ST. XAVIER'S COLLEGE (AUTONOMOUS)

Palayamkottai - 627 002

Autonomous College Affiliated to MSU?

(Recognized as "College with Potential for Excellence" by UGC)

(Re-accredited with **"A" Grade with a CGPA of 3.50**)

DBTSTAR Status?

SYLLABUS

B.SC. ZOOLOGY
(w.e.f 2018 - 19)

Course title B.Sc. Zoology

Aim and Objective

B.Sc. Zoology is mostly suited for the students who are interested in nature, biology and especially animals. It is one of the most useful and degree course at the graduate level with career prospects. This degree programme in Zoology is designed in such a way to develop scientific attitude and interest amon students towards learning the various aspects of zoology in particular and life science in general. The course papers are designed to impart the essential knowedge in taxonomy, biochemistry, physiology, ecology, genetics, cell and molecular biology, aquaculture, entomology, immunology and microbiology. (There are two foundation courses, one is focused on the modern bio-information technology, statistics and their application in modern life sciences, and a general introduction and awareness on Biotechnology and its influence in human life.) No foundation course mentioned in the course pattern.

The various courses in the programme are aimed to develop proficiency both in the theory as well as in practical through experiments, , laboratory work along with the collection and interpretation and presentation of scientific data..

No mention about the coure papers?

In addition to this, the students will be equipped with knowledge in the modern areas of biotechnology and its application in aquaculture, medical science, agriculture, and various bio-based industries. Self employment courses like apiculture, sericulture, aquaculture, vermintechnology and animal husbandry. Students, who pursue this programme and pass out successfully, will surely have an urge to continue higher studies in life sciences: Microbial Gene Technology, Genomics, Biochemical Technology, Marine Biology, . Why give PG here? Environmental Biology, Biochemistry, Microbiology**,** Environmental Biotechnology, Medical Clinical Embryology, Clinical Virology, Bioinformatics, Pharmaceutical and Analytical Chemistry and contribute significantly in its development.

The group project is compulsory and the students may be assigned a topic for the project in the 5th semester itself and should be completed and submitted during the practical assessment at the end of VI semester or as prescribed by the controller's office.

Programme Objectives: The B.Sc. Zoology programme is designed to help the students to:

1. Impart basic, advanced and application knowledge of various branches of Zoology and General biology meant both for a graduate terminal course and for higher studies.
2. Create and inculcate interest in and love of nature with its living creatures.
3. Diversity and association of various animals and their ecological, embryological and evolutionary significance
4. Courses like cell and molecular biology, biotechnology will also provide a glimpse of the application aspect
5. Procure basic skills in the observation and study of nature, biological techniques, biostatistics and related applications in MS-Office, experimental skills and scientific investigation
6. Students get a hands-on experience of the isolation, and identification of proteins using PAGE; identification of blood group, O2, CO2, total dissolved solid, salinity, alkalinity; urea, uric acid, and nitrogenous waste products level in water samples;

7. Acquire basic knowledge and skills in certain applied branches [apiculture, sericulture, aquaculture] to enable them for self employment
8. Impart awareness of the conservation of the biosphere.

Use bulleting instead of numbering.

Expected Outcome of the Programme or course? Usually B.Sc., Zoology Degree is Programme and the various papers are Courses.

The B.Sc. Zoology programme should be able to

1. Classify, Identify and list out common animals (invertebrates, vertebrates)
2. Explain various physiological changes in our bodies
3. Analyze the impact of environment on our bodies
4. Understand various genetic abnormalities
5. Develop respect for nature
6. Explain the role and impact of different environmental conservation programmes
7. Identify and manage harmful and beneficial animals
8. Identify various potential risk factors to health of humans
9. Explain the importance of genetic engineering [cell culture, transgenic animals, antibiotics, engineered microbes, biodiesel, bio-plastics, Biopesticides]
10. Use tools of information technology for all activities related to Zoology
11. Various self employment courses such as vermi technology, bee keeping, sericulture, aquarium fish keeping are well know to the students.
12. Other major students shall learns on common vectors, their diseases, environmental hygiene and public health, and Ornamental Fish Farming

Employments and higher studies Opportunities for B.Sc. Zoology students

1. Employment areas of B.Sc. Zoology includes: pharmaceutical companies, Environmental Agencies, Medical Laboratories, Museum, Agriculture and Veterinary Farms, Medical Representatives, Sales manager of bio-products,
2. After completing B.Sc. Zoology one can seek admission in Master of Science where the student needs to go through the deep knowledge of science.
3. B.Sc. course is globally agreeable where the students from science theme can pursue from any of the approved university.
4. Eligibility of students for higher studies: after completing UG Zoology, the students are eligible for admission in M.Sc., degree course in Zoology, Life sciences, Aquaculture, -- Forensic Science, Genetics, Microbiology, Biotechnology, Integrated biology, Physiology, Aquaculture, Marine biotechnology, integrated Ph.D, P.G diploma courses in lab technology, Radiology. U.G are eligible for B.Ed., TNPSC, IAS, IPS, IFS (group 1 exams). B.Sc. Zoology is also eligible to get admission in MCA, MBA, **M.Sc. Microbial Gene Technology, Genomics, Biochemical Technology, Marine Biology, M.Sc. Environmental Biology,** Biochemistry, Microbiology, **Environmental Biotechnology,** Medical Clinical Embryology, Clinical Virology, Bioinformatics, Pharmaceutical and Analytical Chemistry, **etc.**
5. After completing B.Sc. Zoology, cne can specialize in various fields within zoology like Arachnology, Entomology, Arthropodology, Apiology, Cetology, Anthrozoology,

Conchology, Ethology, Helminthology, Mammalogy, Neuroethology, Myrmecology, Nematology, Ornithology, Paleozoology, Malacology, Primatology, Herpetology etc.

USE BULLETING INSTEAD OF NUMBERRING

IT WOULD BE BETTER IF THE ELIGIBILITY CONDITIONS FOR ADMISSION, ATTENDANCE, PASSING AND AWARD OF THE DEGREE ARE GIVEN HERE.

MENTION ABOUT THE MODALITY OF CBCS ALSO TO BE GIVEN FOR THE BENEFIT OF THE STUDENTS.

INVERTEBRATA

(18 UZO11)

Semester: I **Core: 1** **Credits: 4** **Hours: 60**

Course Objective: To outline the basic classification, concepts of biodiversity and body organization of selected invertebrates.

Expected Outcome: Students will learn how to identify invertebrates up to class level, understand invertebrate's body structure, adaptations, function and their economic importance.

UNIT I: Protozoa and Porifera 12 Hours

General characters, classification, salient features of the classes; Type study – *Paramecium caudatum*; General topic - canal system in sponges; Economic importance of Protozoa and Porifera.

UNIT II: Coelenterata, Ctenophora and Helminthes 12 Hours

General characters, classification, salient features of the classes; Type study - *Obelia geniculata, Taenia solium* and *Pleurobrachia*; General topic - Coral reefs, Affinities of Ctenophora, Parasitic adaptations, Helminths in relation to man

UNIT III : Annelida 12 Hours

General characters, classification, salient features of the classes; Neries, earthworm and leech - Coelom and metamerism - modes of life in polychactes. Onychophora:- Structure, affinities and distribution of Peripatus

UNIT IV : Arthropoda 12 Hours

General characters, classification, salient features of the classes; Prawn, Scropion and Cockroach - Mouthparts, vision, respiration and excretion; Larval forms and parasitism in Crustacea; Metamosphosis and social life in insets

UNIT V: Mollusca and Echinodermata 12 Hours

General characters, classification, salient features of the classes; Type study - *Pila globosa* and *Asterias rubens;* General topic: Oyster culture and pearl formation; Water vascular system Larval forms and affinities of echinoderms

Textbooks:

1. Kohli, K.S. and Kavita Sahni 2010. Animal Diversity and Evolution, Ramesh Book Depot, Civil Lines, Jaipur.

2. Jordan, E.L. and Verma P.L. 2009. Invertebrate Zoology, 15th Edition, S. Chand & Company Ltd., New Delhi, PP. 1127.

Reference Books:

1. Singh, B.K. 2004. Biodiversity conservation and management, Mandal Deep Publications, Jaipur.
2. Ekambaranatha Ayyar 1993. Outlines of Zoology, Volume. I. S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.
3. Arthur E Shipley. 2010. Zoology of the Invertebrata a Text-Book for Students, BiblioLife Publisher, PP.468.
4. Hymen, L.H. 1951. The Invertebtare, Volume 3, Mc Graw Hill, UK.

E-resources

1. https://www.mgccc.edu/learning_lab/science/PROTOZOANS.pdf
2. http://www.angelo.edu/~crussell/Lectures/Ppt/S05/web/chapt11-protozoa.pdf
3. http://nsdl.niscair.res.in/jspui/bitstream/123456789/817/1/Platyhelminthes%20%20-%20Formatted.pdf
4. http://www.bu.edu/gk12/eric/Annelida.pdf
5. http://www.mhhe.com/biosci/genbio/raven6b/graphics/raven06b/other/raven06_46.pdf
6. http://nsdl.niscair.res.in/jspui/bitstream/123456789/693/1/PHYLUM%20MOLLUSCA%20-%20Formatted.pdf
7. https://arxiv.org/abs/1606.01631
8. http://web2.uconn.edu/cyberinfra/module4/Taxonomy.pdf
9. https://www.britannica.com/animal/sponge-animal
10. http://biologyboom.com/phylum-porifera/
11. https://lter.limnology.wisc.edu/sites/default/files/Porifera%20Chapter%204_Frost.pdf
12. http://www.biologydiscussion.com/invertebrate-zoology/phylum-ctenophora/phylum-ctenophora-features-characters-and-other-details/28786

ANIMAL BIODIVERSITY – 1 - PRACTICALS

(Subject Code: 18 UZP 11)

Semester: I Core: 1 Credit: 1 Hours: 2

1. Virtual dissection:
   Grasshopper - https://www.ent.iastate.edu/ref/anatomy/ihop/
   Earthworm - http://www.mhhe.com/biosci/genbio/virtual_labs/BL_14/BL_14.html
   Starfish - http://www.k-state.edu/organismic/images/starfish_gonad.jpg
2. Mounting
   Earthworm (Body setae and penial setae)
   Cockroach (Mouthparts)
3. Mounting of prawn Cephalothorax and abdominal Appendages (marine waste prawn)
4. Separation of spicules using drifted sponges
5. Collection, preservation and submission of invertebrates (dead specimens only).
6. Survey of pond water for free living protozoan's
7. Field Visit: Terrestrial ecosystem and a seashore.
8. Mini project:
   An animal album with photographs, paper cuttings with appropriate write-up
   Photographs, paper cuttings of endangered and threatened invertebrates
9. Study of following specimens : *Hydra*, *Aurelia*, Sea anemone, *Sepia*, Octopus, Star fish, Sea urchin, Sea cucumber, Sea lily, Liver fluke, Tape worm, *Ascaris*, *Nereis*, Earthworm, Leech, Prawn, Scorpion, Millipede, Crab, Scorpion, *Limulus*, *Peripatus*, *Pila*, *Lamellidens*
10. Study of following slides : *Paramecium*, *Euglena*, *Leucosolenia*, Redia larva, Cercaria larva, Trocophore larva, Nauplius larva, Zoea larva, Mysis larva, Megalopa larva, Bipinnaria larva, Planaria

VECTOR BORNE DISEASES

Semester: I NME : 1 Credits : 2 Hours : 30

? Course Objective

To introduce the concept of various invertebrate and vertebrate as human vectors

Outcome of the course:

Students learned how various animals including pet animals which causing various diseases to humans and learned the preventive and control measures of the same.

Unit I: Salient features of human Vectors **Hours: 6**

General salient features of insects, rodents, snail, bird, Dogs, bats, other carnivorous mammals vectors of human beings; Host- vector relationship, Vectorial capacity; Adaptations as vectors.

