BHARATHIAR UNIVERSITY, COIMBATORE – 641 046

Bachelor of Science, Zoology (B. Sc. Zoology)

(For the students admitted from the Academic Year – 2019-2020 onwards)

Objective of the Course:

In recent years the awareness of faunal conservation and taxonomy is gaining more attention. It is the need of the hour to train and orient the younger generation learners towards this direction. The curriculum is designed in such a way to motivate and learn the basic principles and concepts in animal sciences. The successful completion of degree will make the learner capable of identifying and analysing the faunal diversity and adaptation in relation to phylogeny. Modules of the course induct the learner to understand new concepts by continuous observations. The course is also designed in such way to expose the candidate about the job oriented avenues in applied Zoology. The learner will also be capable of undertaking any competitive exams in Zoology or a related subject and the syllabus is equivalent or included all the mandatory core courses stipulated by TANSCHE and UGC.

Medium of Instruction:

The medium of instruction and examination can be in English or Tamil. Learning the concepts and subject in Tamil is highly encouraged. However, Tamil medium learners are advised to follow technical terms and taxonomical terms as such or untranslated to keep learning pace at international standards.

Duration:

The duration of the course is for three years (or six semesters). Theory exam will be conducted on successful completion of Six months / One Semester / on completion of 90 days (450 Hours) of course as prescribed and practical will be conducted at the end of every year. The admission for the course can be conducted once in a year, subjected to the rules and regulations of University time to time.

Eligibility:

Pass in HSC (+2) or equivalent with Zoology/Biology and Chemistry as subjects of study.

Passing Minimum:

A candidate shall be declared to have passed in a paper if he/she should obtain not less than 40% of marks in the external examination. A candidate failing to secure the minimum marks prescribed shall be required to reappear for the examination in that paper.

Qualification of the Faculty:

M..Sc. degree in Zoology or equivalent recognized by Bharathiar University / TANSCHE along with qualifications prescribed by University/UGC time to time.

Conformation of Degree:

The successful candidates will be conferred with Bachelor Degree in Zoology

Scheme of Examination – CBCS Pattern (Revised)

Part	Course Title	Total Hr/Wk	Examinations				Credit
			Dur. Hr	CIA	External	Total Marks	
Semester I							
I	Language I	6	3	25	75	100	4
II	English I	6	3	25	75	100	4
III	Core Course I: Animal Diversity – Non Chordata	6	3	25	75	100	4
	Core Practical I	4	-	-	-	-	-
	Allied A Course I **Chemistry/Botany/Biochemistry**	4	3	20	55	75	3
	Allied Practical	2	-	-	-	-	-
IV	Environmental Studies	2	3	-	50	50	2
Semester II							
I	Language II	6	3	25	75	100	4
II	English II	6	3	25	75	100	4
III	Core Course II: Animal Diversity – Chordate	6	3	25	75	100	4
	Core Practical I	4	3	40	60	100	4
	Allied A Course **II Chemistry /Botany/Biochemistry**	4	3	20	55	75	3
	Allied Practical	2	3	20	30	50	2
IV	Value Education – Human Rights	2	3	-	50	50	2
Semester III							
I	Language III	6	3	25	75	100	4
II	English III	6	3	25	75	100	4
III	Core Course III: Comparative Anatomy of Vertebrates.	5	3	25	75	100	4
	Core Practical II	2	-	-	-	-	-
	Allied B Course I Botany /Chemistry/Biochemistry	4	3	20	55	75	3
	Allied Practical	2	-	-	-	-	-
	Skill Based I: Sericulture	3	3	20	55	75	3
IV	Non Major Elective I *	2	3	-	50	50	2
Semester IV							
I	Language IV	6	3	25	75	100	4
II	English IV	6	3	25	75	100	4
III	Core Course IV: Ecology, Evolution & Zoogeography	5	3	25	75	100	4
	Core Practical II	2	3	40	60	100	4
	Allied B Course II Botany/Chemistry/Biochemistry	4	3	20	55	75	3
	Allied Practical	2	3	20	30	50	2

IV	Skill Based II: Biostatistics & Computer Applications	3	3	20	55	75	3
	Non Major Elective I *	2	3	-	50	50	2
Semester V							
III	Core Course V: Cell Biology & Biochemistry.	5	3	25	75	100	4
III	Core Course VI: Microbiology	5	3	25	75	100	4
III	Core Course VII: Genetics & Immunology	5	3	25	75	100	4
	Core Practical III	2	-	-	-	-	-
	Core Practical IV	2	-	-	-	-	-
III	Elective Course I: A/B/C#	3	3	20	55	75	3
III	Elective Course II: A/B/C#	3	3	20	55	75	3
III	Elective Course III: Practical#	2	-	-	-	-	-
IV	Skill Based Course III: Biophysics & Instrumentation.	3	3	20	55	75	3
Semester VI							
III	Core Course VIII: Animal Physiology.	5	3	25	75	100	4
III	Core Course IX: Developmental Biology.	5	3	25	75	100	4
III	Core Course X: Biotechnology.	5	3	25	75	100	4
III	Core Practical III	2	3	40	60	100	4
III	Core Practical IV	2	3	40	60	100	4
III	Elective Course I: A/B/C#	3	3	20	55	75	3
III	Elective Course II: A/B/C#	3	3	20	55	75	3
III	Elective Course III: Practical#	2	3	20	30	50	2
IV	Skill Based Course IV: Practical	2	3	30	45	75	3
IV	Extension activities**	1	-	-	-	50	2
	Total					**3500**	**140**

***** Non Major Elective I: Basic Tamil I / Advanced Tamil I / Yoga / Women studies & Non major Elective II: Basic Tamil II / Advanced Tamil II / General Awareness. It is compulsory that those who opt for any languages other than Tamil, they should choose Basic Tamil (Who don't studied Tamil) or Advanced Tamil (For those who studied Tamil up to HSC).

** Only internal marks.

 # Elective Courses

List of Elective courses(Colleges can choose one course from Elective I & II, Elective III will be the practical of Elective II)		
Elective Course I	A	Human Genetic and Counseling – Course I & II,
	B	Pest and their control – Course I & II.
	C	Wild life management and Conservation – Course I & II.
Elective Course II	A	Pathology and clinical laboratory technology – Course I & II.
	B	Poultry science & Management – Course I & II.
	C	Apiculture – Course I & II.
Elective Course III	A	Pathology and clinical laboratory technique – Practical.
	B	Poultry science & Management – Practical.
	C	Apiculture – Practical.

Question Paper format:

Theory (75 marks)

Section A (10 x 1 = 10) – Only Multiple Choice (Two question from each Unit, One word answer question with four answers).
Section B (5 x 5 = 25) – Short Answer type (One question with choice from each unit).
Section C (5 x 8 = 40) - Essay type (One question with choice from each unit).

Theory (55 marks)

Section A (10 x 1 = 10) – Only Multiple Choice (Two question from each Unit, One word answer question with four answers).
Section B (5 x 3 = 15) – Short Answer type (One question with choice from each unit).
Section C (5 x 6 = 30) - Essay type (One question with choice from each unit).

Practical (60 marks)

Mark slit up given along with concerned Practical.

Course I:Animal Diversity- Non Chordata

Objectives

1. To understand the taxonomy and relationship and evolution of animals.
2. To identify the phyla of invertebrate animals, and recognize their distinguishing features;
3. To appraise the diversity of animals in a phylogenetic context.
4. To understand how different body designs solve biological problems related to physiological and environmental challenges.
5. To develop an appreciation for the role of invertebrates in biological communities, ecological interactions, and conservation problems

Unit I: Classification & Protista

Concept of five kingdom classification of life. Introduction to Protista & Animal kingdom – Systems of classification & nomenclature - levels of organization - Types of symmetry. General characters of Protista & Classification with examples.
Type study: Paramecium.
General topics: Parasitic Protozoa, Life Cycle of Plasmodium, Locomotion & Nutrition in Protozoa.

Unit II:Porifera&Coelenterata

Characters & classification (up to class) of Porifera&Coelenterata with examples – Salient features of – *Ctenophora*.
Type study: Leucosolenia, Obelia Colony.
General topics: Canal system in sponge, Polymorphism in Coelenterata, Diversity (Types) of corals and structure of coral polyp, Coral reefs.

Unit III: Platy helminthes, Aschelminthes& Annelids

Characters & classification (up to class) of Platy helminthes, Aschelminthes& Annelids with examples.

Type study:*Taenia, Ascaris, Megascolex.*
General topics: Coelom coelomoducts&metamerism, Parasitic adaptations in Helminths and annelids, Filter feeding in Polychaetes.

Unit IV: Arthropoda

Characters & classification (up to class) of Arthropoda with examples. Brief descriptions of *Limulus* (living fossil), Sacculina (Parasitic castration), Copepods, Scorpion, Spider, *Peripatus*(affinities), Millipeds&Centipeds.
Type study: Cockroach & Prawn,
General topics: Crustacean larvae.

Unit V: Mollusca and Echinodermata &Hemichordata.

Characters & classification (up to class) of Mollusca and Echinodermata with examples. Characters of Hemichordata. Brief descriptions of Fresh water Mussel, *Chiton, Sepia,* Starfish, SeaCuccumber&Balanoglossus
Type study: Pila, **Starfish (External and Water Vascular system only)**

General topics: Larval forms of Mollusca, Torsion & de-torison in Mollusca, Economically important Mollusca, Echinoderm larva, Evolutionary affinities of Hemichordata.

