manis,* Bat.
D. **Cell types :** Epithelial : Simple, Squamous and Ciliated – Muscular : Striated, Non – striated and Cardiac – Connective tissue – Bone and adipose tissue.
E. **Cell and Molecular Biology:** Models for DNA, RNA, tRNA Structure and DNA replication.
F. **Draw and Label the parts (Osteology):** Head (Skull), Pectoral and Pelvic girdle, Forelimb and Hindlimb, Skeleton of frog, Pigeon – Synsacrum, Skull/ Dentition – Rabbit, Dog and man.

Reference books:

1. Verma, P.S.2013. A Manual of Practical Zoology of Vertebrates, S. Chand and Company Ltd, Ram Nagar, New Delhi.
2. Amsath,A.2013. Practical Manual in Zoology, MMA Publications, Adirampattinam.
3. Lal,S.S. 1996. Textbook of Practical Zoology - Vertebrates. Rastogi Publications, Meerut.

Semester III **Hours: 4**

ME I ` **Credits: 2**

SERICULTURE

Unit – I

History and economic importance of sericulture- Silk producing organisms: Mulberry Silk worm, Tasar silk worm, Muga silk worm and Eri silkworm – Uses of silk –
Bombyx mori: biology, life cycle, sex determination of larva ,pupa and adult Commercial races of India.

Unit – II

Moriculture: Optimum conditions for mulberry growth; Methods of propagation: Vegetative propagation - Irrigation, manuring, pruning, cutting, grafting layering and mulching. harvesting and storing of mulberry leaves.Diseases and pests of mulberry and its control methods.

Unit – III

Rearing Facilities**:** Rearing house - Rearing appliances - Appliances used for feeding - Bed cleaning - disinfection and maintaining optimum culture conditions; Rearing methods**:** Chawki rearing of young age worms in India - paraffin paper rearing - box rearing, net method, co-operative rearing.

Unit – IV

Cocoon- Cocoon types- univoltine, bivoltine and multivoltine. Physical and commercial characterization of Cocoons. Identification of defective cocoons. Storage of cocoons.Marketing of cocoons.

Unit – V

Silk reeling- stifling, flossing and deflossing of cocoons. Reeling appliances and process of reeling, re-reeling. Raw silk testing. By-products of silk and their applications.

Text book:

Ganga, G. and Sulochana Chetty, J. An Introduction to Sericulture (2nd Edition). Oxford and IBH Publishing co. Pvt-Ltd., New Delhi.

References:

1. Taxima, Y. 1972. Hand Book of Silkworm Rearing. Fuji Publication, Tokyo.
2. Ullal, S.R. and Narasimhanna, M.N. 1979. Hand book of Practical Sericulture. Central Silk Board, Bombay.
3. Tomar, B.S and N.Singh. A Text Book of Applied Zoology. 2007. Emkay publications. Delhi.

SEMESTER III **Hours: 2**
SBE II **Credits: 2**

AQUACULTURE

UNIT I

History and Importance of aquaculture;Types of Culture systems- traditional, semi-intensive and intensive. Fisheries in Tamil Nadu and India – Inland and Coastal fisheries.

UNIT II

Fish farm- site selection-Water quality parameters - construction and preparation of fish ponds, breeding pond, nursery pond, stocking pond- raising ponds.Feeds for cultivable species- natural, supplementary and live feed.Crafts and Gears used in culture fisheries.

UNIT III

Types of culture- monoculture- poly culture; culture of Indian Major carps (Catla, Rohu, Mirgal) – induced breeding and hypophysation. Ornamental Fish Culture.

UNIT IV

Culture methods for marine prawn (*Penaeus monodon*) and fresh water prawn (*Macrobrachium rosenbergii*). Hatchery techniques- feed types and management. Prawn diseases and treatment. Pearl culture.

UNIT V

Preservation and processing of fish and prawn- fishery byproducts. MPEDA, Agencies involved in marketing of aquaculture products (CMFRI, CIFRI, CIFA, CIBA).

Text Books:

1.Santhanam,R. 1987. Fishery Science, Daya Publishing House.
2. Arumugam.N. 2014. Aquaculture, Saras Publication.