Unit II: Insect Vectors-I **Hours: 6**

General life cycle, mode of disease transmission, prevention and control of Mosquitoes

Unit III: Insect Vectors-II **Hours: 6**

General life cycle, mode of disease transmission, prevention and control of flies, cockroaches, louse, triatominae, rhodnius

Unit IV: Other invertebrate vectors **Hours: 6**

General life cycle, mode of disease transmission, prevention and control of fleas, ticks and mites, snails,

Unit V: Vertebrate vectors **Hours: 6**

General life cycle, mode of disease transmission, prevention and control of birds, dogs, mammals

Textbooks

Mathews, G. 2011. Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell

Online free book: Vector-Borne Diseases-https://www.ncbi.nlm.nih.gov/books/NBK52941/

Reference books

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

E-resource

1. https://www.rentokil.com/vector-control/disease-vectors/
2. http://www.who.int/mediacentre/factsheets/fs387/en/
3. http://apps.who.int/iris/bitstream/10665/42498/1/WHO_CDS_CPE_SMT_2001.14.pdf
4. http://www.who.int/water_sanitation_health/resources/vector337to356.pdf
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3668993/

PUBLIC HEALTH AND HYGIENE

(Sub code:)

Semester: 1 NME: I Credits: 2 Hours: 30

Objectives: To create awareness about human health, communicable and non-communicable diseases and their management.

Expected outcome: To gain knowledge about human health and nutrition for leading a healthy life.

UNIT I: Health Concepts 6 Hours

Determinants of health; indicators of health; personal hygiene; public health and community health.

UNIT II: Nutrients 6 Hours

Macro nutrients – proteins, carbohydrates, and lipids; micronutrients and trace elements; vitamins; Energy requirements ; balanced diet ; malnutrition in children and adult.

UNIT III: Nutritional requirements 6 Hours

Nutitiona1 requirements of growing children, adults, pregnant women, lactating women and convalescents.

UNIT IV: Diseases and Treatment 6 Hours

Communicable diseases - viral and bacterial diseases (Polio, STD and Tuberculosis); Non communicable diseases - diabetics, heart diseases and kidney problems.

UNIT V: Environment and Health 6 Hours

Causation; symptoms; prevention and management of waterborne (Typhoid and Cholera) and airborne diseases (Tuberculosis).

Textbooks:

1. Sorna Raj .R & Kumerasen V. 2010. Public health and hygiene, Saras Publications.
2. Ambika Shanmugam (1999). Fundamentals of Biochemistry for Medical Students, Published by the Author, Chennai.
3. Shubhangini A. Joshi (1992) Nutrition and dietetics - Tata McGraw Hill, Publishing company Ltd. New Delhi.

Reference Books:

1. Srilakshmi, S. 1993. Dietetics - New Age International (P) ltd. Publishers (New Delhi.
2. Ananthanarayanan and Paniker, 2000. Text Book of Microbiology, Orient Longman, Chennai.

CHORDATA

(Sub Code: 18 UZO 21)

Semester: II **Core: 2** **Credits: 4** **Hours: 60**

Course Objective: To understand the basic classification, concepts of biodiversity and a descriptive account of the classes under Chordata.

Expected Outcome: Students will learn to identify chordates up to sub-class level, will be aware of their importance; impact of human activities and need for biodiversity conservation.

UNIT I: Prochordates and chordates **12 Hours**

Hemichordates and chordates - Classification and specific characteristics features, Distribution and hot spots, threatened and endangered species, key difference between hemi and chordates, evolutionary perspective and phylogenetic relationships; Brief accounts on Amphioxus, Balanoglossus and Ascidian

UNIT II: Pisces **12 Hours**

General characteristics and classification Pisces up to class; Brief accounts on Cyclostomes, Holocephali and Dipnoi.

General topics - Retrogressive metamorphosis in Ascidian, Respiration and Migration in fishes.

UNIT III: Amphibia and Reptilia **12 Hours**

General characters of Amphibia and Reptilia and classification up to orders

General topics: Paedomorphosis and Parental care in Amphibia (3 examples); South Indian Poisons snakes, snake bite and first aid.

UNIT IV: Aves **12 Hours**

General characteristics and classification of Aves with salient features up to sub-classes with examples. Type study: *Columba livia*.

General Topics: Origin of Birds, Flight adaptations and mechanism of flight.

UNIT V : Mammalia **12 Hours**

General characters and classification of mammals up to subclass with salient features and examples.

Type study: *Oryctolagus cuniculus*. Brief account on Monotremes and Marsupials

General topic: Aquatic mammals and Dentition in mammals.

Textbooks

1. Kohli, K.S. and Kavita Sahni. 2010. Animal Diversity and Evolution, Ramesh Book Depot, 65 Shivaji Nagar, Civil Lines, Jaipur.
2. Jordan. E.L. and Verma P.S. 2004. Chordate Zoology, S. Chand and Company Ltd., New Delhi.

Reference books

1. Ekambaranatha Iyer 1995. Manual of Zoology, Vol. II, S. Viswanathan Pvt. Ltd., Chennai.
2. Diana R. Kershan 1988. Animal Diversity, University Hyman, London.
3. Kumar, H.D. 1999. Biodiversity and sustainable conservation, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Thangamani *et al*. 2009. A textbook of Chordates, Saras Publication, Nagercoil.

E-Resources

1. https://www.earthlife.net/inverts/hemichordata.html
2. http://www.askiitians.com/biology/animal-kingdom/phylum-chordata-and-hemichordata.html#difference-between-lower-and-higher-chordates
3. http://www.biozoomer.com/2011/11/pisces-classification-super-class.html

ANIMAL BIODIVERSITY - II PRACTICAL

(Sub Code: 15 UZP 21)

Semester: II **Core: 2** **Credits: 1** **Hours: 30**

1. Mounting of Placoid Scales - Preserved specimens (Shark skin)
2. Diversity of Feathers.
3. Simple phylogenetic grouping of Animals
4. Virtual dissection -Frog –https://www.emindweb.com/demo/frog/
5. Activity card preparation – observation of birds and their behaviour
6. Key for identification of poisonous and non-poisonous snakes
7. Field Visit: Terrestrial ecosystem and a Sea shore.
8. Submission: Work sheets, Map of Hot spots of the world, pictures of endangered species.
9. Project related to Biodiversity and submission of report.
10. Spotters: Prochordates: Amphioxus, Balanoglossus, Ascidian; Pisces: Cyclostomata, Petromyzon, Myxine, Pisces, Scoliodon, Astrape, Anguilla, Echenis, Hippocampus, Sardine, Channa, Catfish, Diodon, Tetrodon; Amphibia: Ichthyophis, Salamandra, Ambystoma, Axolotyl larva, Rachoporus, Bufo; Reptilia: Hemidactylus, Draco, Chameleon, Cobra, Viper, Enhyrina, Echis, Dendrophis, Typlops, Chelon-sea turtle, Tertudo-sea tortoise, Crocodile; Aves: Blue jay, Netolopus, Indian spoonbill, great Indian hornbill, pelicanus, White breasted kingfisher, Braminikite, Parakeet, Patridge, Black drango, Quail; Mammals: Hedge hog, Loris, Mangoose, Pangolin, Chetopterus, Porcupine; Osteology of Rabbit- skull dorsal view, Lower Jaw, Lumbar vertebrae, Pectoral girdle, Pelvic girdle, Fore and Hind limb.

ORNAMENTAL FISH FARMING

Semester: NME : 2 Credits: 2 Hours : 30

Unit 1: Management of Aquarium 6 hours

Design and construction of glass aquarium and setting up of aquarium – under gravel filter, pebbles, plants, drift wood, ornamental objects and selection of fishes, accessories (aerators, light, filters) maintenance of water quality.

Unit 2: Identification of biology common ornamental fishes 6 hours

Identification, distribution and biology of common ornamental fishes - fighting fish, Gold fish, koicarp, Gourami, Angel fish, Red tailed black shark.

Unit 3: Breeding of common ornamental fishes 6 hours

Breeding technologies of common ornamental fishes - fighting fish, Gold fish, koicarp, Gourami, Angel fish, Red tailed black shark.

Unit4: Food and Feeding 6 hours

Culture of live feed organism (Zooplankton, Rotifers, Copepods, Cladocerans, Brine shrimp), Artificial feeds. Methods of fish feeding, balanced diets for aquarium fishes.

Unit 5: Disease management and Economics 6 hours

Identification of common parasites (argulus, lernaea, nematodes) and bacterial, viral, fungal diseases of ornamental fishes and their control and prophylaxis. Economics of ornamental fish culture.

Text Book:

1. Jameson, J.D. and Santhanam. R. 1996, Manual of ornamental fishes and farming, Technologies Peejay, Thoothukkudi.

Reference Books:

1. Rath, R.K. 2000. Freshwater Aquaculture. Scientific Publishers (India). PO Box: 91, Jodhpur.
2. Mohan Kumar, C. 2008. Handbook on ornamental fish diseases, MPEDA , India
3. Arumugam, N. 2010. Home Aquarium, Saras Publication.

VERMIBIOTECHNOLOGY

(Sub Code: _____)

Semester: II SBE: 3 Credits: 2 Hours: 2

Objective: To impart knowledge on the recent trends in vermi-technology, vermi-composting, agricultural and economic importance of earthworms.

Expected outcome: The students will gain basic knowledge and hands on experience on vermiculture and vermicomposting.

Unit I: Types, Collection and Preservation of earthworms 5 Hours

Types and basic characteristics of species suitable for vermicomposting; Roll of earth worms in soil fertility, Biology of *Lampito maruitti*; Collection and Preservation of Earthworms; Flow sheet for vermi technology.

Unit II: Culturing techniques of earthworms and composting materials 5 Hours

General method; Pot method; Wooden box method; Propagation; Factor affecting culturing of earthworm; Vermicomposting materials; Preliminary treatment of composting materials.

Unit III: Small scale techniques of Vermicomposting 5 Hours

Indoor dual bin method; Bed method; Pit method; Heap method; Expandable worm tower assembly method; Hanging basket method; Physical, chemical and biological properties of vermi-compost.

Unit IV: Large scale techniques of Vermicomposting 5 Hours

Outdoor dual bin; Raised cage; Dual pit; Commercial model; Trickling filter vermicomposting; Keep it simple and save (KISS) plan.

Unit V: Vermiwash and Economics 5 Hours

Chemical composition of vermiwash; Techniques of vermiwash production: Ecoscience Research Foundation Method, Karuna's method, Kale's method - Advantages of Vermicomposting; Prospects of vermi-culture as self employment venture.

Textbooks:

1. Somani, L.L. 2008. Vermicomposting and vermiwash. Agrotech Publishing Academy, Udaipur.
2. Talashilkar and Dosani, 2005. Earthworm in Agriculture. Agrobios (India), Jodhpur.

Reference Book:

1. Ranganathan, L.S. 2006. Vermibiotechnology from soil health to human health – Agrobios, India.

ANIMAL HUSBANDRY
(Sub. Code: 15USB41)

Semester: II SBE: 3 Credits: 2 Hours: 2

Objectives: To make aware of the graduates about the importance of animal husbandry for income generation and to create self employment venture.

Expected Outcome: Students gain basic knowledge on animal farming technology and also gained preventive and curative methods for various diseases

Unit 1: Dairy farming **5 Hours**
Breeds and types of cattle breeds; housing of dairy animals, dairy products; nutritive value of milk; Lactometer

Unit 2: Poultry farming **5 Hours**
Poultry houses; Management of checks, growers, and layers; Management of broilers and layers; Nutritional requirement for different stages of layers and broilers; common poultry diseases.

Unit 3: Goat and Sheep farming **5 Hours**
Breeds of Indian goats and sheep; Exotic breeds of goats and sheep; Nutrition requirements; Housing and management of lambs and kids; Common diseases and vaccination

Unit 4: Rabbit farming **5 Hours**
Types and breeds of rabbits; nutritional requirement; housing and farm management; care and rabbit management

Unit 5: Pig Farming **5 Hours**
Types of breeds of pigs; housing and maintenance of pigs, nutritional requirements; care during veining; common diseases and their management

Text Book:

1. Banerjee, G.C. 2010. Text book of animal husbandry, Oxford & IBH Publishing company Pvt. Ltd, New Delhi, India
2. Arumugam, N., Jeyasurya, Nair, N.C., Soundarapandian, N., THangamani, A., Narayanan, L.M., Leelavathi, S., Murugan, T., Prasanna Kumar, S., Johnson Rajeshwar, J. and Ram Prabu, R. 2013. Economic Zoology, Saras publication, Nagerkoil

Reference Book:

1. Sandeep Tomar 2011. Basic operations of Animal husbandry, Oxford Publishers, New Delhi.

E-resources

1. http://www.agrifarming.in/rabbit-farming/
2. http://www.sheepfarm.in/goat-sheep-farming-business-plan

CELL AND MOLECULAR BIOLOGY

(Sub Code: 18 UZO 31)

Semester: II **Core: 3** **Credits: 4** **Hours: 60**

Objective: To study the structural and functional aspects of cell organelles as well as mechanism of gene regulation and expression.