Learning Outcome:

1. The learner will be able to understand the diversity and basic taxonomy of Non chordates.
2. The learner will get an idea of adaptation and importance of non-chordates.
3. The learner will be able to identify the animal at basic level.
4. The paper will give a strong observation skill and prompt him to think about its conservation, sustainable economic utilisation and its potentials in technological prospects.

Books for reference (Use latest Editions)

1. Barnes, R.D. *Invertebrate Zoology* (1982) Vi Edition. Holt Saunders International Edition.
2. EkambaranathaAyyar& T.N. Ananthakrishnan, *Manual of Zoology Vol – I , Part I & II*S.Viswanathan Pvt. Ltd. Chennai..
3. Kotpal RL, Agarwal SK &Khetarpal RP *Invertebrates*,Rastogi Publications, Meerut.
4. Jordan And Verma Invertebrate Zoology S. Chand & Co, New Delhi
5. Anderson TA, *Invertebrate Zoology*, Oxford University Press, New Delhi.
6. Barrington EJW, *Invertebrate Structure and Functions*. English Language Book Society.
7. Hyman LH, *The Invertebrates (6 vols).* McGraw-Hill Companies Inc. NY
8. Nair NC, Invertebrata&Chordata, Saras Publication Nagercoil.
9. Nair NC, Leelavathy S, SoundaraPandian N Murugan T & Arumugam N *A Text Book of Invertebrates*,Saras Publication Nagercoil.

10. Ebanasar J & and Sheeja BD *Outlines of five kingdoms of life,* Shine and Twinkle Publication,Nagercoil.

Course II: Animal Diversity - Chordata

Objectives

1. To understand the taxonomy and relationship and evolution of animals.
2. To identify the class of vertebrate animals, and recognize their distinguishing features.
3. To appraise the diversity of animals in a phylogenetic context.
4. To understand how different body designs solve biological problems related to physiological and environmental challenges.
5. To develop an appreciation for the role of vertebrates in biological communities, ecological interactions, and conservation problems

Unit I Fishes

General characters and classification of Chordata (up to class) with examples. Brief descriptions of *Amphioxus*, *Ascidia*, Hag fish, *Scolidon*, Mullet, *Anabas*, Cat fish, Sea horse.

General topics: Affinities of Prochordates, Accessory respiratory organs in teleost, Types of Fins and function Comparison of Teleost and elasmobranches, Evolutionary significance of Dipnoi, Migration of Fishes.

Unit II Amphibia

Classification and characters of Amphibia (up to order with examples). Habitat, classification, examples and brief descriptions of Frog, Toad, Salamander, Ambystoma, Tree frog.

General topics: Origin of Amphibia, Metamorphosis of Frog, Limbless amphibians, Parental care in amphibian, Paedomorphosis.

Unit III Reptilita

Classification and characters of Reptilia (up to order with examples). Habitat, classification, examples and descriptions of *Calotes*, *Sphenodon*, Varanus, Chameleon, Snakes, Chelonia&Crocodilia

General topics: Identification of Poisonous and non-poisonous snakes – Poison apparatus and types of poison.

Unit IV Aves

Classification and characters of Aves (up to order with examples). Habitat, classification, examples and brief descriptions of Pigeon, Horn bills, Kingfisher, Heron, Parrot, Wood pecker, Finches & Sunbird.

General topics: Flightless Birds, Flight Adaptations in Birds, Feet and Beak modifications, Wetland birds, Sound production in Birds.

Unit V Mammals

Classification and characters of Mammals (up to order with examples). Habitat, classification, examples and brief descriptions of Kangaroo, Bat, Rabbit, *Panthera*, *Hyena*, Monkey, Apes, Deer, Elephant &*Rhinoceros*

General topics: Diversity of Marsupials, Affinities of Echidna, Dentition in Mammals, Aquatic mammals and adaptation, Odd and even toed ungulates, Insectivorous mammals, Adaptive radiation in Mammals, Oestrous cycle in mammals. .

Learning Outcome:

1. The learner will be able to understand the diversity and basic taxonomy of chordates.
2. The learner will get an idea of adaptation and importance of chordates.
3. The learner will be able to identify any vetenrate animal at basic level.
4. The paper will give a strong observation skill and prompt him to think about its conservation, sustainable economic utilisation and its potentials in technological prospects.

Books for references (Use latest Editions)

1. Arumugam N *Animal Diversity - Volume - 2 - Chordata*, Saras Publication, Nagercoil
2. Thangamani A, Prasannakumar S, Narayanan LM, Arumugam N *A Text Book of Chordates*, Saras Publication, Nagercoil.
3. EkambaranathaAyyar& T.N. Ananthakrishnan, *Manual of Zoology Vol – II*, S. Viswanathan Pvt. Ltd. Chennai..
4. KotpalRL *Mordern Text Book of Zoology Vertebrates*, Rastogi Publications, Meerut.
5. Young, J.Z. 1950. *Life of Vertebrates.* Clarendon Press, Oxford, UK.
6. Pough Harvey F, Christine M .Janis and John B. Heiser .2002. *Vertebrate Life*, Pearson Education Inc. New Delhi.
7. Verma PS, Chordate Zoology, S Chand Publishers, New Delhi

Core Practical I

Instruction:

The Board of studies do not encourage the dissection of animals and advised to rely of alternative digital methods. Those departments undertaking dissection should compulsorily constitute a dissection monitoring committee as per UGC rules. It is to be ensured that the animals used for dissection is not removed from the wild and is in compliance with UGC regulations time to time. It is the duty of the college/department to adhere strictly to the Wildlife Protection Act and its amendments.

Major

Prawn / Cockroach / Earthworm/ Fish (Any two): Digestive System & Nervous system.

Micrometry measurement of given Protozoan /micro arthropod / any sample.

Minor

Prawn/ Cockroach/Mosquito (Any two): Mounting of Appendages / Mouth parts
Earth worm: Mounting of body setae
Fish: Mounting of Scales
Motility of Paramecium – Hanging drop method.

Visit to any nearby area of biodiversity significance (Report should be included in record).

Submission of Photo Album of invertebrates & Vertebrates with identification and classification (Evaluation of report should be based on field effort, diversity of photos, classification and identification. Costly presentation of photos albums should compulsorily be discouraged, as the objective of this is to make students familiar with fauna).

Spotters:

Classify giving reasons:*Paramecium, Obelia*, Liver fluke, *Ascaris, Pila*, Star fish, *Balanoglossus*, Any fish, Tree frog, Snake, King Fisherand Bat.
Draw labeled sketches:*Paramecium*, Trochophore, Any Echinoderm larvae.
Biological significance: *Paramecium* –Conjugation, Malarial Parasite, Gemmules, *Limulus*, Hippo campus, Nautilus. Axolotl larva,
Relate structure and function: Spicules of sponges, Scolex of tapeworm, *Nereis*parapodium, Carapace and plastron, Electric organ – *Narcine*.
Descriptive Notes:*Hydra, Physalia*, Rotifer, Sea cucumber, Chiton, Placoid scales, Chameleon, Quill feather.

Question Pattern: Major: 20, Minor: 10, Record: 5, Spotter: 15 (5 spotters each carry 3 marks), Album: 10

Core Course III: Comparative Anatomy of Vertebrates

Objectives

1. To understand the comparative anatomy and relationship in view of evolution.
2. To make an in-depth knowledge about various vertebrate organs and organ system.
3. To develop a knowledge about the structural organization of each vertebral group and to understand the structural complexity in advanced taxa.

Unit I Digestive & Respiratory System

Comparative account of Digestive system of shark, frog, pigeon and rabbit – Ruminant stomach and function. Gills of fishes – Pharyngeal derivatives – Swim Bladder - Comparative account of Lungs and air ducts in Vertebrates.

Unit II Nervous System

Comparative account on structure of Brain, Cranial and spinal nerves of Shark, Frog and Rabbit. Sense organs of vertebrates.

Unit III Skeletal System

Regions of Vertebral column - Structure of typical vertebrae - Types of vertebrae – Ribs and sternum. Comparison of Skull, Pelvic, pectoral girdle and limbs of Shark, Frog and

Rabbit. Account of skull of Reptiles. Exoskeleton of Vertebrates (Scales, Feathers, hairs etc.).

Unit IV Circulation & Musculature

Aorta and aortic arches – Comparative account of heart, arterial system and venous system in shark, frog, *Calotes*, pigeon and rabbit. Brief account of appendicular musculature – Electric organs in fish.

Unit V Urogenital System

Comparison of Pronephros – Mesonephros and Metanephros with examples. Comparison of Urogenital system of frog, Pigeon and rabbit.

Learning Outcome:

1. The learner will develop and idea of the structural organisation of chordates.
2. The learner will develop an idea of functioning of each organ and formation of organ systems.
3. The learner will be able to identify and understand the increasing complexity of organ systems with advancement of evolution.
4. The paper will give a strong basic insight in understanding advanced courses like Physiology and Biochemistry.