References:

1. Jhingeran, V.G. 1982. Fish and Fisheries of India. Hindustan Publishing corporation of India.
2.Pillai T.V.R. 1988. Aquaculture Principle and Practices.Fishing news books.
3.Santhanam,R. 1992. A manual of fresh water aquaculture Oxford I.B.H
4.Shanmugam, K.1982. Fishery Biology and Aquaculture. Leo Pathipagam.

SEMESTER IV **Hours: 6**
CC VI **Credits :6**

CELL AND MOLECULAR BIOLOGY

UNIT- I

Cell types –prokaryotic and eukaryotic cells – Ultra structural organization of Plasma membrane– Unit membrane model – fluid mosaic model and functions – Permeability, passive transport, active transport, endocytosis, exocytosis; Modifications of plasma membrane. Cytoplasm – Physico - Chemical and biological properties.

UNIT-II

Endoplasmic Reticulum -Ultra structure types and functions. Golgi complex – Morphology, structure, role in secretion and other functions. Ribosomes, Lysosome and Centrosome – Morphology, chemistry and functions.

UNIT-III

Mitochodria – Ultra structure and functions. Ultra Structure of inter-phase nucleus and nucleolus: Organization of chromosome – Giant chromosomes- Cell cycle-Cell division – mitosis and meiosis. Cancer Biology.

UNIT-IV

Structure and types of DNA: DNA replication and repair mechanism; Types of RNA – Processing of RNA molecules. Mutation-types, induced mutation - Molecular basis of mutation.

UNIT-V

Molecular techniques- Southern, Northern and Western blotting; DNA fingerprinting –PCR-Isolation of DNA and RNA -Sanger's DNA Sequencing method – Plasmid extraction. Centrifugation colorimeter; dialysis, chromatography, electrophoresis.

Text Book:

1. Gupta, P.K. Cell and Molecular Biology, Rastogi Publications, India.
2. VermaAgarwall. Cell Biology,Himalaya Publishing House, Bombay.
2. Powar, C.B. 1989, Essentials of Cytology, Himalaya Publishing House, Mumbai

Reference Books:

1. DeRobertis, E.D.P and E.M.F. DeRobertis, 1987, Cell and Molecular Biology. VIII Ed. Lea and Febger, Philadelphia.
2. Friefelder, D., 2003, Essential of Molecular Biology; Narosa Publishing, New Delhi
3. Lewin, B. 2008, Genes IX, Jones and Barlett Publishers, Boston.
4. Strickberger, M.W., 2005 Genetics, Prentice Hall of India, New Delhi.

Semester: IV **Hours: 2**
NME I **Credits: 2**

APICULTURE

(Receiving dept: Botany)

UNIT – I

Scope of Apiculture - Honey bee species- characteristics - Comb types ; Life cycle of *Apis Indica* - communication in bees - Nuptial flight - waggle dance- pheromones.

UNIT – II

Modern method of bee keeping - Description Newton's bee hive - Accessories- Location of Apiary- Bee pasturage- Floral calendar.

UNIT – III

Care and Management of Bee hive - Social organization of honey bee - division of labour- Acquiring of Bee hive - Queen and its management - summer and winter season management - swarm control- advantages of bee pollination in crops.

UNIT – IV

Diseases and enemies of honey bees ; Viral diseases - Thai Sac Brood Virus, Apis iridescent virus; Bacterial diseases- American Foul Brood, European Foul Brood . Enemies - wax moth, *Galleria mellaonella* , wasps , rats, birds, Rattle Snake.

UNIT – V

Honey and Byproducts of Apiculture - Extraction of honey- properties - composition and uses of honey. Byproducts - Bee wax, bee venom , propolis, royal jelly. Economics of Apiculture.

Textbooks

5. Sankar .C ,et ., al. - 2006, Theni Valarppu Thozhilnutpangal, Hans Rover Agriculture Science Centre, Perambalur.

References

9. N.Arumugam et.,al. 2009. Applied Zoology, Saras Publication, Nagercoil.
10. Jawaid Ahsan et .,al. - 2000- A Handbook on Economic Zoology , S.Chand & Co.Ltd, New Delhi.