Expected outcome: The students are expected to know about the structural organization and functional aspects of cell organelles, basic understanding about the cell division, nucleic acids, their repairing mechanism, regulation and expression.

Unit I: Microscopy **12 Hours**

Principles and Applications of light, Phase contrast, Fluorescent and Electron Microscopes (Scanning Electron Microscope and transmission electron microscope); Micro-technique - Tissue fixation, sectioning and staining; Ultra structure organization of virus, bacteria and animal cell; Differences between Prokaryotic and Eukaryotic cells

Unit II: Cell organelles **12 Hours**

Ultrastructure and function Plasma membrane, membranous organelles (Endoplasmic reticulam, Golgicomplex, Mitochondria, Peroxisomes, Lysosomes,Transport Vesicles), non-membranous organelles (Ribosomes, Microtubules, Action Filaments, Intermediate Filaments, Centrioles)

Unit III: Nucleus and cell division **12 Hours**

Interphase nucleus - Nuclear envelope, Chromatin, Nucleolus, Nuclear matrix; The dividing nucleus – cell cycle, phases of mitosis and meiosis, Chromosome (morphology, banding, number, karyotyping), Cell death, cellular differentiation and proliferation.

Unit IV: Nucleic acids, DNA repair and Mutagenesis **12 Hours**

Salient features of DNA and RNA; Watson and Crick model of DNA, DNA forms; Mechanism of DNA replication; DNA Repair Mechanisms - Pyrimidine dimerization and mismatch repair; Modern concept of prokaryotic and eukaryotic genes; Mutation – types; mutagens, molecular basis.

Unit V: Gene expression and regulation **12 Hours**

Gene expression –transcription, **conversion of DNA to RNA, Post-transcriptional modifications, RNA transport, Translation, protein folding;** Gene Regulation - Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trp operon; Transcription regulation in eukaryotes - Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting

Textbooks:

1. Powar, C.B. 1977. Cell Biology, Himalayas Publishing House, Bombay.
2. Gupta, P.K. 1999. Cell and Molecular Biology, Rastogi Publications, Meerut, India.
3. Verma, P.S. and Agarwal, V.K. 1998. Concepts of Molecular Biology, S. Chand & Company, Ltd. New Delhi.

Reference Books:

1. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
2. Karp, Gerald 2012. Cell and molecular Biology, John wiley and sons Newyork
3. Prakash S. Lohar 2007. Cell and Molecular Biology, M.J.P. Publications, Chennai.
4. Freifelder, D. 1984. Essentials of Molecular Biology, Narosa Publishing House, New Delhi.
5. Sivarama Sastri, K.G. and Padbanaban and Subramanian 1994. Textbook of Molecular Biology. Mac Millan India Ltd. New Delhi.
6. Ajay Paul. 2011. Text book of cell and molecular Biology, Third Edition, Books of Allied (P) Ltd., Chintamani Das Lane, Kolkatta.
7. Jeyanthi, G.P. 2009. Molecular Biology, M.J.P. Publishers, Chennai.
8. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

E-resources

1. https://www.hccfl.edu/media/572066/microscopy.pdf
2. http://www.science-info.net/docs/AO-Spenser/GreysHandbook.pdf
3. http://www.microbiologynotes.com/differences-between-prokaryotic-and-eukaryotic-cells/
4. https://www.kenhub.com/en/library/anatomy/cellular-organelles
5. http://www.iupui.edu/~anatd502/lecture.f04/cell.f04/Nucleus.pdf
6. http://www.cuchd.in/e-library/resource_library/University%20Institutes%20of%20Sciences/Fundamentals%20of%20Biochemistry/Chap-15.pdf
7. http://bmg.fc.ul.pt/Disciplinas/FundBiolMolec/11aMutationRepair.pdf
8. https://www.news-medical.net/life-sciences/Gene-Expression-An-Overview.aspx

CELL AND MOLECULAR BIOLOGY – PRACTICAL

(Sub code: 15 UZP31)

Semester : II **Core : 3** **Credits : 1** **Hours: 30 (2)**

1. Study of compound microscope – Setting and handling procedures
2. Squash preparation of onion root tip for mitotic stages
3. Squash preparation of grasshopper testis for meiotic stages
4. Smear preparation of human blood for RBC/WBC
5. Differential count of WBC
6. Study of Polytene chromosomes from Chironomous / Drosophila larvae
7. Extraction, isolation and quantification of DNA (animal samples)
8. Smear preparation of squamous epithelium of human buccal cavity.
9. Separation and isolation of cells by sedimentation.
10. Separation of nucleic acids using AGE
11. Restriction enzyme digestion and separation of DNA fragments
12. Molecular weight determination of protein/peptides – using D-Gel software
13. Preparation of liquid culture medium (LB) and raise culture of *E. coli*

Spotter: Plasma membrane, Mitochondria, Ribosomes, Lysosomes, Endoplasmic reticulum, nucleus, Nucleolus, Golgi complex, Centrioles, Types of chromosomes, Ultra structure of chromosomes, Cell secretion, DNA double helix, Variants of double helical DNA, Protein synthesis, DNA- Replication, Structure of Lac operon, DNA repair, Types of Mutation

SERICULTURE

(Sub code: 15 USB 32)

Semester: III **SBE: 5** **Credits: 2** **Hours: 30**

Objectives: To make the students aware of the economic importance of silkworm for income generation and to create a self employment venture.

Expected outcome: Students will know about the sericulture/silk industry and will provide an opportunity to expose them to a cottage industry as well as an employment opportunity.

Unit I: Moriculture **6 Hours**

Different varieties of mulberry, planting materials, mulberry cultivation; Weeds of mulberry, insect pest and microbial diseases and their management

Unit II: Silkworm rearing **6 Hours**

Classification of silkworms, Life cycle of *Bombyx mori*, egg production technology, Silkworm rearing technology; spinning, harvesting and storage of cocoons

Unit III: Natural enemies and management 6 **Hours**

Natural enemies of silkworm (parasitoids and predators); Silkworm diseases (a brief account on viral, bacterial, fungal and protozoan diseases) and their management

Unit IV: Silk production **6 Hours**

Physical and commercial qualities of silk – silk reeling – reeling appliances – quality testing.

Unit V: Economics and marketing **6 Hours**

Prospects of sericulture in India; Economics of mulberry, mulberry and non-mulberry sericulture; Marketing - role of Central Silk Board, Future prospects.

Textbook

1. Ganga, S. G. and Sulochana Chetty, J. 2008. Introduction to sericulture (II Ed.), Oxford and IBH Publishing House, New Delhi.
2. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB, Bangalore

Reference Book:

1. David, B.V. and Ramamoorthy, V.V. 2011. Elements of economic entomology. NP Namrutha Publications, Chennai.
2. Sengupta, K. A. 1989. Guide for Bivoltine Sericulture; Director, CSR & TI, Mysore

R-Resources

1. **http://csb.gov.in/assets/Uploads/documents/note-on-sericulture-2016-17.pdf**
2. **http://csb.gov.in/publications/annual-report/**

APICULTURE

(SBE: _____)

Semester: **SBE: 5** **Credits: 2** **Hours: 30**

Objective: To enlighten the students about the honey bees, its life style, the social behavior, handling of equipments and colonization. The students may be benefitted by the culture practices and the economic importance.

Expected outcome: Students will know about the Apiculture and will provide an opportunity to expose them to a cottage industry as well as self employment opportunity.

Unit I: Honey bees **6 Hours**

Scope of Bee keeping, Present status of Apiculture in India and Tamil Nadu; Honeybee – Systematic position, Species of Honey bees, Morphology and Life history; Stinging apparatus and bee poisoning

Unit II: Bees and their behaviors **6 Hours**

Bee colony – Castes, natural colonies and their yield; Bee foraging - Pollen and nectar yielding plants; Honey bee – behaviour – swarming – Pheromones; Queen and its management

Unit III: **Apiary** **6 Hours**

Apiary Management – Artificial bee hives (eg: Newton's hive) – types – construction of space frames – Selection of sites – Handling – Maintenance – Instruments employed in Apiary.

Unit III: Economic importance **6Hours**

Honey extraction; Honey – Composition – Honey extraction, seasonal maintenance; Bee wax and its uses; National and International markets for Honey and Wax; Apiculture as Self employment venture.

Unit IV: Natural enemies and management **6 Hours**

Natural enemies – parasites and predators and their control; Diseases: viral, bacterial, fungal and protozoan diseases (two examples each) and their management.

Unit V: Economic importance **6 Hours**

Economic importance -honey; beewax, bee venom, pollination; Prospects of apiculture as self employment venture.

Text Books:

1. Johnson, J., and Jayachandra, I. 2005. Apiculture, Olympic Graphics, Marthandam.
2. Shukla, G. S. and Upathyay, V.B. 2000. Economic Zoology, Rastogi Publications, Meerut.
3. Abrol, D. P. 1997. Bees and Beekeeping in India. Kalyani Publishers, Ludhiana
4. Singh, S. Bee keeping in India, Indian Council of Agricultural Research, New Delhi.

Reference Books

1. Sharma, P. and Singh L. 1987. Hand book of bee Keeping, Controller Printing and Stationery, Chandigarh.
2. Stephen, R1998. Introduction to Bee Keeping, Vikas publishing house, New Delhi.
3. Nagaraja, N and Rajagopal, D. 2009. Honey bee diseases, Parasites, Pest, Predators and their Management. MJP publishers, Chennai.
4. David, B.V. 2003. Elements of economic Entomology, Popular Depot, Chennai.
5. Amsath, A. and Marimuthu Govindarajan, 2013. Apiculture. Lambert Academic Publishing.

E-resources

1. https://aabees.org/ebooks/Honey_bee_e_book.pdf
2. https://www.easternapiculture.org/addons/2013/Delaney/HoneyBeeBiologyIindividual.pdf
3. http://www.sembabees.org/pdfs/biologyhoneybee.pdf
4. http://www.fao.org/3/a-a0849e.pdf
5. http://lib.icimod.org/record/7676/files/attachment_301.pdf

ANIMAL STRUCTURE AND FUNCTION

(Subject Code: 188 UZOA 31)

Semester: III **Allied: Theory 1** **Credit: 4** **Hours: 60**

Objectives: To aim of the course is to provide basic and advanced knowledge of animals as taxonomy, morphology and physiology and also the functional organization of animals.

Expected outcome: After the course, the students should be able to identify common animals and gain an insight on the organ systems that make up a human body.

Unit I: Invertebrata **12 Hours**

Salient features of invertebrates, classification up to phyla with diagnostic features and examples. Type study: Cockroach

Unit II: Chordata **12 Hours**

Classification up to classes of Vertebrata with diagnostic features and examples.

Type study: Frog – External morphology, digestion, respiration and circulation, reproductive systems

Unit III: Digestion, Respiration and Excretion of human **12 Hours**

Digestion – morphology of alimentary canal, Physiology of digestion and absorption; Respiration – morphology of lungs, respiratory pigments, transport of oxygen and carbon dioxide, respiratory quotient; Excretion - structure of kidney and nephron, mechanism of urine formation.

Unit IV: Circulation, Nervous system and Receptors of human **12 Hours**

Circulation – heart morphology, composition and functions of human blood, cardiac cycle, blood pressure; Nervous system - structure of neuron, nerve impulse conduction, reflex action; Receptors - Structure of eye and physiology of vision.