Books for references (Use latest Editions)

1. Saxena RK &SumithraSaxena. *Comparative Anatomy of Vertebrates* Viva Books Private Limited, New Delhi.
2. KulshrethraSK *Comparative Anatomy of Vertebrates*, Anmol Publications Pvt Ltd. New Delhi.
3. KotpalRL Sasthry&Shukla*Comparative Anatomy and Developmental Biology*,Rastogi Publications, Meerut.
4. EkambaranathaAyyar& T.N. Ananthakrishnan, *Manual of Zoology Vol – II*, S. Viswanathan Pvt. Ltd. Chennai..
5. Waterman, A.J. *Chordate Structure and Function*. Macmillan Co. London.
6. Arumugam N *Animal Diversity - Volume - 2 - Chordata*, Saras Publication, Nagercoil
7. A. Thangamani A, Prasannakumar S, Narayanan LM, Arumugam N *A Text Book of Chordates*, Saras Publication, Nagercoil

Skill Based I: Sericulture.

Objectives

1. To train the students to do Sericulture.
2. To develop a basic skill & knowledge in Sericulture.

Unit I Mulberry cultivation

Brief outline of History of Sericulture - Scope & opportunities in Sericulture – Types of Silk - Organic Silk - Vanya Silk. Mulberry cultivation: Nursery – Planting – irrigation – Pruning – harvesting.

Unit II Silk worms

Morphology of Silk worm –Types of Silkworm –Silk glands - Life cycle of Silkworm – Brief out line of non-mulberry sericulture & its potential.

Unit III Rearing

Silkworm rearing –outdoor & indoor rearing – Rearing houses – Hatching – incubation – Feeding Silkworms - protection & rearing – rearing appliances – Mounting & harvesting.

Unit IV Diseases

Hygiene conditions in silk production – Diseases of silk worm – Prevention – Fungal infection to Cocoon. Disease of Mulberry trees & Prevention.

Unit V Processing

Silk fiber formation – Properties of cocoon filament – Pre reeling process – Cocoon boiling. Reeling technology – re-reeling technology – raw silk industry – byproducts of Silk industries.

Learning Outcome:

1. The learner will be able to practice Sericulture as a passion or profession.
2. The course will give awareness about applications of Zoology in the field.

Books for references (Use latest Editions)

1. Sericulture Manual Vol 1-3 (Mulberry cultivation) Food and Agriculture Organization of the United Nations, Rome.
2. Sarkar D.C. Ericulture in India, Central Silk Board, Government of India, Bangalore.
3. Tanaka Y. Sericology, Central Silk Board Publication, Bangalore.
4. Eikichi Hiratsuka Silkworm breeding, Oxford and IBH publications, New Delhi
5. Hrccrama Reddy, G. Silkworm Breeding, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi. 2.
6. Otsuki el.al. . Silkworm Egg Production (Translated from Japanese Language), Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.

7. Mahadevappa, D. Halliyal, V.G., Sankar, D.G and Bhandiwad, R. 2000. Mulberry Silk Reeling Technology, Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Dandin, S.B et.al.. Advances in Tropical Sericulture, National Academy of Sericulture Sciences India, Central Silk Board, Bangalore, India.

Course IV: Ecology, Evolution & Zoogeography.

Objectives

1. To develop awareness about the environment and the interaction of various components.
2. To develop an idea of the adaptations and its significance in relation to evolution.
3. To make the students aware of how organic evolution occurred and how the various life forms come into existence.
4. To make the students aware of the historical periods during the evolution of earth and status of fauna during the particular age.
5. To develop and idea of the distribution of the various faunal components.

Unit I Ecological concepts

Ecosystem structure & function. Limiting factors. Biogeochemical cycles: Carbon, Nitrogen, water and Phosphorous. Concept of Species, Population dynamics and Growth curves. Food web Pyramids & Trophic levels. Animal relationships: - Mutualism, commensalism, parasitism, competition, predation.

Unit II Ecosystems

Habitat ecology: Freshwater, Estuarine and Terrestrial ecosystems (Detailed study). Ecotone& edge effect. Air, Water, Noise& thermal Pollution. E-Waste – definition and management.

Unit III Theories of Evolution

Theories of Organic evolution. Fossils – types and formation. Evidences of evolution Convergent & Divergent evolution. Natural selection – Isolation & Speciation.

Unit IVGeological time scale

Hardy Weinberg Equilibrium & Genetic drift. Colouration - Mimicry types & Significance. Geological time scale (Pre-cambrian Eon; Up to periods for Paleozoic & Mesozoic era; up to epoch for Cenozoic era) .

Unit V Zoogeography

Zoogeographical regions – Palaearctic, Nearctic, Neotropical, Oriental, Australian and Ethiopian regions - their Climatic and faunal peculiarities. Wallace line, Discontinuous distribution - Continental Drift. Brief outlines of Human evolution.

Learning Outcome:

1. The students will be able to present an overview of diversity of life forms in an ecosystem, will be able to differ between Qualitative & Quantitative study.
2. The learner can correlate choice of habitat for organisms to Abiotic Factors, aspects of energy transfer and will be able to explain the necessity for and adaptations, providing examples.
3. Students will be able to describe the history and development of evolutionary thought, list and describe the evidence for evolution and its required corollaries & mechanisms by which evolution occurs.
4. Students will be able to describe the history of life on earth.

Books for references (Use latest Editions)

1. Verma PS, & Agarwal VK *Cell Biology, Genetics, Evolution and Ecology*, S Chand Publishers, New Delhi.
2. Arumugam N *Concepts of Ecology*, Saras Publication, Nagercoil.
3. Gupta PK, Cytology, Genetics & Evolution, Rastogi Publications, Meerut.
4. Verma PS, & Agarwal VK, *Environmental Biology: Principles of Ecology*, S Chand Publishers, New Delhi
5. Sharma PD, *Elements of Ecology*, Rastogi Publications, Meerut.
6. Chapman JL & Reiss MJ, *Ecology: Principles and Applications*, Cambridge University Press, New Delhi.
7. Odum EP, *Fundamentals of Ecology*, W.B Saunders College Publishing, Philadelphia.
8. Arumugam N *Organic Evolution*, Saras Publication, Nagercoil.
9. Benton AH & Werner WE, *Field Biology and Ecology*, Tata McGraw Hill, New Delhi.
10. Ridley M, *Evolution*, Blackwell Publishing
11. Barton NH, Briggs DEG, Eisen JA, Goldstein DB and Patel NH, *Evolution*. Cold Spring, Harbour Laboratory Press.
12. Hall BK &Hallgrimsson B, *Evolution*, Jones and Bartlett Publishers.

Skill Based II: Biostatistics & Computer Applications

Objectives

1. To develop awareness about the application of statistics in Zoology.
2. To train how the biological data are processed and interpretations are made.
3. To give an introduction to computer and data bases

Unit I Sampling & Graphs

Types of Sampling –Concept of Sampling in Biology. Frequency distribution – Individual, discrete & Continuous series.

Drawing practice: Histogram, Ogive, Bar, Pie chart.

Unit II Measures of Central Tendency

Concept & equations of Mean & deviation (individual, discrete & continuous series)

Problem Solving: (individual series alone) Mean, median, mode and Standard Deviation.

Unit III Co-relation & Regression

Concept & types of Co-relation & regression.

Problem Solving: Co-efficient of Correlation, Regression for X on Y & Y on X.

Unit IV Test of Significance

Concept of Students "t", Chi square.

Problem Solving: "t" test – independent & dependent, Chi square.

Unit V Computer Applications

Central Processing Unit – Output & Input devices – Storage devices – Software & hardware – Basic operation of MS Word, Excel & Power Point – Browsers & Search engines – Introduction to Biological databases – significance of NCBI.

Learning Outcome:

1. The course will give an idea how data should be managed & Processed.
2. The course will develop the research aptitude of the students.

Books for references (Use latest Editions)

1. Ramakrishnan P Biostatistics Saras Publication Nagercoil.
2. Arumugam N Basic Concepts of Biostatistics Saras Publication Nagercoil.
3. Banerjee PK Introduction to Biostatistics S. Chand Publication, New Delhi.
4. Pandey M Biostatistics Basic and Advanced Viva Books, New Delhi.

Core Practical II

Instruction:

The Board of studies do not encourage the dissection of animals and advised to rely of alternative digital methods. Those departments undertaking dissection should compulsorily constitute a dissection monitoring committee as per UGC rules. It is to be ensured that the animals used for dissection is not removed from the wild and is in compliance with UGC regulations time to time. It is the duty of the college/department to adhere strictly to the Wildlife Protection Act and its amendments.

Major

Estimation of dissolved oxygen of river, pond, sewage and industrial effluent.
Estimation of salinity & PH and its relation to temperature.
Estimation of free Carbon-di-oxide of water samples.
Estimation of Carbonate & Bicarbonates.
Demonstration of Vertebrate (Frog / Rat) **dissection using Multimedia** – Digestive, Brain, 5th Cranial, 10th Cranial, Urinogenital System (Wherever possible digital dissections recommended).

Minor

Estimation of pH of given water Samples
Estimation of Temperature of Given Water Samples
Mounting of Zooplankton (from local water body)
Identification of Zoogeographical realms from the world Map & Describe the specific fauna

Visit to any Polluted / Pond Ecosystem and submission of a study report with Photos.