SEMESTER V **Hours: 6**
CC VII **Credits :5**

ANIMAL PHYSIOLOGY

Unit I

Nutrition: Physiology of digestion- ingestion, digestion, absorption, assimilation and egestion. Circulation- Structure and physiology of heart -haemopoisis- blood corpuscles – blood function, blood volume and its regulation, cardiac cycle, blood pressure,ECG.

Unit II

Respiration - Physiology of respiration - transport of gases (O_2 and CO_2). Respiratory pigments- Haemoglobin – structure and function.
Excretion: Physiology of excretion – Kidney structure, urine formation, elimination; regulation of water, electrolyte and acid base balance.

Unit III

Thermoregulation – Poikilotherms and Homeotherms. Comfort zone, body temperature – physical and chemical acclimatization – homeostasis.Osmoionic regulation.
Muscle physiology – Types of muscles - Ultra structure and contraction of smooth (skeletal) muscles.

Unit IV

Neurophysiology: Brain and spinal cord- central and peripheral nervous system, Neurons, synapse, synaptic transmission, conduction of nerve impulse, action potential. Reflexes - types.
Recpetors – Photoreceptors and phonoreceptors.

Unit V

Endocrine glands: Pituitary, thyroid, adrenal, pancreas - structure and functions. Basic mechanism of hormone action and their regulation.
Reproductive physiology: Structure and physiology of testis and ovary. Neuro-endocrine regulation of reproduction.

(All the systems are based on mammalian physiology)

Textbooks

1. Verma P.S. and V.K. Agarwal.1992. Animal Physiology. S. Chand and Co.

References

1. Berry A.K. 1998. A textbook of animal physiology. Embay publications, Delhi.
2. Mariakuttikan and N. Arumugam, 2002 Animal Physiology, Saras publications, Nagarkoil.
3. Rastogi.S.L. 1997. Essential of Animal physiology. New Age International Publishers, New Delhi

Semester: V **Hours: 6**
CC VIII **Credits: 4**

GENETICS AND EVOLUTION

UNIT- I

Mendel's laws of inheritance – Gene interaction-Allelic and Non allelic interaction; Linkage,and Crossing over with Drosophila as example; Multiple alleles: Blood groups and their inheritance. Sex determination – Chromosomal, Environmental and hormonal basis of sex determination.

UNIT- II

Chromosome – Structure and Function – DNA as genetic material – Transformation – Conjugation-Transduction- Molecular Genetics: Fine structure of gene-cistron, recon and muton – gene expression and regulation in prokaryotes – Operon model.

UNIT-III

Genetic code - Transcription and Translation - Protein biosynthesis; Initiation-Elongation-Termination-Post translational modifications.

UNIT-IV

Origin of life, Lamarckism, Darwinism,Neo Lamarkism, New Darwinism, De Vries theory of mutation, Modern synthetic theory of evolution. Evidences for evolution – Embryological and Biochemical evidences.

UNIT-V

Colouration and Mimicry. Hardy-Weinberg principle. Speciation, Isolating mechanism. Evolution of Man – Cultural and future.

Text Book:

.

1. Verma, P.S. and V.K. Agarwal, 2002, Evolution, S.Chand& Co. New Delhi.
2. Gardner, E.J., 2007, Principles of Genetics , 8th edition, Willey India Publishers

References:

1. Meyyan, R.P., 2005. Genetics, Saras Publications, Nagercoil.
2. Arumugam, 2002, Evolution, Saras Publications, Nagercoil
3. Miglani, G.S.,2007, Advanced Genetics –2nd edition, Narosa Publishing, New Delhi
4. Strickberger, M.W., 2005 Genetics, Prentice Hall of India, New Delhi.
5. Stansfield,W.D.,1977,The Science of Evolution,Collier Macmillan,London.
6. Dobzhansky,T.,et al,1977 Evolution, W.H.Freeman and Co.,San Francisco.