Unit V: Endocrine Glands and Reproductive System **12 Hours**

Structure and hormones of endocrine glands - Pituitary, thyroid, adrenal, islets of Langerhans; Human reproductive system, female reproductive cycle, contra captives

Text books:

1. Jordan EL., Verma PS. 2012. Invertebrate Zoology, Chand and Company.
2. Verma, Tyagi, Agarwal, 1997. Animal Physiology, Chand and Company.
3. Ayyar, E. 2009. A manual of Zoology, Volume 11, S. Visvanathan P Ltd., Chennai.

Reference books:

1. Ekambaranatha Ayyar M., Ananthakrishnan TN. 1995. A Manual of Zoology, Vol. I (Invertebrata) Part I & II. Viswanathan Pvt. Ltd.
2. Kotpal RL., 2000. Invertebrates. Rastogi Publications.
3. Rastogi SC. 2001. Essentials of Animal Physiology. New Age International Publications.

ANIMAL STRUCTURE AND FUNCTION - PRACTICALS

(Subject Code: 18 UZPA 31)

Semester: III **Allied: 1** **Credit: 1** **Hours: 30**

1. Virtual dissection of cockroach (Digestive system, Nervous system and Reproductive system).
2. Mounting of Cockroach, mosquito, houseful mouthparts
3. Mounting of prawn appendages
4. Collection, isolation of soil nematodes
5. Virtual dissection of frog (Digestive system, Nervous system and Reproductive system).
6. Rabbit osteology – Skull, lower jaw, pectoral girdle, pelvic girdle, forelimb, hindlimb.
7. Effect of temperature on salivary amylase activity.
8. Qualitative estimation of excretory products.
9. Observation of cellular constituents of human blood.
10. Quantitative Estimation of haemoglobin using haemoglobin meter.
11. Demonstration of blood pressure.
12. Study of following slides: *Paramecium, Leucosolenia*
13. Study of following preserved specimens: *Hydra, Taenia solium, Ascaris, Megascolex, Palaemon, Pila globosa, Asterias, Amphioxus, Balanoglossus, Ascidian, Anguilla, Rhacophorous, Chamaeleon, Naja naja*, Pelican, Parrot, Rabbit, Bat, *Manis* (pangolin),
14. Study of following Models: Human – digestive system, lungs, kidney, nephron, heart, neuron, eye, thyroid.

BIOSTATISTICS AND COMPUTER APPLICATION

(Sub code: 18 UZO 41)

Semester: IV **Core: 4** **Credits: 4** **Hours: 60**

Objective: To understand the basic biostatistical methods and use of computer application to solve the common and scientific problems in science.

Expected outcome: Students learn and familiarize how to collect, categories, present and analyze the data with various statistical and computer tools.

Unit I: Data–collection, categorization and presentation **12 Hours**

Primary and secondary data collection; Sampling-methods, merits and demerits, sampling error; Categorization - ungrouped and grouped data with continuous and discontinuous series; Presentation – Tabulation and Diagrammatic presentation –line, bar diagram, pie diagram, histogram, Ogive and Dot diagram.

Unit II: Measures of central tendency and significance: **12 Hours**

Mean, median, mode, standard deviation and standard error; Kinds and measures of skewness, measures of kurtosis; Chi-square test, Student's'*t*' test; simple correlation; linear regression and regression line; One way ANOVA.

Unit III: MS-word (2009) **12 Hours**

MS-word- home, insert, page layout, references, mailing, review and view menus; Creating, editing, formatting and aligning new word document; Numbering and bullets, Spelling and grammar check; saving and printing; Creating and formatting table; Inserting pictures; Review a word file

Unit IV: MS-Excel (2007) **12 Hours**

Specific menu and tool bars; Creating and formatting table; Chart wizards –creation and formatting charts; Functions–significance tests (*t*, Z, F), Correlation, regression, chi-square analyses, distribution (poison, skewness), probability.

Unit V: MS-Power Point **12 Hours**

Specific Menus and tools; Preparation, formatting and slide show; Inserting pictures, charts, photographs and tables; Organization chart; Design template, Animation – schemes and customs; Preparation of power point show of any one animal (taxonomy, anatomy, systems, adaptations).

Textbooks:

1. Ramakrishnan, P. 1995. Biostatistics, Saras Publication, Nagercoil.
2. Gurumani N. 2005. An introduction to Biostatistics, Tamil Nadu Book House, Chennai.
3. Sanjay Saxena 2006. M.S. Office 2000 for every one, Rrevised edition IV, Vikas Publication Pvt. Ltd, New Delhi.

Reference book:

1. Zar 2003. Biostatistical analysis (IV Ed.), Pearson Education, Singapore.
2. Pradad, S. 2001. Elements of biostatistics. Rostrogi Publication, Meerut, India.
3. Annadurai, B. 2007. A Text Book of Biostatistics, 1st Edition
4. Bittu Kumar. 2013. Microsoft Office 2010. V & S Publishers; Latest Revised Edition, pp.208.

E-resources

1. http://www.nios.ac.in/media/documents/316courseE/E-JHA-31-10A.pdf
2. http://dspace.vpmthane.org:8080/jspui/bitstream/123456789/2836/1/Measures%20of%20Central%20Tendency.pdf
3. http://www.indiana.edu/~ensiweb/lessons/oat.stat.signif.pdf
4. http://www.nysl.nysed.gov/libdev/nybbexpress/curriculum/poklib/word102.pdf
5. https://www.tutorialspoint.com/excel/excel_tutorial.pdf
6. https://www.computer-pdf.com/office/powerpoint/

BIOSTATISTICS AND COMPUTER APPLICATION - PRACTICAL

(Sub code: 18 UZP 41)

Semester: IV **Core Practical : 4** **Credit: 1** **Hours: 30 (2)**

1. Formatting a document (number and bullets, alignment, spelling and grammar), saving, renaming and printing a document
2. Table creation and formatting (spilt cell, merge cell, addition and deletion of columns, rows and cells)
3. Preparation mails using Mail merge option
4. Arrangement of references in chronology and also with alphabets using A to Z option
5. Creation of a formula (Statistical, Arithmetic functions)
6. MS Excel – Functions (student *t* test, Z and F tests)
7. Using biological data find out regression slope and correlation coefficient
8. Chart creation – Column or Bar, Error bar, Pie diagram and Line diagram
9. Power point slide preparation – texts, tables, bullets and numbers, charts, clipart, word art and pictures with animations
10. Email and internet usage

AQUACULTURE

(Sub code: 18UZOE 41)

Semester: IV **Elective: 1** **Credits: 4** **Hours: 4**

Objective: To objective of this paper is to introduce and also to familiarize the basic and aspects of culture practices of both fin fish and shell fishes, feeding and breeding techniques. And this paper also to provide disease management of fin and shell fishes.

Expected outcome: Students will acquire knowledge on Aquaculture, cultivable fish species, fish breeding and rearing technologies and will help them to pursue higher studies and research and job opportunities in aquaculture.

Unit I: Pond construction and management **12 Hours**

Aquaculture-Global scenario, Present status in India and Tamil Nadu; Fish pond construction- site selection; types of ponds, water quality analyses, liming and fertilization, morphology and commercial characteristics of cultivable fishes, culture practice, predator and weed control

Unit II: Fin fish culture **12 Hours**

Composite fish culture (Indian Major Carps and Murrels); sewage fed fish culture and integrated fish culture.

Unit III: Shellfish and seaweed culture **12 Hours**

Culture of marine prawns, edible and pearl oysters, adaptive management; Seaweeds- types and their culture practices

Unit IV: Feeding and breeding techniques **12 Hours**

Live feed organisms – Artemia and rotifers culture; Fish feed - types, formulation and preparation, techniques, Consequences of artificial feeding; Natural and artificial breeding; Breeding – Bundh breeding and induced breeding; rearing of hatchlings, fry and fingerlings.

Unit V: Applied aquaculture **12 Hours**

Identification of cultivable fish species; Morphometry of pond (Enclosed rectangular method/Shore length/ shore area and shore line development); Demonstration of breeding technologies - natural seed production, artificial fertilization and induced breeding (hypophysation).

Textbooks:

1. Rath, A.K. 2011. Freshwater Aquaculture, Third Edition, Scientific Publishers, Jodhpur, India.
2. Santhanam, R. 1990. Fisheries Science, Daya Publishing House, New Delhi.

Reference Books:

1. Ninawe, A. S and Khadkar, G. D. 2009. Nutrition in Aquaculture, First Edition, Narendra publishing House, New Delhi.
2. Biswas, K. P. 2000. Prevention and control of fish and prawn diseases. Narendra publishing house, New Delhi.
3. Arumugam, M. 2008. Aquaculture, Saras Publications, Nagarkoil.
4. Jhingran, V.G. 1997. Fish and Fisheries of India. Hindustan Publishers, New Delhi.

E-resources

1. **http://agritech.tnau.ac.in/fishery/fish_freshwaterprawn.html**
2. **http://www.fao.org/3/contents/6c2f5977-bc3e-528e-b90f-ee63c7605e27/AC417E00.htm**
3. **http://nacogdoches.agrilife.org/files/2011/06/feeding_fish_7.pdf**

FISHERY BIOLOGY

(Sub code: 18UZOE 41)

Semester: IV **Elective: 1 (optional)** **Credits: 4** **Hours: 60**

Objective: To introduce and to familiarize the basic aspects of Indian fisheries, Fisheries techniques and classification of fishes.

Expected outcome: Students will acquire knowledge about fishery resources, commercial value of fishes, fish processing technologies and marketing and will help them to pursue related research avenues and job opportunities.

Unit I: Classification of fish **12 Hours**

General characters of fishes, classification up to sub-classes; Salient features with special reference to Placoderms, Chondrichthyes, Holocephali, Elasmobranchii, Osteichthyes and Dipnoi with examples.

Unit II: Common edible fishes of Tamil Nadu **10 Hours**

Freshwater fishes: Indian Major Carps - Catla, Rohu, Mrigal; Catfishes -*Heteropneustus fossillis*, *Clarius batrachus*, *Mystus gulio*; Murrels – *Channa striatus*, *Channa marulius*, *Channa punctatus*; Tilapia; Brackish water fishes - *Chanos chanos*, Grey mullets and *Etroplus suratensis*, Marine fishes - Bony fishes- Pomfrets, Indian Mackerel, Seer fish, Carangids, Ribbon fish, Flat fishes and sardines; Shell fishes - Prawns, Oyster and Mussels.

Unit III: Adaptation in fishes **12 Hours**

Fin types and function; Scales of fishes - Placoid, cycloid, ctenoid; Accessory respiratory organs - Buccopharyngeal epithelium, Integument, external gills, Labyrinthiform organs, Opercular lungs, Air bladder/ swim bladder, A special part of alimentary canal

Unit IV: Indian fishery **12 Hours**

Types and status - Prospects, Capture and culture fishery; Inland, estuarine, coastal, marine fishery. Crafts and gears: Types of crafts - canoes, Kattumaram, Vallam, Vanchi, Fibre boats, Trawlers and line vessels; Gears - Gill nets, cast nets, Trap nets, purse net gumcha), lift nets, Seine nets, Trawl nets and Dredges, and line fishing.

Unit V: Fish processing and marketing **12 Hours**

Principles of fish processing; Methods of preservation - curing, drying, wet curing, smoking, Icing, freezing, deep freezing, freeze drying, canning; Economic importance of fishes, their products and by-products' and marketing.

Textbooks:

1. Rath, A.K. 2011. Freshwater Aquaculture, Third Edition, Scientific Publishers, Jodhpur, India.
2. Santhanam, R. 1990. Fisheries Science, Daya Publishing House, New Delhi.
3. Arumugam, M. 2012. Aquaculture and Fisheries, Saras Publications, Nagarkoil

Reference Books:

1. Ninawe, A. S and Khadkar, G. D. 2009. Nutrition in Aquaculture (I Ed.) Narendra publishing house, New Delhi.
2. Jhingran, V.G. 1997. Fish and Fisheries of India. Hindustan Publishers, New Delhi.

E-resources

1. http://fisheries.tamu.edu/files/2013/09/Fins-and-Scales-%E2%80%93-A-Project-for-4-H-Members.pdf
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=88437
3. http://www.ciba.res.in/Books/ciba0076.pdf
4. http://nptel.ac.in/courses/120108002/module5/lecture9.pdf
5. http://www.ncap.res.in/upload_files/others/oth_2.pdf

IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY

(Sub code: 15UZOA41)

Semester: IV Allied : Theory 2 Credits: 4 Hours: 60

Objective: To know about the fundamental aspects of the immune system, antigen antibody reaction as well as techniques involved in animal cell culture and gene manipulation.