Spotters

A. Identify the given Vertebrae / Skull - Fish, Frog, *Calotes*, Pigeon, Rat
B. Identify the Fore/Hind Limb: - Fish, Frog, *Calotes*, Pigeon, Rat
C. Comment of Animal Relation Ship: *Sacculina* on Crab /Hermit Crab & Sea Anemone.
D. Ecological Adaptation: *Chameleon, Balanus, Chaetopterus, Anabas*
E. Comment on the Evolutionary Significance; Fossil, Limulus, Analogous organs, Homologous organs.

Question Pattern: Major: 20, Minor: 10, Record: 5, Spotter: 20 (5 spotters each carry four marks), Report: 5

Course V:Cell Biology & Biochemistry.

Objectives

1. To give an insight to the ultra-structure of cellular components.
2. To give an idea about the biochemistry.
3. To give a clear idea about the how the basic metabolism occur inside the cell.

Unit I Introductory Cytology

Cell theory - Prokaryotic and Eukaryotic cells. Cytological techniques: Fixation– Sectioning & Staining. Principles & Resolving power of compound microscope, Confocal microscope and electron microscope. Cell Junctions - Ultrastructure and functions of plasma membrane.

Unit II Cell Organelles

Nucleus & Nucleolus. DNA structure and function - DNA Replication - Chromatin – Nucleosome. Chromosomes: – Structure, types, giant chromosomes. Ultrastructure and functions of Endoplasmic reticulum, Golgi body & Ribosomes.

Unit III Metabolism & Cell cycle

Ultrastructure and functions of Lysosomes, centrosomes, Mitochondria. Glycolysis and Krebs cycle. Electron transport chain and formation of ATP. Cell cycle - Mitosis, Meiosis -regulation. Apotosis& Cancer (brief outlines).

Unit IV Protein Synthesis

Types & role of RNA- Structure of t-RNA. Ultra structure, function and types of ribosome. Properties of Genetic code - Detailed study of Protein synthesis – Polysome – differences in eukaryotes – Short outline of post transcriptional modifications.

Unit V Biochemistry

Structure and Classification of Carbohydrates, Protein and lipids. Enzymes: - mechanism of action – classification and factors influencing enzyme action. Glycogenesis – Glycogenolysis, Gluconeogenesis and HMP shunt. Beta oxidation of fats.

Learning Outcome:

1. Students can can the structures and purposes of basic components of cells, especially biomolecules, membranes, and organelles.
2. Students will develop an idea how cellular components are used to generate and utilize energy in cells.
3. Students will explain the cellular components underlying mitotic cell division.
4. Students will be able apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Books for reference (Use latest Editions)

1. Arumugam N, Cell Biology & Molecular Biology, Saras Publications, Nagercoil.
2. Arumugam N, Cell Biology, Saras Publications, Nagercoil.
3. De Robertis EDP &De Robertis EMF, Cell and Molecular Biology, Lippincott Williams & Wilkins.
4. Fatima D , Narayanan LM , Meyyan RP, Nallasingam K, Prasannakumar S, Arumugam N. Biochemistry, Saras Publication, Nagercoil.
5. Gupta PK, Cell Biology, Rastogi Publications, Meerut.
6. Jain JL, Jain N & Jain S, Fundamentals of Biochemistry, S. Chand Publications, New Delhi.
7. Pawar CB, Cell Biology, Himalaya Publications.
8. Ramadevi K, AmbikaShanmugam's Fundamentals of Biochemistry for Medical Students, Lippincott Williams & Wilkins
9. Verma PS & Aggarwal VK Cell Biology S. Chand Publishers, New Delhi.

Course VI: Micro-Biology.

Objectives

1. The course is intended to make aware of the students about the classification, diversity, organization, application and pathogenicity of the microorganisms existing the ecosystem.
2. The course will help the students to learn about the various microbial culture techniques and its handling.
3. The course will give an idea that how microbes are used in various industries for generation of various products related to day to day life.

Unit I Classification

Characters and basic classification of Kingdom Monera and Fungi. Systematic position of Virus – classification - Structure of bacteriophage & HIV. Viroids and Prions. Ultra structure of *E. coli*.- - bacterial cell wall. General structure of fungi.

Unit II Bacterial culture

Bacterial growth and growth curve – factors influencing bacterial growth. Types of Culture medium – Culture of Bacteria – Sterilisation - Medium – techniques. Maintenance – Characteristics of colonies – staining of bacteria – Bio fermenters and it role in mass culture.

Unit III Food & Agriculture

Control of Microbes. Preservation of Milk. Food Spoilage: Botulism – Staphylococcal –Salmonellosis. Culture of Yeast & economic importance. Microbial Nitrogen fixation - Rhizobium – Azotobacter – Azospirillum - BGA Biofertiliser – VAM fungi – Mycorrhiza.

Unit IV Industrial Microbiology

Role of microbes in Industry –Stages – types and methods of Fermentation. Products of fermentation industry – Ethanol - Citric acid - enzymes Antibiotics –food & dairy products. Basics concepts of Probiotics

Unit V Medical Microbiology

Causative organism, transmission & preventive measures of Cholera, Typhoid, Tuberculosis, Leprosy, Syphilis, AIDS, Chicken pox Hepatitis-B, Polio, Rabies, swine flu – Chikungunya& Dengue.

Learning Outcome:

1. The students will be able to explain the taxonomy, diversity and general structure of micro-organisms.
2. They will develop knowledge about the culture, sterilization, handling, identification and assessing growth characters of microorganisms.
3. The students will develop knowledge about the general microbial techniques for isolation of pure cultures of bacteria, fungi and algae and will master the aseptic techniques to perform routine culture handling tasks safely and effectively.
4. The students will get idea about the microbial spoilage and the potentials in the usage of microbes in agriculture.
5. The students will develop an awareness about the various microbial diseases and the causative organisms.

Books for reference (Use latest Editions)

1. Dubey RC & Maheshwari DK, A Textbook of Microbiology, S. Chand Publishers, New Delhi.
2. Mani A, SelvarajA.M , Narayanan L.M , Arumugam A, Microbiology, Saras Publication, Nagercoil.
3. Pelczar MJ, Chan EC, Pelczar MF. Elements of microbiology. McGraw-Hill International Book Company.
4. Ryan KJ, Ray CG, editors. Sherris medical microbiology. McGraw-Hill Education.
5. Willey JM, Sherwood L, Woolverton CJ. Prescott's microbiology. Singapore: McGraw-Hill.

Course VII: Genetics & Immunology.

Objectives

1. Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels.
2. Students will understand causal relationships between molecule/cell level phenomena ("modern" genetics) and organism-level patterns of heredity ("classical" genetics).
3. Students will learn the mechanism of Mutation and will able to understand how mutations bring changes in an organism.
4. The course will give an insight to the cellular components involved in the immunity.
5. The course will give an awareness of the mechanism, types and concepts regarding immune response.

Unit I

Importance of drosophila in genetics – Culture methods - sex identification – common mutations. Mendelian Laws of Inheritance & Non mendalian inheritance (Incomplete dominance – Co-dominance – Polygenic inheritance – Epistasis –Lethal genes). Crossing over – Linkage in drosophila.

Unit II

Recombination in bacteria: – Transformation – Conjugation – F factor -Sexduction – Transduction –Generalised&Specialised - Plasmids. Chromosome variation (Ploidy) - Euploidy – Aneuploidy – Gene Balancing – Gynandromorphs – Barr bodies – Chromosomal abberations- Non disjunction - Klinefelter, Turner & Down syndrome.

Unit III

Gene Mutations – Types of Mutations – Physical & Chemical mutagens – DNA repair. Sickle cell anemia – Alkaptonuria – Phenyl ketonuria – albinism. Operon concept- Lac &trp operons (outlines)

Unit IV

Cells of immune system - Types of Immunity – Innate and acquired - Antigens - Structure, function and types of a antibodies. B and T cell epitopes, haptens, adjuvants. - Antigen-antibody reactions - T-Cell and B-Cell activation - Monoclonal antibodies.

Unit IV

Basic concepts of major histocompatibility complex. - Basic properties and functions of Cytokines, Interferons and complement proteins - Humoral and Cell mediated immunity. Types of hyper sensitivity. Concepts of autoimmunity and immunodeficiency - Vaccines.

Learning Outcome:

1. Students will be able to describe and apply the principles of Mendelian genetics.
2. Students will be able to describe the flow of genetic information from DNA to RNA to protein.
3. Students will be able to explain how genes are regulated.
4. The students will able to explain how mutation occur and how its role in adaptation and speciation.
5. The students will be able to develop an idea about the cellular and molecular basis of immune response.
6. The students will be able to understand the principles of self-tolerance and autoimmunity and will be able to relate the potentials of immunology in relation biotechnology and applied sciences.

Books for reference (Use latest Editions)

1. Abul Abbas Andrew H. Lichtman Basic Immunology, Saunders.
2. Delves PJ, Martin SJ, Burton DR, Roitt IM. Essential immunology. John Wiley & Sons.
3. Gardner EJ Principles of genetics. London, UK, John Wiley & Sons, Inc..
4. Meyyan RP Fundamendals of Genetics, Saras Publication Nagercoil.
5. Paul WE. Fundamental immunology. New York: Raven Press; 1989.
6. Primrose SB, Twyman R. Principles of gene manipulation and genomics. John Wiley & Sons; 2013 May 28.
7. Ramesh SR, Immunology, Mcgraw Higher Ed.
8. Strickberger MW, Genetics, Pearson publishers.
9. Verma PS & Agarwal VK Genetics, S. Chand Publishers, New Delhi.