Semester V **Hours 6**
Core Course IX **Credits 4**

DEVELOPMENTAL BIOLOGY

UNIT-I

Gametogenesis, Structure of gametes- Egg-membranes-types-maturation- Egg types and ovulation. Fertilization: Recognition of egg and sperm, gamete fusion, activation of egg metabolism, rearrangement of egg cytoplasm.

UNIT-II

Cleavage: Patterns and types of embryonic cleavage, mechanism and control of cleavage.
Amphibian blastulation and gastrulation. Totipotency and Pluripotency.
Morphogentic movements. – Fate map in frog.

UNIT-III

Organogenesis- ectoderm- brain- development of vertebrate eye. Mesoderm - heart , Endoderm- Alimentary danal.

UNIT-IV

Regeneration:- Types of regeneration- amphibian limb regeneration. Metamorphosis- types- amphibian metamorphosis; Insect metamorphosis. Formation of extra embryonic membranes in Chick. Placentation in Mammals.

UNIT-V

Organiser / Induction. Differentiation. Teratogenesis- Developmental mechanism of teratogenesis. Contributions of teratology to developmental biology. Stem cells and applications.

Text Book

Verma , P.S. Agarwal, V.K. and Tyagi, B.S. 1980. Chordate Embryology,
S. Chand and Company Ltd. New Delhi.

References:

1. Developmental biology- Scott F. Gilbert, 5th Edition., SA,
2 .Principles of Animal Developmental Biology-Suresh C.Goel, HPH Rastogi, V.B. and Jayaraj, M.S. 2002.
3. Berill N.J, 1992. Developmental biology, Tata McGraw Hill Publishing company ltd. New Delhi.
4. Twymann, R.M.2003. Developmental biology, Viva Books Private ltd. New Delhi.
5. Arora, M.P. 1992. Embryology, Himalaya Publishing House , New Delhi.
6. Berry, A.K.2013. An introduction to Embryology, EMKAY Publications, New Delhi.

Semester V **Hours: 6**

CCP III **Credits: 5**

Animal Physiology, Genetics and Evolution, Developmental Biology and Biotechnology

Animal Physiology

1. Human salivary amylase activity in relation to temperature andpH.
2. Qualitative estimation of food products.
3. Identification of Nitrogenous waste products
4. Enumeration of RBCs/WBCs by haemocytometer

Spotters: Haemoglobinometer, Kymograph, Sphygmomanometer.

GENETICS:

Recording of Mendelian traits in man, Blood grouping of man, Pedigree (Chart) for autosomal dominant / autosomal recessive characters.

Models: Monohybrid and Dihybrid crosses.

Karyotypes of normal male and female.Klinefelter's syndrome, Turner's syndrome and Down's syndrome.

Drosophila- Male and female identification,Genetic importance, Mutants (Wing, body colour, eye colour).

Evolution:

Evidences- Homologous and analogous organs – paleontological – Nautiloid, Ammonoid fossils.

Spotters: Protective coloration -Leaf insects, Stick insects, Chameleon, Hippocampus, Pepper moth. Mimicry: Monarch and Viceroy butterfly. Quantum evolution; Bat, Pteropus.

Biotechnology

1 Isolation of genomic DNA from human saliva.

2. Spotters: PCR, transilluminator, Electrophoresis unit, P^{BR322} vector, Pharmaceutical products: Insulin

Developmental biology

Spotters: Frog – sperm motility, Sperm, T.S. of Mammalian ovary.

Frog: Egg, cleavage, blastula, Yolk plug and tadpole stages

Chick: Egg, Developmental stages - 24 Hrs, 48Hrs, 72 Hrs. and 96 Hrs. Sheep: Placenta

Field Visit / Tour Report

SEMESTER V **Hours: 4**
ME II **Credits: 4**

BIOTECHNOLOGY

Unit - I

Biotechnology- Scope - Overview of genetic engineering - Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda bacteriophage - Specialized vectors: Shuttle vectors, Expression vectors - Construction and use of pBR 322 – Transposons - Applications of Biotechnology.

Unit - II

Role of Enzymes in genetic engineering: Restriction endonuclease, ligases, SI nucleases, DNA polymerases, ribonucleases, reverse transcriptase, deoxyribonuclease -Klenow fragment, linkers, adaptors and homopolymers.Isolation of DNA/plasmids – rDNA technology.