Expected outcome: The students will learn the principles and applications of immunology and animal biotechnology.

Unit I: Immune system **12 Hrs**

Concepts, components and principles of innate and adaptive immune systems; Haematopoiesis; Cells of immune system - B cells, T cells and macrophages; Primary and secondary lymphoid organs.

Unit II: Antigen and Antibodies **12 Hrs**

Antigens – properties, types and determinants; Antibodies – classes, structure, mechanism of action, functions: Monoclonal and polyclonal antibodies; ELISA and RIA techniques and their applications

Unit III: Immuno-prophylaxis, Hypersensitivity and Autoimmunity **12 Hrs**

Vaccines – definite, types, mechanism of action, immunization schedule; Hypersensitivity - Definition, types, treatment of type I anaphylactic hypersensitivity; Autoimmunity – classification, disorders and therapy

Unit IV: Animal cells culture **12 Hrs**

Characteristic features of animal cells in growth; Requirement - culture media, Equipments; Isolation of animal tissue- physical and chemical methods; Establishment of cell culture - primary, secondary cell culture and cell lines; Organ and embryo culture.

Unit V: Technique of gene manipulation in animals **12 Hrs**

Strategies of r-DNA technology; DNA finger printing ;Gene transfer methods; Cloning methods-Dolly; Transgenic animals; causes of infertility in male and female *; in vitro* fertilization (IVF) and embryo transfer.

Text Books:

1. Chakravarthy, Ashik, K. 1996. Immunology – Tata Mc Graw-Hill Publishing Company Ltd., New Delhi.
2. Purohit, S. S. 2000. Biotechnology Fundamentals and Applications, Agrobios, Jodhpur, India
3. Roitt I.M. 2000. Essential Immunology. Blackwell Scientific Publishers, London.

Reference Books:

1. Kuby, J. 1999. Immunology W.H. Freeman and Company, New York.
2. Roitt, Brostoff and Male, 1993. Immnunology, Mosby, London.
3. Gupta, P. K. 1999. Elements in biotechnology, Rastogi Publication, Meerut, India.

E-resources

1. https://microbiologyinfo.com/antigen-properties-types-and-determinants-of-antigenicity/
2. http://www.kean.edu/~jfasick/docs/Fall%2009%20&%20SP10%20%20A&PII/Chapter%2021b.pdf
3. http://jeeves.mmg.uci.edu/immunology/CoreNotes/Chap04.pdf
4. http://cdrwww.who.int/immunization/documents/Elsevier_Vaccine_immunology.pdf
5. http://www.lab.anhb.uwa.edu.au/hb313/main_pages/timetable/lectures/2007%20Tissue%20Culture%20Lecture%202%20combinedBjanka.pdf

IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY - PRACTICAL

(Sub. Code: 15 UZPA 41)

Semester: IV **Allied: 4** **Credit: 1** **Hours: 2**

1. Blood grouping and Rh factor.
2. WBC count in human blood
3. Double diffusion
4. Radial immuno diffusion.
5. Separating lymphocytes.
6. Haemagglutination test.
7. Cell viability test
8. Blood coagulation/ Clotting time
9. Tissue culture media preparation – solid and liquid
10. Spotters: Immunoglobulins, Thymus,bone marrow, Lymphnode, Macrophage, Spleen, Bursa of fabricious, Antigen and antibody reaction ,Engineered vaccine, Transgenic mice, Animal cloning – Dolly, Monoclonal antibodies, Cell growth curve, Embryo culture- *invitro* fertilization

WILDLIFE AND NATURE WATCH

(Sub code:)

Semester: IV **SBE: 6 (other students)** **Credits: 2** **Hours: 30**

Objective: To expand and enhance knowledge of the underlying conceptual and theoretical framework required by conservation biologist.

Expected outcome: You will recognize and demonstrate an understanding of conservation issues along a spectrum ranging from individual animals to populations, reintroductions, habitat restoration and anthropogenic sources of conflict. To live with nature and develop a productive hobby. To understand the value and limitations of applying biological principles and disciplines to real-world conservation.

Unit I: Wildlife in India **6 Hours**

Definition, WWF India, Brief account of National Parks, Biosphere Reserve, World Network of Biosphere Reserves, Wild life sanctuaries, Tiger Reserves and project Tiger; National symbols (animals)

Unit II: Tools and Techniques **6 Hours**

Tools - Trial and digital cameras, Track plates, GPS Units, Binoculars, Wildlife Callers; Techniques – count, tracking, capturing-marking-recapture, genetic sample collection, census, radio-telemetry, Pugmarks, traps, radio-telemetry.

Unit III: Wildlife Biology and Conservation **6 Hours**

Biology of selected wild animals of Western Ghats; Snakes of India - identification of poisonous and non poisonous snakes, first aid for snake bite; Wildlife conservation – principles, needs and efforts in India.

Unit IV: Bird Watching **6 Hours**

Birds of Tirunelveli district, Morphology of birds, Bird behavior, Silhouette: Shape, Size, Bird flight.

Unit V: Eco-Ethics **6 Hours**

Wildlife tours - Dress code, Behavior code, Do's and Dont's, Zoo behaviour; Eco-living, Man-wildlife conflicts, Man-eaters.

Reference Books:

1. Prater, 1974. The Books of Indian Mammals, Oxford University Publication, New Delhi
2. Salim Ali, 1996. Birds of Indian Subcontinent, Bombay Natural History Society publication, Bombay.
3. Richard Grimmet, 2007. Princeton field guide Birds of India,
4. Romulus Whitaker 2004. Common Indian Snakes, Oxford University Publication, New Delhi
5. Jim Corbett, (2001). Man-eaters of Kumaon, Oxford India Publications, Chennai.
6. Jim Corbett, 2001. Man eating leopard of Rudraprayag. Oxford India Publications, Chennai.

E-resources

1. www.wii.gov.in
2. www.wwfindia.org
3. www.bnhs.org
4. www.indianjungles.com
5. www.sanctuaryasia.com
6. www.cranes.org

Aquarium Fish Keeping

(Sub code:)

Semester: IV SBE: 6 (other students) Credits: 2 Hours: 30

Objective: Introducing the concept of fish keeping in home.

Expected outcome: Students will learn about the aquarium fishers, their breeding techniques and maintenance.

Unit 1: Introduction and aquarium **6 Hours**

Scope and utility value of aquarium fish industry; Different varieties of exotic and indigenous fishes; Aquarium – Design and construction, aquarium accessories.

Unit 2 Biology of aquarium fishes **6 Hours**

Common characters, sexual dimorphism and biology of aquarium fishes (Guppy, molly, sword tail, fighting fish, Gold fish, angel fish, blue morph, anemone fish, butterfly fish)

Unit 3 : Food and Feeding **6 Hours**

Live fish feed organisms - Daphnia, Rotifers, Copepods, Cladocerans, Brine shrimp, Blood worm, Tubifex; Artificial feed - ingredients, formulation, preparation of pellets, feeding schedules; commercial fish feeds.

Unit 4: Fish Breeding and rearing of Egg layers **6 Hours**

Fish Breeding- Gold fish, Angel fish, Zebra fish and Neon tetra; Hatchery and Nursery management system for egg layers; Live fish packing and forwarding techniques

Unit 5: Maintenance and Management Aspects **6 Hours**

General aspects of aquarium maintenance; Ornamental Fish-diseases and their management; Aquarium plants – selected, propagation and Management; Water quality management

Text Books:

2. Jameson, J.D. and Santhanam. R. 1996. Manual of ornamental fishes and farming, Technologies Peejay, Thoothukkudi.
2. Arumugam, N. 2010. Home Aquarium, Saras Publication

Reference Books:

4. Rath, R.K. 2000. Freshwater Aquaculture. Scientific Publishers (India). PO Box: 91, Jodhpur.
5. Mohan Kumar. C. 2008. Handbook on ornamental fish diseases, MPEDA , India
6. Arumugam, N. 2010. Home Aquarium, Saras Publication
7. Jayashree, K.V., Thara Devi, C.S., Arumugam, N. Home aquarium and ornamental fish culture, Saras Publication

Web resources

1. www.mpeda.com www.cifa.in/
2. www.fao.org › FAO Home › Fisheries & Aquaculture
3. www.ofish.org www.nabard.org/english/fish_ornamental_fish.aspx

BIOCHEMISTRY (INTER DISCIPLINARY)

Offered by Department of Chemistry and Zoology

(Sub code: 15UZO 51)

Semester: V Core: 5 Credits: 4 Hours: 4

Objective: To inculcate the basic knowledge on the biochemical aspects of animals.

Expected outcome: The students will acquire knowledge about the biomolecules.

Unit I: Biophysical chemistry 12 Hours

Acid-base concepts, concepts of pH, factors affecting pH, pH scale, ionic product of water, buffers, Hasselbalch equation, buffer capacity, Titration curves of strong and weak acid base combinations, role of pH in biological systems and biologically important buffers. Introduction to carbon chemistry; catenation; classification of organic compounds; compounds with mono and poly functional groups; simple qualitative tests for functional groups.

Unit II: Biophysical aspects 12 Hours

Concepts of activity and activity coefficient, common ion effect, electrical double layers, Helmhotlz, Perin model, electro osmosis, electrophoresis, zeta potential, Donan's Membrane equilibrium, ionic motion, viscosity, surface tensions and surfactants. Isomersism - types with examples; chirality

Unit III: Carbohydrates **and Lipids 12 Hours**

Carbohydrates: chemical nature, properties, classification; Monsosaccharides – Eg. Glucose; Oligosaccharides and Polysaccharides; Metabolism – Glycolysis, Kreb's cycle, Lipids: chemical nature, properties, classification and fatty acids, metabolism – β oxidation, biosynthesis of saturated fatty acids – palmitic acid.

Unit IV: Amino acids and Proteins 12 Hours

Amino acids: structure, properties, classification, transamintion, deamination and biosynthesis of urea.

Protein: biological importance, properties, classification, structural organization – primary (peptide bond), secondary (α and β), tertiary (myoglobin) and quaternary (haemoglobin) structure.

Unit V: Nucleic acids, Enzymes and Vitamins 12 Hours

Nitrogen bases, nucleosides, nucleotides, chemistry of DNA, variants of DNA, and types of RNA; Enzymes -Classification, mechanism of action; Vitamins: Types, sources, structure, deficiency manifestation.

Textbooks:

1. Satyanarayana and Chakrapani 2008. Essential of biochemistry, Books and allied (P) Ltd, Kolkata.
2. Ambikashanmugam, 1999. Fundamentals of biochemistry for medical students, Arthur's Publication, Chennai.
3. Rastogi, S.C. 1998. Biochemistry, Tata McGraw Hill Publishing Company Ltd, New Delhi.
4. Agarwal, G.R. 1995. Textbook of biochemistry, Goel Publishing House, U.P., India

Reference Book:

1. Lehningar, A. 1993. Principles of biochemistry, CBC Publishers and distributors, New Delhi.
2. Jain, J. L. 2003. Fundamentals of biochemistry, S. Chand and Co. Ltd. New Delhi.
3. Murray, Granner, Mayes and Rodwell, (1996). Harper's review of biochemistry, Apleton of Large, Connecticut.
4. Creighton, Thomas, E. 1993. Protein structure and molecular properties, W.H. Freeman and Company, New York.
5. Black Stock, J.C. 2008. Biochemistry, Viva Books Pvt. Ltd., New Delhi.
6. Campbell, Farrell. 2008. Biochemistry, Baba Barkha Nath Printers, India.
7. Jain, 2004. Fundamental of biochemistry, S. Chand publication. New delhi.

ECOLOGY

(Sub Code: 18 UZ 052)

Semester: V **Core:** **Credits: 5** **Hours: 75**

Objective: Ecology and Environmental Biology course provides the students with a basic and advanced scientific knowledge relevant to addressing current environmental issues. In particular, you will possess theoretical knowledge required for ecological work such as environmental and pollution monitoring, and nature conservation and management.