Skill Based III: Biophysics & Instrumentation.

Objectives

1. To develop skill in understanding & handling molecular science & instrumentation.
2. To make the students capable of understanding the under lying principles of various reaction and biological interactions.

Unit I Bimolecular Interactions

Valence of carbon - Polar & non polar molecules – Covalent, ionic & Co-ordinate bonds. Hydrogen bonding - weak interactions, ester linkage, electrostatic, Disulphide& peptide bonds - Van-der Waals forces. Isomerism & optical activity.

Unit II Solutions

Hydrophiles&hydrophobes - Acid-Base concept, Molarity, Molality & Normality, Ampholyte, pH &pKa value -.Redox potential – Principles of diffusion & Osmosis – Hypo, hyper and isotonic solutions.

Unit III Thermodynamics

First & Second laws of thermodynamics, Biological applications of enthalpy, free energy, activation energy, unavailable energy and entropy, Thermodynamics of passive and active transport - high energy phosphate bond - Electron-transport chain.

Unit IV Instrumentation Principles

Principles of light microscopy & Electron microscopy - pH meter – Centrifugation – Chromarography – Electrophoresis - Colorimeter & Spectrophotometer – ECG – interpretation of electrocardiograph.

Unit V Signaling & Kinetics

Enzyme action: Michaelis-Menton equation - Vmax - Km - Line Weaver Burk plot. Action potential – refractory period – synaptic potential. Excitation & conduction of heart beat. Radio-labeling & Tracer techniques.

Learning Outcome:

1. The students will be capable of interpreting and understanding the basis of molecular biology.
2. The learner will be trained in preparing solutions and handling instruments at basic level.

Books for reference (Use latest Editions)

1. Arumugam N Cell Biology & Molecular Biology, Saras Publication, Nagercoil
2. Arumugam N Cell Biology, Saras Publication, Nagercoil
3. Fatima D , Narayanan LM , Meyyan RP, Nallasingam K, Prasannakumar S, Arumugam N. Biochemistry, Saras Publication, Nagercoil.
4. Jain JL, Jain N & Jain S, Fundamentals of Biochemistry, S. Chand Publications, New Delhi.
5. Robertis D. Cell and molecular biology. Lea &Febiger,U.S
6. Verma PS & Aggarwal VK Cell Biology S. Chand Publications, New Delhi.

Course VIII: Animal Physiology

Objectives

1. To familiarise students with the principles and basic facts of Animal Physiology.
2. To give students an insight about the molecular and cellular basis of physiological functions in animals.
3. To give an idea about the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis.
4. To make aware of the studentsabout how the structure-function relationshipssynchronisealong with the molecular signals.

Unit – I Nutrition & Respiration

Nutrition: Digestion and absorption of carbohydrates proteins and lipids. Mineral & Vitamins –its deficiency. Hormonal control of digestion. Respiratory pigments-structure of haemoglobin, Transport of O2&CO2- Bohr effect - Regulation of respiration - carbon monoxide poisoning, bronchitis, asthma - Physiological effects of smoking.

Unit – II Circulation & Excretion

Blood- composition and functions of blood plasma and formed elements, Mechanism of blood clotting, Types of Hearts – Heartbeat & pace maker – Cardiac cycle – ECG - Pulse and blood pressure. Nephron structure & mechanism of urine formation, -. Excretory products, Osmo-regulation in fishes.

Unit – III Muscle & Nerve Physiology

Brief account of types of muscles - Ultra structure of striated muscle, Muscle contraction& properties. Neurons – structure & types - Impulse propagation, synaptic transmission, neuro transmitters - Reflex action, Nerve disorders – epilepsy, Alzheimer's disease, Parkinson's disease.

Unit IV Sense Organs

Structure of eye, physiology of vision, visual elements and pigments, photo chemistry of vision - Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract - Structure of ear and mechanism of hearing - Hearing impairments – deafness, labyrinthine disease - Olfactory, gustatory and tactile sense organs

Unit V Reproductive Physiology

Puberty, adolescence, pregnancy, parturition, lactation and birth control. Endocrine glands in man - Hormones, action and disorders - Feed-back mechanism, Outlines of mechanism of hormonal activity.

Learning Outcome:

1. The students will be able to explain how the various organ systems are coordinated and controlled.
2. The students will be able to list the functions of various organs in relation to physiological process.
3. The students will develop the idea of multilevel controlling and feedback mechanism in relation to various physiological functions.
4. The students will be able to understand the basic physiological process related to adaptation, metabolism and major requirements.

Books for reference (Use latest Editions)

1. Arumugam N &.Mariakuttikan A Animal Physiology Saras Publications, Nagercoil.
2. Bhagavan NV, Medical biochemistry, fourth edition Academic Press.
3. Guyton AC, Hall JE, Text Book of Medical Physiology, Elsevier
4. Jain AK Textbook of Physiology. Avichal Publishing Company.
5. Lehninger AL, Michael Cox, Nelson DL, Biochemistry. Macmillan.
6. Tyagi BS, Agarwal VK &Verma PS Animal Physiology S. Chand Publishers, New Delhi.

Course IX: Developmental Biology.

Objectives

1. To make aware of the students about the theories, concepts and basics of Developmental Biology.
2. To provide students the idea of sex cells, fertilization, cleavage, differentiation and development of organs.
3. To make aware of the induction, organizers and development of extra embryonic structures.
4. To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing.
5. To give students idea about teratogenesis, invitro fertilization, stem cells and amniocentesis.

Unit I Gametes & Fertilization

Basic concepts of developmental biology – theories - Structure humanSpermatozoa - Structure of mammalian egg - Egg membranes Patterns of egg - Spermatogenesis – Oogenesis. Fertilization – mechanism and significance – Parthenogenesis.

Unit IIBlastulation& Gastrulation

Cleavage - Planes & Patterns of cleavage - Factors controlling cleavage - Fate map. Blastulation – Morphogenetic movements - gastrulation frog & chick.

Unit III Organogenesis

Development of Brain, Eye and Heart in frog. Development of Nervous system in chick &Foetal membranes in chick & Mammals.

Unit IV Applied Embryology

Organizer concept –Structure – mechanism of induction and competence. Nuclear transplantation - teratogenesis – Regeneration: types - events and factors. Transgenic mice - Retroviral method – Microinjection method - Embryonic stem cell method. Methods to culture embryo.

Unit IVPlacentation & Techniques

Placentation in Mammals –Ostrous - Menstrual cycle and menopause - Pregnancy – trimesters – development. *Erythroblastosisfoetalis* -Twins – types. Infertility – causes - Test tube baby and Assisted Reproductive Technology – Embryo transfer – Amniocentesis.

Learning Outcome:

1. The learner will be able to understand methodological approaches to the study of embryonic development and the characteristics of the principal experimental models.
2. The students will be able to identify embryonic structures in preparations, photographs and diagrams.
3. The students will be able to develop an idea, how to arrange sequences in developmental processes in order.

4. The learner will be able to understand the derivatives of embryonic structures.
5. The students will be attain a basic conceptual knowledge of the principal cellular mechanisms of development and identify the genetic and molecular elements that are involved.
6. The studentswill be able to explain the clinical implications of development and the mechanisms that intervene in developmental alterations.
7. The students will be able to apply the principles of the development in applied sciences like Biotechnology, Genetic engineering and Molecular Biology.

Books for reference (Use latest Editions)

1. Arumugam NA Text Book of Embryology, Biotechnology Saras Publication Nagercoil.
2. Balnisky BI An Introduction to Embryology, W.B. Saunders and Co.
3. BerrilNJ,Kars G(1986). Developmental biology, McGrawHills
4. Gilbert SF (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
5. Majumdar NN Vetebrate embryology; Tata McGraw-Hill, New Delhi.
6. Verma PS & Agarwal VK Chordate Embryology, S. Chand Publishers, New Delhi.

Course X:Biotechnology.

Objectives

1. The objective of this course is to give a firm foundation in the fundamentals of modern Molecular techniques.
2. The course will give and insight to the mechanism of Gene Expression and Regulation.
3. The course will give idea about a nut shell idea of various protocols followed in Biotechnology in relation to animal science.

Unit IRecombinant DNA technology

Restriction endonuclease – sequence recognition. DNA Ligase. Identification & isolation of gene of interest - Cloning vectors and recombination –. Screening of recombinant DNA. Application of recombinant DNA technology. Commercial production of Insulin. Human Genome Project.

Unit II Molecular Techniques

Methods to isolate DNA – PCR types, Principle& applications. Electrophoresis – types and Principle. Blotting – types – applications. DNA finger printing and its applications –RAPD – FISH- RFLP. DNA probes & diagnosis.

Unit III Animal tissue culture

Applications – Primary culture. Steps involved in mammalian cell culture- *He la*&*WI38* cell lines – Maintenance of cell lines – Techniques and Application of organ culture. Animal cloning – Dolly.

Unit IV Applications

Genetically modified Animals- Single cell Protein from microbes – Biofuels – Solid waste management – Liquid Waste Management – Biogas production - Biopesticides. Production of bacterial, fungal algal and yeast biomass – Mushroom Culture.

Unit V Enzyme Biotechnology

Microbial production & application of enzymes – Ribozymes- Artificial enzymes- Immobilization of enzymes methods and its application. Biosensors - Cryobiology – Methods of cryo-preservation.