Unit - III

Medical and farm biotechnology - production, methodology and applications of Hybridoma and Monoclonal antibodies – Transgenic animals- DNA finger printing - Gene therapy :In-vivo, Ex-vivo - Application of biotechnology in medicine.

Unit- IV

Industrial biotechnology: Enzyme Technology: Enzyme production, Isolation and purification of enzyme, immobilization of enzymes - Fermentation: Fermenter structure, types and process of fermentation - Ethanol production - Production of Antibiotic : penicillin - Single cell protein (SCP).

Unit - V

Agricultural biotechnology –Biofertilizer - Nitrogen fixation – Biopesticides – GMO -Role of Genetically Modified Organisms.
Environmental biotechnology – Biofuels – Bioremediation – Sewage water remediation.

Text book:

1. Dubey, R.C. 2007. A Text Book of Biotechnology. S. Chand and Company Ltd, New Delhi

References: 1. Ignacimuthu, S.J. 2002. Basic Biotechnology. Tata Mc Graw-Hill Publishing Company, Ltd., New Delhi.

2. Kumerasen, V. 2001. Biotechnology, Saras publication, Kanyakumari.

3. Arora, P.M.2003. Biotechnology , I Edition. Himalayas Publishing House, Mumbai.

4. Gupta, P.K.2004. Biotechnology and Genomics, Rastogi Publication, Meerut.

SEMESTER VI **Hours: 2**

NME II **Credits: 2**

PUBLIC HEALTH AND HYGIENE

(Receiving dept: Botany)

UNIT 1

Public health: Physical, mental, social and spiritual health. Hygiene: Food and personal, Nutrition, balanced diet, malnutrition disorders and preventive measures.

UNIT II

Water: Basic needs domestic uses of water and purification, protection of water supply (Water borne diseases – Cholera and Dysentery). Role of environment on health – Occupational health hazards.

UNIT III

Housing and human requirements – Standard requirement of environment – Maintenance of houses for healthy living. First aid and its significance.

UNIT IV

Sanitary health measures: Environmental sanitation – disposal of refuse- food sanitation. Control of infectious diseases. Communicable and non-communicable diseases

UNIT V

Health situation in India – Nutritional health programme – NMEP – TB control – BCG vaccination – AIDS control – Oral Polio vaccine programme – Social welfare care schemes for child care aged and orphans.

Textbooks

Sorna Raj and Kumaresan, 2010. Public health and Hygiene, Saras Publications, Nagercoil.

References

1. Park and Park, 1995. Text book of preventive and social medicine, Banarsidas Bhanot Publishers, Jabalpur Zoo.

2.Verma. S, 1998. Medical Zoology, Rastogi publications, New Delhi.

SEMESTER VI **Hours: 6**
CC XI **Credits: 5**

ENVIRONMENTAL BIOLOGY AND TOXICOLOGY

UNIT: I

Environment: Atmosphere (air), Hydrosphere (water), Lithosphere (soil); Abiotic factors: Temperature and light - Effect of light and temperature on animals. Biotic factors - Animal association - Symbiosis, Commensalism, Mutualism, Antagonism, Antibiosis, Parasitism, Predators and Competition.

UNIT : II

Ecosystem: Concept, Components - Producer, Consumer, Decomposer, Transformer. Trophic level, Energy flow, Ecological pyramids, Productivity, Food chain, Food web. Forest ecosystem- wild life resources and management, Sanctuaries and National parks. Animal protection Act. Environmental protection Act. Space Ecology.

UNIT: III

Community Ecology : Types of Communities; Characteristics of Community - Stratification - Community interdependence - Ecotone - Edge effect; Ecological Niche - Ecological succession. Population ecology : Population size and Density, Natality, Mortality, Age Structure, Biotic potential, Population Dynamics; Regulation of Population Size- Emigration, Immigration and Migration.