Outcome: Students will learn about the distribution of animals in terrestrial and aquatic ecosystems and their interaction with abiotic factors. They also learn about the technology advancement and their implication and to address current environmental issues**.**

Unit I: Principles of Ecology **Hours: 15**

Definition, Scope, Branches, Biosphere, Biotic and abiotic factors and their roles, Ecosystem-concept, components, types, food chain, food web, Trophic level, ecological pyramid, energy flow; Strategic species concepts- Keystone species, Indicator species, Umbrella and flagship species

Unit II: Population and community **Hours: 15**

Population Ecology–Definition, Density, growth, Estimation, Natality, Mortality and Age distribution; Community characteristics, structure and stratification, ecological niche, ecotone and edge effect; Animal relationship -Symbiosis, Commensalisms, Mutualism, Antagonism, Antibiosis, Parasitism, Predation, Competition; Ecological Succession

Unit III: Biogeochemical cycles **and habitat ecology** **Hours: 15**

Biogeochemical cycles - Carbon, Oxygen, Nitrogen, Phosphorous, sulphur; Habitat Ecology - Fresh water, Marine Water, Estuarine, Terrestrial habitat; Manmade ecosystems; Niche concepts

Unit IV: Conservation and Natural resources **Hours: 15**

Biodiversity - Concept, types and components; value, loss and action; Global biodiversity hotspots; IUCN species categories – rare, endangered and threatened; Causes of Animal extinction; Remote sensing techniques for Conservation; Wildlife Sanctuaries in Tamil Nadu; Natural resources management - renewable and non-renewable; Biodiversity conservation – *in situ* and *ex situ*

Unit V: Pollution and control **Hours: 15**

Sources and causes, effects (human, environment), prevention and control of Air, noise, water, soil, thermal and radiation pollution; Pollution control devices; Biomagnifications; Bioindicators and their role in environmental monitoring; Pollution control acts and regulations of India.

Textbooks:

1. Verma, P.S. and Agarwal, V.K. 2015. Environmental Biology (Principles of Ecology), Chand & Company, Ltd., New Delhi.
2. Veer Bala Rastogi. 2001. Organic Evolution, Kedar Nath Ram Naths, Delhi.
3. Mohan P. Arora. 2001. Ecology, Fourth Edition, Himalaya publishing house, New Delhi.

Reference Books:

1. Odum, E.P. 1971. Fundamentals of Ecology, W.B. Saunder's Co. Philadelphia.
2. Sharma P.D. 1991 Ecology and Environment. 6th Ed. Restogi Publication. Meerut
3. Saha, T.K. 2013. Ecology and Environmental Biology, Fifth Edition, Books and Allied (P) Ltd., Kolkata, PP.628.

E-resources

1. https://www.gov.mb.ca/waterstewardship/fisheries_education_sustain_dev/education/outcomePages/grade10/pdf/cycle.pdf
2. https://en.wikipedia.org/wiki/Conservation_biology
3. http://download.nos.org/333courseE/10.pdf
4. http://bio1510.biology.gatech.edu/module-2-ecology/population-ecology/
5. https://www.cbd.int/2010/biodiversity/#tab=2
6. http://tamilelibrary.org/teli/wildlife1.html
7. http://www.biologydiscussion.com/ecology/top-4-types-of-habitat-ecology/59797
8. https://en.wikipedia.org/wiki/Pollution

DEVELOPMENTAL BIOLOGY

(Sub code: 15 UZO53)

Semester: V **Core: 7** **Credits: 4** **Hours: 60**

Objective: To understand the development and functioning of various organs as well as to know about the concepts, trends and patterns of animal development.

Expected outcome: Students are expected to understand the fundamentals of animal development and their evolutionary significance.

UNIT I: Gametogenesis and Fertilization **12 Hours**

Frog and chick -Primordial germ cells, structure of ovary and testis ; Spermatogenesis and oogenesis- ovulation; Types of eggs; Fertilization - external and internal, physiological and chemical changes, post fertilization changes; Parthenogenesis (General account).

UNIT II: Cleavage, Fate Map and Gastrulation **12 Hours**

Cleavage rules - patterns of cleavage; Cleavage in Frog; Fate map and gastrulation; morphogenetic movements.

UNIT III: Organizer and Organogenesis **12 Hours**

Types of embryonic induction - structure, mechanism and theories of induction; organizer concept; organogenesis - brain, eye, heart and kidney in frog; development of metanephros in chick.

UNIT IV: Extraembryonic Membranes and Placenta **12 Hours**

Egg membranes; Development and factors involved in the formation of amnion, chorion, allantois and yolksac - their function; Formation of extraembryonic membranes in humans; Origin, types and functions of placenta

UNIT V: Metamorphosis and Regeneration **12 Hours**

Metamorphosis in Frog – physical and chemical changes, causation of metamorphosis; abnormal development; Regeneration - Aging and senescence - metamorphosis in Frog - Cancerous growth; Infertility in male and female; Modern contraceptive technology.

Textbooks:

1. Verma P.S. and Agarwal V.K. (1996). Chordate Embryology, Chand & Co. New Delhi.
2. Jain, P.C. (1994). Developmental Biology, Vishal Publications, Jalandhar.

Reference Books:

1. Balinsky, RJ. 1981. An Introduction to Embryology, CBS College Publishing, Holt, Rinehart and Winston.

GENETICS AND ANIMAL BIOTECHNOLOGY

(Sub. code: 15 UZO53)

Semester: V **Core: 8** **Credits: 4** **Hours: 4**

Objective: To introduce and familiarize the basic aspects of genetics and to inculcate the knowledge of biotechnological tools and their application.

Expected outcome: Students are expected to gain knowledge about the principle of genetics and applications of biotechnology.

UNIT- I Mendelism and its deviations **12 hours**

Mendel's law – Law of segregation and law of independent assortment, test cross and backcross, Allelic interaction- Incomplete dominance, Codominance, Deviations - Complementary genes, Lethal genes, Reversion, Epistasis, Mutiple factor inheritance - ABO blood groups, Rh factor; Polygenetic inheritance – skin colour.

UNIT – II Linkage, crossing over and sex linked inheritance **12 hours**

Linkage and crossing over, linkage map; Sex determination in man and Drosophila; Gynandromorphism (eg: Bonellia); sex linked inheritance in man and drosophila; non-disjunction, holandric genes, sex influenced and sex limited genes; Extra chromosomal inheritance- maternal inheritance.

UNIT – III Human genetics and chromosomal alterations **12 hours**

Pedigree analysis, Human chromosomes and karyotypes; Anomalies of chromosomes – Edward, Down's, Klinefelter's, Turner's and Turner syndromes, sickle cell anaemia; Inborn errors of metabolism - alkaptonuria, phenylketonuria; Chromosomal alterations - deletion, duplication, inversion, translocation; Eugenic, euthenics and euphenics

UNIT – IV Genetic engineering **12 hours**

Recombinant methods-construction of recombination DNA, Introduction of recombinant DNA into host cells, Selection and multiplication of recombinant host cells, expression of cloned gene- bacterial, animal and plant vectors; DNA sequencing, cDNA libraries; Methods of gene amplification- PCR.

UNIT – V Applications **12 hours**

Monoclonal antibodies, DNA finger printing, insulin, drugs, somatotropin production, Cloning method-Dolly; transgenic animals and their applications; Gene therapy and immunotoxins

Text books:

1. Verma, P.S and Agarwal,V.K. 1998. Concepts of Genetics, Human Genetics and Eugenics. S.Chand & Company Ltd, Ram Nagar, New Delhi.
2. Alice Marcus. 2009. Genetics, MJP publishers
3. Dubey, R.C. 2001. A text book of biotechnology, S. Chand & Company, Ramnagar, New Delhi.
4. Sambamurthy, A.V.S.S. 2010. Genetics, Narosa Publication, New Delhi
5. N. Arumugam, LM. Narayanan, A. Mani A.M. Selvaraj, P. Singh, 2013. Genetic engineering, Saras publications

Reference books:

1. Gardner, Simmons and Snusted 2006. Principles of Genetics, JohnWiley & Sons, INC, New York.
2. Tamarin, R.H. 2010. Principles of genetics, Tata McGraw Hill Publishing company, New Delhi.
3. Lewine Benjamin 2007. Gene XII, Pearson Education International, New Jersey.
4. Satyanarayana, U. 2008. Biotechnology, Book and allied Ltd.
5. Das, H.K. 2006. Text book of biotechnology

BIO-INFORMATICS

(Subject code :)

Semester: V **Elective:2** **Credits : 5** **Hours: 4**

Objective: The aim of the paper is to provide an understanding of key modern molecular technologies, their exploitation, and application, and the bioinformatics analyses involved.

Expected outcome: To access, use and evaluate the information available in protein databases to find out about a protein of interest. To understand the developments in DNA sequencing technologies; bioinformatic analyses of DNA. To describe the main principles behind, and carry out, sequence similarity searches and sequence alignments. To predict structure of proteins by computational methods. To recognise the important role of bioinformatics in modern 'Omics technologies, and carry out a bioinformatics analysis with example data.

Unit I: Introduction **12 Hours**

Bioinformatics - History, Scope and Aims, its relation with molecular biology; Tools (FASTA, BLAST, BLAT, RASMOL); Databases (GENBANK, Pubmed, PDB); Software (RASMOL, Ligand Explorer); Biological data bases – Nucleic acid databases (NCBI, DDBJ, and EMBL); Protein databases (SWISS-PROT, Tr EMBL); Genome databases (EMBL, SGD, TIGR, and ACeDB)

Unit II: Sequence Alignment **12 Hours**

Introduction to Sequences, alignments and Dynamic Programming; Dot plots, Simple alignment, Gap, gap penalties, scoring matrices; Local alignment and Global alignment (BLOSSUM and PAM); Pairwise alignment (BLAST and FASTA Algorithm); Multiple sequence alignment (Clustal W algorithm); Dynamic Programming – Needleman and Wunsch algorithm

Unit III: Genomics, Gene Expression, and DNA array **12 Hours**

Prokaryotic genomes -Prokaryotic gene structure; Eukaryotic genomes, and its gene structure, Open reading frame, transcription factors binding sites; Gene expression: SNP, cDNA, STS and EST; DNA array (brief account).

Unit IV: Proteomics **12 Hours**

Protein classification -Families, Super families and folds; Secondary structure prediction: Chou – Fasman; Tertiary structure prediction: ab initio, homology modelling; Proteomic technologies - Mass spectrometry, protein chips, Reverse-phased protein microarrays, Limitations of proteomics; practical applications of proteomics.

Unit V : Metabolic pathways **12 Hours**

Metabolites – metabolomics – exometabolomics, Metabolic pathway databases – Metlin, Massbank, Biocyc, KEGG and Human metabolome database; Analytical techniques and applications.

Textbooks:

1. Rastogi. S.C. Mendiratta, and Rastogi, 2012. Bio-informatics methods and applications. Himalaya Publishing House. New Delhi.
2. Gautam.N. 2006. Bio-informatics data base and algorithm, Narosa Publishing House, New Delhi.
3. David N Mount. 2016. Bioinformatics. Sequence and genome analysis. Cold Spring Harbor Laboratory Publications.

Reference Books:

1. Atwood Terisa, K and Parry Smith and David, J.1999. Introduction to Bio-informatics, Pearson Education, New Delhi.
2. Mani, K. and Vijaya Raj, N. 2011. Bio-informatics for Beginners, Kalaikathir Achagam, Coimbatore.
3. Kranedan, E. and Raymer Mitchel, L. 2003. Introduction to bioinformatics, Pearson Education, New Delhi.

EVOLUTIONARY BIOLOGY

(Sub code: 15 UZO**54**)

Semester : V Core: 8 Credits: 5 Hours : 70

Objectives: To understand the concepts, trends and patterns of evolution of selected groups.

Expected outcome: Students are expected to gain knowledge on patterns of evolution and speciation.

Unit I : Theories and process of Evolution 14 Hours

Primordial earth, Bigbank theory - Geological time scale - Origin of life. Lamarckism - Darwinism - Neo Darwinism, Mutation theory, Modern Synthetic theory; organic variations; isolating mechanism; natural and artificial selection-types (direct, stabilizing, disruption, industrial melanism)

Unit II : Evidences for evolution and species concept 14 Hours

Morphological, embryological, genetic, biochemical, physiological and geological evidences; Biological species concepts; Sub species – sibling species – biotypes; Modes of speciation – allopatric and Sympatric species; isolating mechanism, Macro (Darwin's finches) and mega evolution.