Learning Outcome:

1. The course will give an idea about thevarious techniques used in modern biotechnology.
2. The course will give an insight to the current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, animal and forensics.
3. The learner will be able to understand how microbes is used engineer various genes.
4. The students will be able to explain the general principles of generating genetically modified organisms and modern artificial methods in biotechnology.

Books for reference (Use latest Editions)

1. Brown TA. Gene cloning. London: Chapman & Hall; 1995.
2. Kumaresan V Biotechnology Saras Publication Nagercoil
3. Primrose SB, Twyman R. Principles of gene manipulation and genomics. John Wiley & Sons; 2013 May 28.
4. Robertis D. Cell and molecular biology. Lea &Febiger,U.S
5. Verma PS & Agarwal VK Genetic Engineering, S. Chand Publishers, New Delhi

Core Practical III: Cell Biology & Biochemistry, Animal Physiology & Developmental Biology.

Major

Squash Preparation of Onion root tip – stages of Mitosis
Estimation of RBC & WBC in human Blood (Not for colleges offering CLT)
Oxygen consumption of fresh water fish
Identification of given biochemical sample –Monosacchride, Polysacchride, Aminoacid, Protien, Lipid.
Analysis of excretory products- Ammonia, urea and uric acid

Minor

Study of opercular movement of a fish at 10 degree increase and Q10.
Activity of Salivary Amylase (Qualitative).
Preparation of Haemin crystals
Estimation of Hemoglobin

Spotters:

1. Giant Chromosome (Demonstration of Polytene chromosome preparation)
2. Meiosis sub stages in Prophase I. (Demonstration suggested with Pollen of any Liliacea)
3. Kymograph (Demonstration of Muscle twitch with PowerPoint)
4. T.S of Pituitary, Thyroid, Adrenal, Ovary and testis
5. Sperm of Man
6. Egg of Frog
7. Blastula of Frog
8. Gastrula of Frog
9. Development of Chick 18, 24, 48, 72hr
10. Placenta of Sheep, Rabbit.

Question Pattern: Major: 20, Minor: 10, Record: 5, Spotter: 25 (5 spotters each carry 5 marks).

Core Practical IV: Microbiology, Genetics, Immunology & Biotechnology.

Major Practical

Isolation of DNA from any fruit/tissue.
Preparation of Culture Media – Liquid & Solid
Enumeration of microbesin soil
Gram staining.
Thin layer chromatography of any Biological sample (Optional).
Estimation of activity of Protease & Amylase.

Minor

Quality of Milk – MBR test.
Mounting of given fungi.
Antigen – Antibody reaction – ABO blood group
Sterilization of the Culture Medium in Autoclave / pressure cooker
Estimation of sugar in given wine sample.
Determination of Motility of Microbe – Hanging drop (Do not use curd as Lactobacillus is not motile)

Spotters

Drosophila male and female.- Genetic importance, Giant Chromosome, Spirullina, Yeast, Penicillin, Antibiotic sensitivity test, Thymus gland, Autoclave/ Pressure Cooker, Electrophoresis unit, Culture media –Plate, Slant & Broth, Azolla, WIDAL kit , VDRL kit , Mushroom seeds, Bio-pesticide (BT/Fungi), Biofertiliser (Nitosomonas/ Rhizobium /Phosphobacter)

Visit to an industry or lab of Biotechnology or Microbiological importance. Report should be submitted in the Practical

Question Pattern: Major: 20, Minor: 10, Record: 5, Spotter: 20 (5 spotters each carry 4 marks), Report: 5

Skill based IV:Skill based Practical

Major

1. Preparation of Chromate solution at various 5 concentration, measure the OD to verify Beer Lambert law.
2. Prepare isotonic, hypotonic and hypertonic solution and put a drop of blood and observe under the microscope.
3. Measure the length of given leaf (or any other of choice) samples (minimum 20 samples) and calculation of mean, median, mode and Standard Deviation.
4. Given is two groups of samples A & B. A contain 10 leaves (or any other of choice) of a locality and B from other species or locality. Measure the length and check do the samples differ significantly using students "t".

Minor

1. Preparation of Buffer (acetate/ phosphate/ citrate/ borate)of given pH.
2. Identification, sorting and percentage calculation of different types of cocoons.
3. Based on the given values calculate the Correlation coefficient.
4. Based on the given values calculate the regressionequation based on a variable.

Spotter

Mulberry leaf, Silk worm moth, Different instars of larvae, Cocoon,Fungal Parasite of Silk Worm, light microscope, pH Meter, Centrifuge, Chromatograph, Colorimeter.

Report

Visitto Silk farms or commercial silkworm rearing houses or in house training in college.

Question Pattern: Major: 15, Minor: 10, Record: 5, Spotter: 10 (5 spotters each carry 2 marks) Report: 5 marks.

Elective Course: Human Genetics & Counseling

Objectives

1. The give an idea about various aspects of human genetics, heredity and genetic diseases.
2. To train students to seek the possibilities of identifying Human genetics as a Profession.

Elective IA: Human Genetics and Counseling I

UnitI:Chromosome

Human chromosome – International system of Nomenclature - Chromosome number, Idiogram, Banding methods (Q, C, G and R banding).

UnitII:Inheritance

Monogenic traits, autosomal inheritance, dominant, recessive, Sex-linked inheritance, Sexlimited and sex-influenced traits, mitochondrial inheritance, MIM number, consanguinity and its effects,

UnitIII:Pedigree

Pedigree,gathering family history, pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees, - Complications to the basic pedigree patterns.

Unit IV: Syndromes

Human chromosomal disorders (Syndromes) Disorders of chromosome structure and disorders of chromosome number-Trisomy 18, Down's syndrome, Trosomy 13, Cri-du chat syndrome, Parder-ville syndrome, Jacob's syndrome Robertson Syndrome,Cystic fibrosis, Muscular dystrophy, Thalassemia, Major Fragile x Syndrome.

Unit V: Metabolic errors

Non-Mendelian Inheritance-Mitochondrial disorder, Sex mosaicism - uniparaentalDisomy and Genomic Imprinting. In-born errors of metabolism: Alkaptoneuria – Galactosemia - Gaucher's disease - Glucose-6-phosphate dehydrogenase deficiency -Tay-Sach's disease, Niemann Pick disease..

Elective IA: Human Genetics and Counseling II

Unit I: Blood group

Blood groups (major types) - Blood transfusion - *Erythroblastosisfoetalis*. Physiology and genetics of blood groups. Population genetics: Hardy-Weinberg principle and its application in human population.

Unit II: Diagnosis

Prenatal diagnosis: Chorionic villi sampling, foetoscopy, ultrascopy, amniocentesis - peripheral blood leucocyte culture. Dermatoglyphics: Terminology, methods of observation and printing, dermatoglyphic features of syndrome.

Unit III: Brain diseases

Degenerative brain diseases: Stroke - Alzheimer's disease - Parkinson disease. Chromosomal position effect and gene variegation - epigenetic control of gene activity. Molecular medicines in cancer therapy. Microarray as a tool for detection of human genetic disorders

Unit IV: Behavioural genetics

Genes related to behaviour - Genetic and environmental manipulations, learning and memory. Dementia – Schizophrenia - Mood disorders - Anxiety disorders - childhood personality disorders - antisocial personality - criminal behavior.

UnitV:

Human Genome Project – History - Sequencing of Human Genome - Promises and Achievements - Ethical, Legal and Social issues. Other Genome Projects initiated as a direct consequence of HGP completion,Human Genome Diversity Project.

Learning Outcome:

1. The course will give an idea about the various genetic disorders.
2. The course will give an insight about the opportunities in Human Genetics.
3. The students will be able to explain the genetic disorders and prompt them to undertake genetics as subject of research in higher studies.

Books for reference (Use latest Editions)

1. Gangane SD Human Genetics Elsevier.
2. Gardner EJ Principles of genetics. London, UK, John Wiley & Sons, Inc..
3. Meyyan RP Fundamendals of Genetics, Saras Publication Nagercoil.
4. Strickberger MW, Genetics, Pearson publishers.
5. Verma PS & Agarwal VK Genetics, S. Chand Publishers, New Delhi

Elective Course: Pest and their Control

Objectives

1. The course is framed to make the learner aware of various pest & its control methods.
2. To train the students to handle the pest outbreak in Agricultural fields.

Elective IB :PEST AND THEIR CONTROL I

Unit I

Introduction, definition and causes for insect assuming pest status Classification of pest Types of damage caused by pests Importance of pest control Pest survaivilance and forecasting and pest outbreak.

Unit II

General characters, bionomics and control measures of following agricultural pests
Pests of paddy:
1. *Tryporyzaincertulus* (Lepidoptera) 3. *Orseoliaoryzae* (Diptera)
2. *Hieroglyphusbanian* (Orthoptera) 4. *Dicladisarmigera* (Coleoptera)
Pests of Wheat:
1. *Anaphothripssudanensis* (Thysonoptera) 2.*Odentodermis obesis* (Isoptera) 3. *Mythimana separate* (Lepidoptera).