TOXICOLOGY

UNIT : IV

Scope and importance of Toxicology, Classification of Toxicants - Cardiotoxicants, Immunotoxicants, Hepatotoxicants and Food additives. Routes of entry of Toxicants, LC_{50} and LD_{50}. Dose response relationship - selection of exposure, Duration of exposure, Types of human exposure. Mode of action of Toxicants, Toxic effect, Toxicological methods - Acute, Sub acute and Chronic toxicity tests.

UNIT : V

Environmental toxicology : Introduction and importance of toxicants in atmosphere; toxicants in hydrosphere - domestic, industrial, heavy metals, land, thermal and radiation. Bio-magnifications. Environmental monitoring - EIA, EIM.

Textbooks

1. Rastogi, V.B. and M.S.Jayaraj.1997. Animal ecology and distribution of animals. Kedarnath, Ramnath.
2. Verma P.S. and V.K.Agarwal.1996. Principles of ecology. S. Chand and Co., New Delhi.
3. Arumugam, N.1992. Concepts of ecology. Saras publications, Nagercoil

References

1. Claude, F., Christiane, F., Paul, M. and Jean, D.1998. Ecology Science and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Sood, A. 1999. Toxicology. Sarup & Sons. Darya Ganj. New Delhi.
3. Dr. Kamaleshwar Pandey, Dr. J.P.Shukla, Dr. S.P. Trivedi. 2005. Fundamentals of Toxicology. New central Book Agency P(LTD). Kolkatta -700 009.

SEMESTER VI **Hours: 6**
CC XII **Credits: 5**

IMMUNOLOGY

UNIT I

History of Immunology, Types of immunity- Innate and acquired immunity. Physical, biochemical and cellular factors in innate immunity. Active and passive immunity in acquired immunity. Lymphoid organs- primary lymphoid organs- thymus, bone marrow, Bursa of fabricius ; secondary lymphoid organs- spleen, lymph nodes , tonsils and payer's patches.

UNIT II

Cells of immune system; origin of stem cells- cells of lymphoid lineage : lymphocytes- structure and functions of B- lymphocytes, Plasma cells; T- lymphocytes, NK cells and K cells. Cells of myeloid lineage; Study on monocytes and polymorphonuclear leucocytes, Neutrophils, Eosinophils and basophils.

UNIT III

Antigen, Types of antigens, properties; definition of hapten, adjuvant. Antibodies: Basic structure of immunoglobulin, types of immunoglobulin, biological properties. Immune responses; Humoral and cell mediated immunity. Hypersensitivity reactions. Immunological tolerance.

UNIT IV

Major histocompatibility complex (MHC) - types and functions OF . MHC molecule in human – functions. Complement: classical and alternate pathways. Auto immune diseases- Pernicious anemia and Rheumatoid arthritis. Vaccination- Principle and types. Transplantation immunology. Types of grafts, Mechanism of grafts rejection.

UNIT V

Basic idea on immunological techniques- precipitation- VDRL test; Immunodiffusion- immunoelectrophoresis; agglutination- ABO blood typing, Rh blood grouping. Widal test, ELISA and RIA.

Textbook

1. Fatima , D. and Arumugam N. 2001. Immunology , Saras Publication , Kanyakumari
2. George John and Vijayaraman. 2010. Noi Thadaikapiyal

References:

1. Shetty , N. 2006. Immunology, New Age International Private ltd., Publishers, New Delhi.
2. Shastry, N.V. 2005. Principles of Immunology, Himalaya Publishing House, New Delhi.
4. Rao, C.V. 2006. Immunology, Narosa Publishing house, New Delhi.
5. Kannan, I. 2007. Immunology, MJP publishers, Chennai.
6. Janis Kuby.1997.Immunology.W.H.Freeman & company, New York.
7. Ivan M. Roitt *et al*., Essential Immunology. XII Edition, Wiley- Blackwell Publishers.UK.

Semester VI **Hours 5**
Core XIII **Credits 4**

MICROBIOLOGY

Unit I

History and Scope of Microbiology- Classification based on Cellularity. Bacteria – Major features of Bacteria, Structure of Bacteria (E.coli). Nutritional types of bacteria, Bacterial reproduction. Economic importance of Bacteria.