Unit III : Adaptations 14 Hours

Origin of adaptive and non adaptive characters, Kinds of adaptations - Convergent and adaptive radiation; Pre and post adaptations; Adaptive radiation in Darwin's finches and Placental mammals and mimicry.

Unit IV : Zoogeographical realms and origin of vertebrates 14 Hours

Zoogeographical realms – names & animal distribution according to Wallace scheme, Avian and Mammalian faunal distribution in different realms; Origin of fishes, reptiles and birds; Evolution of horse; Origin and evolution of man.

Unit V: Evolutionary history and Phylogeny 14 Hours

Major events in the history of life; Fossils - types; Incompleteness; Dating of fossils; The evolution of populations; Extinction and mass extinction; Phylogeny and the tree of life; molecular evolution; Bioinformatics for Phylogenetic tree analysis.

Text books:

1. Verma, P.S. and V.K. Agarwal, 2010. Reprint, Cell Biology, Genetics, Molecular Biology, Physiology, Evolution and Ecology, S. Chand & Co., New Delhi – 110 055.
2. Veer Bala Rastogi, 2001. Organic Evolution, Kedar Nath Ram Naths, Delhi.
3. Verma P.S. and Agarwal V.K. 1998. Concept of Evolution, Chand and Company Ltd., New Delhi.
4. Sanjib Chattopadhyay, 2012. Life- Evolution, Adaptation, Ethology (III Ed). Books & Allied (P) Ltd.

Reference Books :

1. Dobzhansky, T., Ayala, J., Stebbins, G. and Valentine, W. 1973. Evolution. Surjeet Publication, New Delhi.
2. Moody, P. 1978. Introduction to Evolution (V Ed.). Kalyani Publishers, New Delhi
3. Minkoff and Eli, 1984. Evolutionary Biology. Addison Wesley, Publishing Company, London.

EVOLUTIONARY BIOLOGY

(Subject code: 15 UZO)

Semester : IV Core: Credit: 5 Hours: 70

Objective: To understand the concepts, trends and patterns of evolution as well as evolution of selected groups.

Expected outcome: Students are expected to acquire knowledge about origin of life patterns of evolution, behaviour, natural selection and speciation.

Unit I: Origin of cells and Evolutionary thoughts 14 Hours

Origin of biomolecules, chemical and biological evolution of life; concepts of Oparin and Haldane-experimental evidences. Lamarckism, Darwinism-natural selection, mutation theory and modern synthetic theory. Hardy-Weinberg law; Factors influencing Hardy-Weinberg law.

Unit II: Paleontology evolutionary history 14 Hours

Evolutionary time scale: eras, period, and epoch; Major events in the evolutionary time scale, fossils; Evolution of horse; Physical and cultural evolution of Man.

Unit III: Patterns of evolution 14 Hours

Speciation, concepts, Sequential and divergent evolution, isolating mechanisms; micro, macro and mega evolution; Adaptive radiation of reptiles, birds and mammals; migration, navigation, domestication.

Unit IV: Behavioral and Natural selection 14 Hours

Natural selection in action, fitness and adaptive value, industrial melanism; Variation – pre-adaptation and post adaptation; normalizing, directional and diversifying selection; Group and individual selection, Altruism-Kin selection. Mimicry and coloration- Batesian and Mullerian mimicry.

Unit V: Molecular Evolution 14 Hours

Principles of molecular evolution studies; methods of molecular evolution studies; DNA bar coding- mtDNA, molecular phylogeny– history, terms, definition and limitations, construction of phylogenetic trees using molecular data, construction of phylogenetic trees.

Textbooks

1. Veer Bala Rastogi, 2001. Organic Evolution, Kedar Nath Ram Nath, Delhi.
2. Verma P.S. and Agarwal V.K. 1998. Concept of Evolution, Chand and Company Ltd., New Delhi.
3. Sanjib Chattopadhyay, 2008. Life Evolution, Adaptation Ethology. Arunabha Sen Kolkatta.
4. Barton, NH, Briggs, DEG., Eisen, JA., Goldstein, DB. and Patel, NH. 2007. Evolution. CSHL Press.
5. Strickberger, M.W. 2005. Evolution. Jones and Bartett Publishers, London

Reference Books

1. Dobzhansky, T., Ayala, J., Stebbins, G. and Valentine, W. 1973. Evolution. Surjeet Publication, New Delhi.
2. Earnest Mayer, 1978. Animal species and Evolution. Harward University Press, Massachusetesz.
3. Moody, P. 1978. Introduction to Evolution (V Ed.), Kalyani Publishers, New Delhi.

4. Bryson brown, 2009. Evolution. Pentagon press.
5. Peter Stiling, 2002. Ecology Theories and Applications.4th edition. Prentice – Hall India.
6. Mohan P. Arora, Arora, H. 2013. Organic evolution, Himalaya Publishing house.

BIOCHEMISTRY – PRACTICAL

(Sub code: 15UZP51)

Semester: V Core: 5 Credits: 1 Hours: 30

1. Qualitative determination of carbohydrates
2. Qualitative determination of proteins
3. Qualitative determination of fats
4. Qualitative detection of amylase enzyme activity.
5. Determination of pH in water samples
6. Estimation of total hardness in water samples
7. Absorption maxima of coloured solution using colorimeter.
8. Separation of amino acids and determination of Rf value by paper chromatography
9. Demonstration of SDS PAGE and Agarose gel electrophoresis.
10. Spotters: Structure of glucose, Starch, Secondary structure of protein, Myoglobin, Haemoglobin, Oleic acid, Cyclic AMP, Urea cycle, Kreb cycle, Structure of DNA, Structure of RNA-Types, Enzyme action- lock and key model, Induced fit model; Fat soluble and water soluble vitamins, Instruments**:** pH meter, colorimeter, Paper chromatography, gel electrophoresis, spectrophotometer and centrifuge.

ECOLOGY – PRACTICAL

(Sub. Code: _____)

Semester: V Core: 8 Credit 1 Hours: 30

1. Determination of primary productivity (dark and light bottle)
2. Transparency of water using Secchi disc
3. Examinations of freshwater/marine water plankton
4. Quantitative analysis of soil pH
5. Estimation of dissolved oxygen of available water samples
6. Estimation of dissolved salinity available water samples
7. Determination of water hardness – Silicates, calcium, chlorides and phosphates
8. Estimation of LC_{50} /LD_{50} using SPSS software
9. Preparation of field report based on the visit to a Wild Life Sanctuary/National Park/Zoo/Biosphere Reserve/Natural Ecosystems
10. Ecosystem - Aquatic (freshwater and Marine) and terrestrial (Grass land and forest); Pyramids (biomass, number and energy)- Animal inter relationship, (Parasitism, parasitic castration, Commensalism, Mutualism), Food chain and food web, energy flow in an ecosystem, Biogeochemical cycle (Phosphorous, Nitrogen and Carbon); Instrumentations – thermometer, anemometer, barometer, hygrometer

GENETICS AND ANIMAL BIOTECHNOLOGY - PRACTICAL

(Sub code:)

Semester: V **Core: 7** **Credits: 1** **Hours : 30**

1. Demonstration of Monohybrid and Dihybrid cross using coloured beads.
2. Verification of Hardy – Weinberg's law using beads (partial and complete)
3. Human height – weight to study polygenic inheritance
4. Probability – Coin tossing (two coin only)
5. Isolation of casein from milk
6. Isolation of citric acid from lemon juice
7. Protein –PAGE
8. DNA - AGE
9. Demonstration of DNA amplification (PCR)
10. Demonstration- Isolation of cells using trypsin
11. Media preparation for animal cell culture
12. Cell viability test

Spotters: gene interaction- test cross, Incomplete dominance, Codominance, Complementary genes, Lethal genes, and Epistasis, Rh factor, Free-Martin, colour blindness, human abnormalities, hypertrichosis (holandric gene), chromosomal alterations, construction of recombination DNA, PCR, Monoclonal antibodies, DNA finger printing, insulin production, Cloning.

EVOLUTION– PRACTICAL

(Sub. Code: 15 UZP54)

Semester : V **Core: 8** **Credit 1** **Hours : 30**

1. Variation in left thumb impression
2. Serial homology in prawn appendages
3. Animals of evolutionary importance – Peripatus, Limulus and Archaeopteryx
4. Mimicry : Leaf insects, Stick insects, Monarch and Viceroy butterflies
5. Polymorphism in shell
6. Adaptive radiation in feet of birds
7. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
8. Darwin's Finches with diagrams/ cut outs of beaks of different species
9. Construction of Phylogenetic trees and interpretation of results (Sequence of 16S rRNA gene or COI)
10. DNA databases and sequence retrieval from databases
11. Multiple sequence alignment (CLUSTAL W)
12. Multiple DNA polymorphism
13. Visit to Natural History Museum and submission of report
14. Spotters: Evolutionary Biology: Oparin and Haldane experiment, Lamarckism, Darwinism, Natural selection, Geological time scale; Fossils; Evolution of horse, man, adaptive radiation in birds, reptiles, Mammals, Isolating mechanism, Industrial melanism and Mimicry

EVOLUTIONARY BIOLOGY– PRACTICAL

(Sub. Code: ……)

Semester: V **Core: 8** **Credit 1** **Hours: 30**

1. Variation in left thumb impression
2. Animals of evolutionary importance – Peripatus, Limulus and Archaeopteryx
3. Mimicry : Leaf insects, Stick insects, Monarch and Viceroy butterflies
4. Polymorphism in shell
5. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
6. Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Construction of Phylogenetic trees and interpretation of results. (Sequence of 16S rRNA gene or COI)
8. DNA databases and Sequence retrieval from databases.
9. Demonstration of editing the sequences.
10. Multiple Sequence Alignments (CLUSTAL W).
11. Phylogenetic analysis of bony fishes:
12. mtDNA polymorphisms
13. Comparison of protein sequences and construction of phylogenetic trees (CO I ,COX and COII)
14. Visit to Natural History Museum and submission of report

Evolutionary Biology: Oparin and Haldane experiment, Lamarckism, Darwinism, Natural selection, Geological time scale; Fossils; Evolution of horse, man, adaptive radiation in birds, reptiles, Mammals, Isolating mechanism, Industrial melanism and Mimicry

ANIMAL PHYSIOLOGY

(Sub. code: 15 UZ0 61)

Semester: VI Core: 9 Credits: 5 Hours: 5

Objective: To enable the students to understand the general principle, physiological functions of animals as well as to understand the nature, mechanism and uses of various receptors present in the animals.

Expected outcome: The students are expected to understand the structure and functions of human systems.

Unit I: Nutrition and Digestion 14 Hours

Food - Nutritional requirements – carbohydrates, proteins, fats, minerals, and vitamins; calorific values and daily requirements. Digestion, absorption and assimilation in man. Gastrointestinal hormones; Standard, active and routine metabolism, balanced diet, BMR and BMI.

Unit II: Respiration & Circulation 14 Hours

Respiration: Types, Properties and functions of respiratory pigments; Structure of mammalian lungs-exchange and transport of gases (CO_2 & O_2), neural and chemical regulation; respiratory quotient (RQ).

Circulation: Composition, properties, haemopoiesis and functions of blood, Types of heart-neurogenic and myogenic hearts with examples; structure of human heart and its working mechanism – Heartbeat, cardiac cycle, blood pressure, mechanism of blood clotting and ECG – its principles and significance.

Unit III: Excretion, osmoregulation and thermoregulation 14 Hours

Classification of animal on the basis of excretory products; Structure and function of Kidney and nephron - urine formation, regulation of water balance, electrolyte and acid base balance.

Osmoregulation - osmoconformers and osmoregulators; water and ionic regulation by aquatic and terrestrial animals; Thermoregulation - thermoregulators and thermoconformers.

Unit IV: Effectors and Receptors 14 Hours

Muscle - Types of muscles, ultrastructure of skeletal muscle, physiology and theories of muscle contraction.