Unit III

General characters, Bionomics and control measures of following agricultural pests
Pests of sugarcane:
1 *Chiloinfuscatellus* (Lepidoptera) 2. *Pyrillaperpusilla* (Hemiptera)
3. *Aleurolovusbarodensis* (Hemiptera) 4. *Scirphophaganivella* (Lepidoptera)
Pests of cotton:
1. *Pectinophoragossypiella* (Lepidoptera) 2. *Aphudsgossypii* (Hemiptera) 3. *Eariasvitella*(Lepidoptera) 4. *Dysdercuscingulatus* (Hemiptera).

Unit IV

General characters, Bionomics and control measures of following agricultural pests.***Pests of cereals:***
1.*Chilopartellus* (Lepidoptera) 2. *Antherigonasoccata* (Diptera).
Pests of Pulses:
1.*Helicoverpaarmigera* (Lepidoptera) 2. *Melanogromyza* obtuse (Diptera)
Pests of vegetables:
1.*Leucinodesorbonalis* (Lepidoptera) 2. *Pierisbrassicae* (Lepidoptera) Pests of fruits:
1.*Papilio demolues* (Lepidoptera) 2. *Daccuscucurbitae* (Diptera).

UnitV

General characters, Bionomics and control measures of pests
Stored grain pests:
1.*Triboliumcastraneum* (Coleoptera) 2.*Sitophillus oryzae* (Coleoptera) 3.*Tricoderma granarium* (Coleoptera).
House hold pests:
1. Bed bug, 2. House fly, 3. Human louse, 4. Cockroach and 5. Mosquitoes.

Elective IB: PEST AND THEIR CONTROLII

Unit – I

Principles and methods of pest control using techniques such as mechanical, biological, ecological, cultural, genetic techniques – sterile male techniques, Quarantine, legislative measures.

Unit – II

Classification of insecticides: Based on mode entry, mode of action, chemical nature-inorganic, organic compounds- DDT, Endosulfan, Fenitrothion, Malathion, Monocrotophous, OximeCarbamates.

Unit – III

Insecticide formulations and application technology: Dusting and dusters, sprayers – Mannually operated – Hydraulic sprayers, Power operated – Pneumatic sprayer, Aerosols, Fumigants, Baits.

Unit – IV

Integrated Pest Management (IPM), Chemosterilants, Sex attractants, Pheromonal control.

Unit – V

Pest other than insects – Rat, Crab, Snail, Birds – Peacock, Parrot, Concept of host-pest interaction.

Learning Outcome:

1. The course will give an awareness about various pests and their control measures.
2. The students will be able to handle pest outbreak in a locality.

Books for reference (Use latest Editions)

1. Imms AD Text book of Entomology Vol. I & II Ed. By Richard and Owen. ELBS
2. Metcalf RL, Luckmann WH, editors. Introduction to insect pest management. John Wiley & Sons.
3. Nair K.K.Anandhakrishnan TN & David BV General and applied Entomology. Tata Mc.Graw Hill Publ. Delhi.
4. Pedigo LP. Entomology and pest management. Macmillan Publishing Company.

Elective Course: Wildlife Management &Conservation

Objectives

1. The course is framed to train the students about various wildlife techniques.
2. To train the studenst to find job opportunities as biologists in Reserves.

Elective IC: Wildlife Management & Conservation I

Unit I Introduction to Wildlife

Scope and opportunities of Wildlife Sciences – Major types of forest types of India - Protected areas – Sanctuaries - National Parks – Tiger reserves – Biosphere Reserves and their role.

Unit II Wildlife Conservation

IUCN Red Data list – CITES – Endangered Mammals of India & Conversation – Project Tiger & Project Elephant. Conservation of Indian rhino, lion &Thar. Importance of Zoo in Conservation

Unit III Ornithology

Terms used in description of Birds Plumage & parts – Types of Bills – Types of feet – Identification of birds in the field based on tail, bill, crest, leg &colour.

Unit IV Indian Butterflies

Butterflies & Moths – Identification of types of Swallowtails: Club tails – Roses - Bird wings – Mime –Mormon – Raven - Helen - peacock – Jay – Blue bottles – Sword tails – Zebra. Whites, sulfurs and orange-tips.

Unit V Important Reserves

History, Location, Habitats, Fauna and importance of Mudumalai Tiger Reserve – Sathyamangalam Tiger Reserve – KalakkadMundanthurai Tiger Reserve – Anamalai Tiger Reserve – Gulf of Mannar.

Elective IC: Wildlife Management & Conservation II

Unit I Wildlife Techniques.

Peadometer – Field Compass – GPS – Introduction to GIS – Camera traps – Quadrates - Line transects – Presence/Absence Survey.

Unit II Wildlife Census.

Planning census – sample counts – Block counts – Roadside counts – Dung count – Pugmark & waterhole census – Identifying animals based on indirect signs – Capture recapture techniques – tiger, co-predator monitoring census methods (WII) – usage of Mstripes.

Unit III Animal Behaviour

Foraging behaviour - group foraging - Breeding seasons - factors - courtship, polyandry, polygamy - promiscuity - brood parasites –Aggression – Competition – Social spacing – Territory –Social behaviour of elephants and lion.

Unit IV Wildlife Conservation

Joint Forest Management - Tribes & forestry programmes - Watershed management – Deforestation – impacts – Afforestation – Habitat fragmentation – corridors – Human Animal Conflicts – Mitigation of Conflicts.

Unit V WPA&Ecotourism

Brief outlines of WPA1972 and amendments - Biological diversity Act 2002 - Forest right Act 2008. Ecotourism – Potentials of eco-tourism as Career of a Zoology graduate.

Learning Outcome:

1. The course will give an idea about the wildlife Management techniques..
2. The course train the students to conduct wildlife related surveys and analyses the wildlife related threats.

Books for reference (Use latest Editions)

1. Ali S, Ripley SD. Handbook of the birds of India and Pakistan. Compact edition. Oxford University Press and BNHS, Mumbai. Ali, S. and SD Ripley.
2. Caughley G, Sinclair AR. Wildlife ecology and management. Blackwell Science.
3. Divan S, Rosencranz A. Environmental law and policy in India: Cases, materials and statutes. New Delhi: Oxford University Press.
4. Kehimkar ID. Book of Indian butterflies. Oxford University Press; 2008.
5. Prater SH, Barruel P. The book of Indian animals. Bombay: Bombay Natural History Society.
6. Sale JB, Berkmueller K. Manual of wildlife techniques for India.

Elective Course: Pathology & Clinical Laboratory Technology

Objectives

3. The course is framed to make the learner well aware of various methods practiced in a clinical lab.
4. To train the students to find job opportunities in Clinical labs.

Elective IIA: Pathology & Clinical Laboratory Technology I

Unit I Basic laboratory principles:

Organization of clinical laboratory - Safety measures - Chemical, fire & Electrical - Lab Technician Duties and Responsibilities - Professionalism & Ethics in laboratory workers, Modern Laboratory set up - Clinic borne infection and personnel hygiene.

Unit II Basic Laboratory Equipments:

Light Microscope – Incubator - Hot Air Oven – Autoclave - Laminar Air flow Chamber - Water Bath -- Centrifuge –Haemocytometer -Albuminometer - Urinometerhaemoglobinometer - Microtome - Glassware –Description of Glassware, its use, handling and care.

Unit III Preparation of Reagents:

Buffer and pH - Preparation of Normal, Per cent and Molar solutions - Physiological saline, Clinical Laboratory records- -Quality control: Accuracy, Precision, and Reference values, use of chemicals and their interactions, danger signs, production techniques, and disposal methods.

Unit IV Basic Clinical Chemistry:

Collection of blood – Anticoagulants - Separation of Serum and Plasma - Blood cell count & differential count – Estimation of Haemoglobin (Sahlis&Cyanmethemoglobin) - Clotting time -bleetting time – ESR – PCV – Blood smear & staining for observation parasites.

UnitV Automation in Clinical Laboratory:

Semi & Fully Autoanlaysers – ELIZA – Use of PCR – HaematologyAnalysers – Cell counters – HPLC analysis for Haemoglobin fractions.

Elective IIA: Pathology & Clinical Laboratory Technology II

Unit I Function Tests

Renal function tests, Liver function tests, Arterial blood gas analysis.

Unit II Body fluids

Urine: Collection &preservation - Composition – volume – appearance &odour - Specific gravity - Microscopic examination. Measurement of glucose & protein. Faecal examination: Microscopic – Occult blood – Helminthes Parasites. Semen analysis: count & motility.

Unit III Microbiology &Cytology

Wet Preparations of microbes - Staining preparations: Simple – Differential - Special staining methods Bacterial Identification and Antibiotic susceptibility testing. FNAC – smear & fixation – PAP Staining – Biopsy for cancer.

Unit IV Histopathology

Microtomy: Fixating – dehydration – clearing – infiltration - embedding – Block preparation –Sectioning – Mounting – Staining. Principle of double(H & E stain) – PASM Staining.

Unit V Blood Transfusion

Screening of donor compatibility testing, safety, procurement of supplies. Screening donor's blood for infectious agents -HIV, HCV, HBV, *Trepanoma palladium*, *Plasmodium*, HTLV-Bacterially contaminated Blood. ABO – Rh blood groups - other red cell antigens and antibodies. Coombs test.

Elective IIA - Practical:Pathology & Clinical Laboratory Technology

Major Practical

2. Total count of RBC.
3. Total count of WBC.
4. Differential count of Blood
5. Microscopic identification of pus or cast cells and qualitatively check for the presence of blood in Urine
6. Smear the given bacteria with Gram's staining and interpret the result.