Unit II

Bacterial Growth- Methods of Bacterial growth, growth rate, growth curve. Culture medium- Bacterial culture-culture techniques- methods of culturing bacteria. Isolation of pure culture, maintenance of bacterial culture.

Unit III

Algae- characteristics, General structure of spirulina, Economic importance. Fungi Charecteristics, General structure of penicilium, Economic importance. Virus – Charecteristics of virus- Structure of Adinovirus – Bacteriphage – Virions – Virioids – prions – Life cycle of Phages.

Unit IV

Aquatic microbiology – Sources of water – Standards of water – Microorganisms in aquatic environment – methods of purification of potable water- Determination of sanitary quality of water- Methods of waste water treatment. Soil microbiology – Soil microorganisms – Role of Microorganisms in soil formation – Rhizosphere- Nitrogen cycle.

Unit V

Microorganisms of food – Microbial examination of food – Food spoilage – Spoilage of Meat, Fish, Milk. Medical microbiology – Normal microflora of human body – Bacterial diseases (Tuberculosis and Cholera) – Viral diseases (AIDS and Rabies) – Fungal diseases (Mycoses).

Text Books

1. A Text book of microbiology. R.C. Dubey, D.U. Maheshwari, S.Chand and company Ltd 2005.
2. Sharma, P.D. 1998: Microbiology, Rastogi Publ. Meerut, India
3. Vijaya Ramesh, 2005: Environmental Microbiology, MJP.Publ., Chennai, India

References

1. Medical Microbiology, Rajan,S. 2007, MJP.Publ. Chennai, India.
2. Pelczer, M.J., Reid, R.D. and Chan, E.C.S. (1996), Microbiology, V Ed., Tata McGraw Hill Publishing Company Ltd., New Delhi.

SEMESTER –VI **Hours: 4**
CCP IV **Credits: 3**

ENVIRONMENTAL BIOLOGY AND TOXICOLOGY, IMMUNOLOGY, MICROBIOLOGY, BIOTECHNOLOGY AND BIOSTATISTICS & BIOINFORMATICS

Environmental Biology

1. Estimation of Dissolved oxygen.
2. Estimation of Salinity
3. Estimation of Calcium
4. Examination of intertidal fauna
5 Examination of marine plankton

Spotters:
Animal association (Hermit crab, Sacculina on crab, Echinis with fish), pH meter, Secchi disc, maximum and minimum thermometer, Anemometer, Barometer, Hygrometer.

Toxicology
1. Estimation of LC_{50} (Demonstration in groups using different toxicants) in fishes.
2. Estimation of toxicants (metals, organophosphorus) in industrial effluents in fishes.
3. Observation of pH and salinity variations in different soil, water samples**.**

Immunology
1. ABO Blood grouping and Rh factor typing.
2. Lymphoid organs of mouse (Demo)
3. Double immunodiffusion (Demo)

Microbiology
1. Demonstration of sterilization procedure for culture media and equipment.
2. Preparation of culture media for microbes, serial dilution techniques (in groups)
3. Distribution of microbes in water (demonstration and observations.)
4. Fixing and gram staining of bacteria
5. Hanging drop preparation of Lactobacillus.

Spotters: Autoclave and Petri-dish, colony counter, inoculation loop.

Biochemistry

1. Qualitative and quantitative tests for proteins,
2. Qualitative tests for carbohydrates and fats
3. Electrophoresis (demonstration)

Spotters: Models of Amino acids, Haemoglobin, ATP, Steroids

Bio-statistics:

1. Calculation of mean, median, mode, SD and SE from Molluscan shell dimensions.
2. Diagram construction - Bar, Histogram, and Pie.

Bio Physics

Measurement of pH in samples, Verification of Beer- Lamberts Law. spotters: Compound Microscope, Micrometer, Camera Lucida. pH meter, Centrifuge, Calorimeter**.**

Semester VI **Hours: 5**
ME III **Credits : 4**

BIOPHYSICS AND BIOCHEMISTRY

Unit I

Scope of Biophysics: Colloids- description, and properties, Tyndall effect, Surface tension, Brownian movement, Filtration, Osmosis and Dialysis. Microscopy- Principles and applications of light and Electron microscope (SEM and TEM),

Unit II

Instrumentation: Introduction- Principles-, description and applications of pH meter, colorimeter, Analytical and ultra centrifuge and Paper chromatography. Micrometry.