Nerve physiology - neuron; impulse transmission; Synapse-synaptic; transmission; reflex action; neurotransmission; Photoreceptors, Phonoreceptors, mechano, Chemoreceptors - structure and physiology and functions.

Unit V: Physiology of reproduction and endocrinology 14 Hours

Human male and female reproductive organs, puberty and menopause. Structure, secretion and functions of pituitary, thyroid, parathyroid, adrenal glands, testis and ovary; Hormonal control of estrus and menstrual cycles.

Role of hormones in growth, metamorphosis and reproduction in Arthropods.

Textbooks:

1. Rastogi, S.C. 2001. Essentials of Animal Physiology (III Ed.), New Age International Publication, New Delhi.
2. Verma, Tyagi and Agarwal., 2000. Animal Physiology. Chand and Company Ltd., New Delhi.

Reference Books:

1. Schmidt - Nielsen, K. 2002. Animal Physiology-Adaptation and environment, Cambridge University Press, Cambridge.
2. Eckert, David Randall, 1982. Animal Physiology, Surjeet Publications, Delhi.
3. William S. Hoar, 2004. General and Comparative Physiology, Third Edition, Prentice-Hall of India Private Limited, New Delhi,

IMMUNOLOGY AND MICROBIOLOGY

(Sub code: 15 UZO 62)

Semester: VI Core: 10 Credit: 5 Hours: 70

Objective: To strengthen the knowledge on immune system, immune response, microbial diseases as well as to impart knowledge on microbiological applications.

Expected outcome: The students will learn the fundamentals of immune system, mechanism of defense, microbial classification, disease symptoms, treatment and vaccination.

Unit I: The Immune system **14 Hours**

Cells - B and T cell epitopes, haptens, adjuvants, Null cells, Macrophages; Organs -Primary and secondary lymphoid organs of the immune system; Antigens – characteristics, antigenic determinants, antigen processing and presentation; Antibody – structure, types, binding sites and binding mechanisms; Structure and functions of MHC

Unit II: Immune Response and Reactions **14 Hours**

Antigen and Antibody interactions; Innate and adaptive immunity; Humoral immune response, cell mediated immune response. Hypersensitivity - Types and Mechanisms. Immunity to infection - Antibacterial immunity antiviral immunity. Auto immune disorders-organ specific and Non organ specific

Unit III: Structure and culture of Bacteria **14 Hours**

General structure, classification and identification of bacteria; Culture media for bacteria and fungi; Growth and growth curves of bacteria, fungi and viruses; Factors affecting growth of microbes (temperature, pH and O_2).

Unit IV: Microbial diseases of Man **14 Hours**

Pathogenecity, epidemiology, prevention and control of Bacterial -(*Bacillus anthracis*, *Salmonella typhii*, *Vibrio cholera*, *Clostridium tetanii*, *Mycobacterium tuberculosis*), fungal (Crytococosis, Dermatomycosis, Candidiasis) and viral (Hepatitis, influenza, mumps, Measles, Ziga) diseases.

Unit V: Applications **14 Hours**

Immunoprophylaxis – types of vaccines, production, immunization schedule, vaccine safety; Mono and polyclonal antibiosis; Microbial products – antibiotics, enzymes; Agricultural uses - *Bt*, NPV, Bacculoviruses in agriculture, biopolymers, synthetic peptides.

Textbooks

1. Chackrobarthy, Ashik, K. (1996). Immunology. Tata McGraw-Hill, Publishing Companty Ltd. New Delhi.
2. Sharma, P. D. 2001. Microbiology, Rastogi Publications, Meerut, India.

Reference Books

1. Roit and Delves (2001). Essential Immunology, Blackwell Science, London.
2. Pelczar, M.J. Chan, E.C.S. and N.R. Kreig, (1993). Microbiology, Tata McGraw-Hill, Publishing Companty Ltd. New Delhi.
3. Subhash Chandra Parija. Textbook of Microbiology & Immunology 2nd Edition, Elsevier India, pp.684.

E-resources

1. http://www.helmberg.at/immunology.pdf
2. https://icuadelaide.com.au/files/primary/physiology/immunology.pdf
3. https://is.muni.cz/do/med/mimsa/12840881/12995390/43886337/Microbiology_-_final.pdf
4. https://en.wikipedia.org/wiki/List_of_infectious_diseases
5. http://www2.sunysuffolk.edu/czuraa/BIO244LectureMaterials/BIO244Chapter18Slides.pdf
6. http://www.lamission.edu/lifesciences/Steven/Micro20%20Chapter%2018.pdf
7. https://www.researchgate.net/publication/272179875_Microbial_Healthcare_Products

INSECT DIVERSITY AND PEST MANAGEMENT

(Sub code: 18 UZO63)

Semester: VI **Core:11** **Credits: 4** **Hours: 70**

Objective: To study the elements of insect diversity and structure; as well as to understand about the insect pest of cultivable crops and their management.

Expected Outcome: Students are expected to identify locally available insect and their impacts on human beings and plants and the management strategies for insect pests and vectors.

Unit I. Structure and Salient features **14 Hours**

Morphological features of head, thorax and abdomen; Salient features of insect orders - Orthoptera, Isoptera, Hemiptera, Diptera, Coleoptera, Lepidoptera, Dermaptera, Odonata, Neuroptera and Hymenoptera; Metamosphosis and social life in insets

Unit II: Productive and Beneficial insects **14 Hours**

Bionomics and economic importance of Silkworms, Honeybee and Lac insects; Brief account on biological control agents - Lacewings, ladybird beetles, Trichogramma, Celeonids *Bt*, NPV, Metarizhium; Pollinators, weed killers, scavengers, insect as food and feed.

Unit III: Field crop and Horticultural Crop Pests **14 Hours**

Bionomics, infestation, plant parts damaged, symptoms and management of three major cosmopolitan pests of rice, sugarcane, groundnut, cotton, and coconut. *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus*,

Unit IV: Pests of stored products, Domestic pests and insect vectors **14 Hours**

Bioecology, damage caused and management of *Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum*; Medical importance and management of *Pediculus humanus capitis, Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsylla cheopis.*

Unit V. Pest management concept, components and methods **14 Hours**

Infestations – sucking, defoliators, borers; Economic Injury Level; Pest Management decision making; Brief account on physical, chemical, cultural, genetic control of pests, IPM and BIPM (general account only), GM crops (Eg. Bt cry gene) - concepts and application.

Textbooks:

1. David, B.V. and Ananthakrishnan, T.N. 2004. General and Applied Entomology. Tata-McGraw Hill Publishing Company, New Delhi.
2. Kalyanasundaram, S. and Kalyanasundaram, M. 2003. Pest management in field Crops / Horticultural Crops. Keran Desk Top Publisher, Vellore.
3. Mike W. Service. 2004. Medical entomology for students. Third Edition. Cambridge University Press, USA. PP. 285.

Reference Books

1. Ambrose, D. P (2006). The Insects: Structure, Function and Biodiversity, Kalyani Publishers, Ludhiana.
2. David, B.V. and Ramamoorthy, V.V. (2011). Elements of economic entomology. NP Namrutha Publications, Chennai.

3. Larry P. Pedigo (1988). Entomological pest management. Mac Mille Publishing Company, New York.
4. Romoser, W.S and Stoffolano, J .G. (1998). The Science of Entomology, McGraw-Hill Company, New York.
5. Pedigo, L.P (2002). Entomology and pest Management. Pearson Education, Singapore.
6. Robert F Morris, Edward P. Caswell-Chen and Marcos Kogan (2002). Concept in Integrated Pest Management. Prentice-Hall of India P. Ltd, New Delhi.

ANIMAL PHYSIOLOGY – PRACTICALS

(Sub code: 15 UZP61)

Semester : VI **Core : 9** **Credits : 2** **Hours: 4**

1. Rate of oxygen consumption of a fresh water fish
2. Effect of oxygen consumption of a fresh water fish
3. Salt loss and salt gain in a fresh water fish
4. Effect of temperature on human salivary amylase activity
5. Identification of nitrogenous excretory products – ammonia, urea, uric acid
6. Estimation of Haemoglobin using haemoglobinometer
7. Measurement of blood pressure in Man – Demonstration
8. Preparation of haemin crystals in human/chick blood
9. Qualitative analysis of protease, amylase and lipase in cockroach digestive system.
10. Effect of temperature on fish opercular movement
11. BMI analysis using height and weight
12. Determination of blood clotting time
13. Spotters related to theory –

    Animal physiology: Human brain, heart, lungs, eye, tongue, ear, Pancreas, Human Kidney, Human circulatory system, digestive system, L.S. of testis and Ovary, Types of muscles, Endocrine glands (Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland), ECG, Oxygen dissociation curve (Bohr effect), Menstrual cycle, and Gastro intestinal hormone.

IMMUNOLOGY, MICROBIOLOGY AND ANIMAL BIOTECHNOLOGY - PRACTICAL

(Sub. Code: 15 UZPA 41)

Semester: IV Allied: 4 Credit: 1 Hours: 2

1. Human blood grouping (ABO and Rh factor).
2. WBC count in human blood
3. Double diffusion and radial immuno diffusion.
4. Separating lymphocytes.
5. Haemagglutination test.
6. Demonstration of lymphoid organs of rat (preserved specimen)
7. Demonstration of ELISA
8. Isolation of cells using trypsin
9. Cell viability test
10. Tissue culture media preparation – solid and liquid

Spotters: Immunoglobulins, Thymus, Antigen and antibody reaction, Lymphnode, Macrophage, Spleen, Bursa of fabricious, Engineered vaccine, Transgenic mice, Animal cloning – Dolly, Monoclonal antibodies, Organ culture, Radio Immune assay, Cell growth curve, Embryo culture- *invitro* and fertilizer

INSECT DIVERSITY AND PEST MANAGEMENT

(Sub code: 18UZO62)

Semester: VI Core: 10 Credits: 1 Hours :2

1. Cockroach: Mounting of antennae, mouthparts, spiracles
2. Housefly: Mounting of mouthparts, halter, wing
3. Honeybee (preserved slide) : mouthparts, legs, and sting
4. Mosquito (preserved slide) : life stages, mouthparts, wings
5. Collection and submission of representative harmful insects from different orders
6. Mini-projects

   2.1.Human vectors [mosquitoes, bed bugs, louse, cockroaches] –photos or paper cutting

   2.2. Life cycle, nature of damage, control measures of cotton, paddy, coconut, brinjal, lady's finger pests
7. Spotters related to theory : Insect pests : Agriculture, Forestry, animal, weed killers, scavengers – Aesthetic and scientific valued insects ; Insect orders; Types of head, antennae, mouth parts, legs, wings
8. Field trip and inclusion of report in the record note book – Agro-ecosystem, Agriculture College or Research institutes

Elective 3 - Group Project

Semester: VI **Elective: 3** **Hours: 7** **Credits: 6**

Group projects can help students to develop skills specific to collaborative efforts, which pool knowledge of all individuals, are increasingly important in the professional world. Positive group experiences have been shown to contribute to student learning and retention and also to the institutional growth.

Each group consists of 4 - 6 under-graduate students, based on number students in III B.Sc. class. Students will be selected by the staff members by lot system during the fifth semester. Topics are allotted depends on the interest of the group / research centres of the faculty. Tentative title of the group project is displayed in the department notice board at the beginning of the sixth semester.

Two continuous assessments will be done on 31st and 62nd day of the working day. In the first assessment, review of literature (photo copies of the reprints), objectives, materials and methods and works carried out by the candidates should be submitted for evaluation. In the second assessment, results obtained up to the submission could be submitted along with first assessment materials. Marks for these internal assessments will be allotted by the guide. In the final (External) evaluation students are required to submit hard bound detailed project report in the form of dissertation. It will be evaluated by the guide and external examiner and the marks will be allotted based on dissertation and *viva voce* thereof.

Question Pattern

Degree curse	Examination type	Section A (1 mark)	Section B (2 marks)	Section C (5 marks)	Section D (15 marks)
		No choice	No choice	Either or	Internal Choice
B.Sc.	Internal	5 x 1 = 5	5 x 2 = 10	5 x 1 = 5	2 x 15 = 15
	External	20 x 1 = 20	5 x 2 = 10	5 x 5 = 25	3 x 15 = 45