Minor Practical

1. Estimation of Haemoglobin by Sahlis Method.
2. Estimation of Bleeding & Clotting time
3. Estimation of specific gravity& Albumin in Urine.
4. Semi-quantitative estimation of glucose in urine.
5. Qualitatively detect the presence of bile salts&Urobilinogen in urine.

Spotters

Malarial parasite, Filarial parasite,Tape Worm, ESR, Autoclave, Microtome, Coomb's test, Spermatozoa, Incubator, Water bath, Centrifuge.

Report

Report of visit/ training to a clinical lab of nearby locality.

Question Pattern: Major: 10, Minor: 08, Record: 04, Spotter: 06 (2 spotters each carry 3 marks) Report: 2 marks.

Learning Outcome:

1. The course train the students to be a technician in the clinical lab.
2. The students will be through with the various clinical protocols and instrument handling

Books for reference (Use latest Editions)

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1. Mukherjee KL. Medical Laboratory Technology Volume 1, 2 & 3. Tata McGraw-Hill Education
2. Pagana KD, Pagana TJ. Mosby's Manual of Diagnostic and Laboratory Tests-E-Book. Elsevier Health Sciences.
3. Sachdev KN. Clinical Pathology and Clinical Bacteriology. Jaypee Brothers Publishers.
4. Talib VH, Khurana SR. Handbook of medical laboratory technology. CBS Publication, New Delhi.
5. Varley H. Practical clinical biochemistry. Practical clinical biochemistry.

Elective Course: Poultry Science and Management

Objectives

5. The course is framed to make the learner well aware of various methods in Poultry Science and its management.
6. To train the students to undertake Poultry farming as income source.

Elective II B: Poultry Science and Management - Paper – I

Unit I

History and importance of poultry forming role of the poultry in rural development employment potential. Economic and contributions to national productivity egg, production. Table bird production, manure as by product. Anatomy and physiology of poultry birds with reference to digestive and reproductive system.

Unit II

Breeds of poultry birds and scientific methods of breeding, hybrid selecting and parents for production factors for selection, hatching, selecting eggs for hatching natural and artificial incubation. Types of incubators maintenance of temperature and humidity sterilization of room during hatching separation and culling.

Unit III

Poultry house and equipment's, space requirements. Types of house, number of birds equipment's of feeding production from enemies and adverse condition.

Unit IV

Nutrition of poultry birds: requirement according to age feed formation Classification breeds-stuffs milling by-product, distillers and by-product. Availability raw materials and their cost food graders and uses of antibiotic.

Unit V

Brooding and rearing: sexing, vaccination- natural and artificial brooding. Types of brooding, temperature requirement, culling, debarking, characters of good layers and broilers. Capunetts and capons, rearing of chick.

Elective II-B: Poultry Science and Management Paper – II

Unit I

Management of layers Changes in feeding programme - space requirements - Lighting requirements. Summer and monsoon management - Care of egg - Hen sampling – Cannibalism - Debeaking - Culling Profitability

Unit II

Broiler Management Charateristics of the Broiler chicks - Housing of broiler chicks - Optimum Conditions Feeding and Feed formulations – Sampling - Disease and Health Management Diseases Caused by Viruses, Bacteria and Worms

Unit III

Marek‟sRanikhet Diseases – Fowl pox – Coccidiosis – Worms and other Parasites. Toxicosis and an account of aspergillosis – Aflotoxicosis – Salmonella – Health Cover – Antibiotics – Vaccination and Deworming and Insecticide Treatment, Egg drop syndrome

Unit IV

Marketing, grading and preservation of egg – packing and transportation of eggs – Difference between dark and pale yellow yolk and its taste.

Unit V

Different uses of eggs in preparation of bakery products and other edible items – Nutritive values of egg – relationship between customers, maintenance of prices.

Practical - Poultry science and Management

1) Brooding of poultry bird and their characteristic
2) Preparation of poultry feeds
3) Incubation of Eggs: Temperature and humidity control. Egg rotation –we of candles for eradication of unfertilized eggs. Transfer of chicks to pens.
4) Preparation of poultry pens of chicks spreading of husk in-floor location of feeders and watering equipment arrangements of electric lamps adjustment of height.
5) Feed rotation watering use of antibiotics poultry pens hygiene-clearing of poultry pens.
6) Screening of birds for foot, beak and feather cleanliness isolation of diseased/injured specimens, separation aggressive cannibalistic birds.
7) Sexing, debeaking. Introduction of males.
8) Position of nest marking layers maintains of records.
9) Vaccination of insecticide treatment.
10) Deworming and removal of faecal matter.
11) Biochemical estimation of nutritive contents in a hen‟s egg (demonstration)

Report

Visit to poultry markets/farm /study of specific marketing problems/ in house training in college.

Question Pattern: Major: 10, Minor: 08, Record: 4, Spotter: 06 (2 spotters each carry 3 marks) Report: 2 marks.

Outcome:

1. The course will give an idea how to manage a Poultry farm.
2. The students will be aware about the various procedures involved in Poultry Science..

Books for reference (Use latest Editions)

1. Jadav NV &Sidique MF Handbook of Poultry Production and Management Jaypee Publishers.
2. Banarjee JC &Mandal L Poultry Oxford & IBH.

Elective Course: Apiculture

Objectives

7. The course is framed to make the learner well aware of various methods of beekeeping and the uses of its appliances.
8. To train the students to undertake Apiculture practice.

Elective Course II C: Apiculture I

Unit I Introduction to Bees

Scope & Advantages. Kinds of Honey bee -Apisdorsata – Apisflorea – Apisceranaindica – Trigonairidipennis. Honey Bee colony: Worker - Queen – Drones. External Morphology of Worker Bee.

Unit II Life Cycle & Anatomy

Life cycle &Development of Honey Bee.Food of Honey Bee –Nectar – Pollen – Royal Jelly – Honey. Pollen, Nectar &Water foraging – Swarming.

Unit II Life Cycle & Anatomy

Location & Preparation of Apiary. Acquiring of honey Bees – Catching & caring swarm; Basket – Moderb Hive – Decoy Hive – Pot Hive. Package Bees. Nucleus Colony. Handling of Honey Bees.

Unit III Primitive Beekeeping.

Primitive Beekeeping & structure of Hives - Modern Beekeeping & structure of Hives Advantages and disadvantages of these methods.

Unit IV Apiary Appliances.

Appliances used in Apiary: Comb frame – foundation sheet – Dummy dividion board – Drone & Queen excluder – Swarm trap – Smoker – Uncapping knife –Bee veils – Honey extractor – Bee brush –feeders.

Unit V Extraction & Preservation.

Honey extractor – Methods of extraction, Processing, Packing & Storage. Marketing of Honey.

Elective Course II C: Apiculture II

Unit I Honey

Types of Honey – Properties of Honey – Nutritional and Medicinal value of Honey. Bee Wax – Properties and uses. Methods to identify original honey.

Unit III Stocks & Economics

Uniting of Stocks – Uses & Principles - Methods of uniting. Artificial feeding methods. Economics of Beekeeping: Preparation of project – Infrastructure cost –recurring – expected income and gain – Methods to obtain loan.

Unit IV Queen rearing

Need principles & procedure: Hopkins – Miller – Alley – Doolittle Methods. Rearing calendar – Requirements for Queen rearing – Queen introduction & caring – Grafting.

Unit II Enemies

Damages and preventive measures for Wasps - Greater & Lesser wax moths - Wax Beetles - Black Ants Birds & Mammals.

Unit IV Diseases.

Description of Parasite, Symptoms, Transmission, Diagnosis & Control of Brood Disease and Adult diseases.

Elective Course III C: Apiculture - Practical

Major Practical

a. Extraction of Honey.
b. Setting up of a Newton Hive (Cardboards and others can be used).
c. Estimation of Glucose in Honey.
d. Mounting of Pro, Meso& Meta thorasic legs of Honey bee.
e. Dissection of Wax glands (Optional).

Minor Practical

a) Mounting of Mouth parts.
b) Identifying the quality of Honey.
c) Qualitative identification of Glucose, Fructose & Sucrose in Honey.

Spotters

a) Identification & Description of Whole mount of types of Honey bees.
b) Identification & Description of types of Primitive & Modern Hives.
c) Identification & Description of Appliances Used in Apiary.
d) Identification & Description of Parasites of Honey bee.
e) Identification & Description of Worker, Drone & Queen.

Report

Report of visit or training or in house apiculture in college.

Question Pattern: Major: 10, Minor: 08, Record: 04, Spotter: 06 (2 spotters each carry 3 marks) Report: 2 marks.

Learning Outcome:

1. The course train the students about the honey bee rearing.
2. The students will develop the idea about types of Apiary and appliances.
3. The students will learn how to extract and produce honey.

Books for reference (Use latest Editions)

1. Jayashree KV, Tharadevi CS &ArumugamN Apiculture, Saras Publication Nagercoil.
2. Sammataro D, Avitabile A. The beekeeper's handbook. Cornell University Press;
3. Sanford MT, Bonney RE. Storey's Guide to Keeping Honey Bees: Honey Production, Pollination, Bee Health. Storey Publishing;
4. Sathe TV Fundamental of Beekeeping Daya Publishing House