UNIT - III

Definition and scope of Biochemistry, Classification, structure and Functions of Carbohydrates, Metabolism of Carbohydrate: Glycolysis, TCA cycle, HMP shunt pathway, Glycogenesis and glycogenolysis. Proteins, Protein: General pathway of amino acid metabolism – deamination, transamination and decarboxylation.

UNIT- II

Classification, structure and Functions of Lipid : Beta-oxidation, biosynthesis of saturated fatty acids-Palmitic acid. Nucleic acids:- metabolism of purine and pyrimidine nucleotides. Ketogenesis. Vitamins: water soluble and fat soluble vitamins, occurrence, function and deficiency diseases.

UNIT- III

Enzymes: Definition, nomenclature and classification of enzymes, properties. Mechanism of enzyme action- active site, Lock and Key model, induced fit hypothesis Factors affecting enzyme action. Mechanism of enzyme catalysis, enzyme-substrate complex formation, Allosteric enzymes. Enzyme inhibitors. Haemoglobin structure-abnormalities-sickle cell anaemia, thalassemias-Alpha and Beta.

Text books

1.Biochemistry-Prof.Dulsy Fatima,Dr.P.Meyyan,Saras Publication,2004
2.Biochemistry-P.S.Verma,Chand & co,2004

References:

1 Harper's review of Biochemistry- H.P. Harper et al., Lange Medical Publication 1981
2. Biochemistry – Stryer et al, W.H. Freeman Pubs, 2002, NY
3. Biochemistry 4t Ed. – Voet D & Voet J, VP & Publishers
4. Understanding enzymes – T. Palmer, Prentice Hall, Ellis Harwood, 1995.
5 Principles of Biochemistry- Lehninger A L,W.H.Freeman,2008.N Y

Semester: V **Hours: 2**
SBE III **Credit: 2**

BIOSTATISTICS AND BIOINFORMATICS

UNIT – I

Biostatistics: Biological data – data on a ratio scale, Interval, Ordinal, Normal scales, Discrete and Continuous data. **Collection of data**: Primary data collection: Survey, Experimental & Observation methods. Secondary data collection: Classification and Tabulation of data. Diagrammatic representation of data – Line diagram, Bar diagram, Pie diagram, Pictogram.

UNIT – II

Sampling and Sampling design: Sample – Definition; attributes of a good sample; Sampling methods - Census method, Sample method, random and non random sampling; Size of sample; **Measures of Central tendencies**: Mean, Median, Mode – merits and limitations.

UNIT – III

Methods of Measuring dispersion: Range, Standard deviation, Standard error; Correlation and Regression analysis

UNIT – IV

Bioinformatics: Definition, Scope of bioinformatics. **Biological databases: Primary nucleic acids databases:** NCBI, GenBank, EMBL, DDBJ;

UNIT – V

Primary protein databases: PIR, MIPS, SWISS PROT. **Secondary databases:** Print, Blocks; **Composite databases**: NRDB, OWL; **Specialised databases:** Flybase.

Textbooks

6. Palanichami, S. and Manoharan, M. Statistical Methods for Biologists. Palani Paramount Publications, Palani.
7. Attwood, T. K and Parry – Smith, D. J. 2004. Introduction to Bioinformatics. Pearson Education (Singapore).

References

11. Sokal, R. R and Rohlf, F. J, 1981. Introduction to Biostatistics, WH Freeman and co, USA.
12. Veer bala Rastogi. 2007. Fundamental of Biostatistics. Ane Books India, Chennai.
13. Ramakrishnan, P. 1995. Biostatistics. Saras Publications, kanyakumari.
14. Prasad, S. 2001. Elements of Biostatistics. Rastogi Publication, Meerut.
15. Bliss G I. 1970. Statistics in Biology. Mc Graw Hill Book Company, Vol I an II