UNIVERSITY OF KERALA

First Degree Programme in Zoology

Choice Based Credit and Semester System

Zoology Core Course

Syllabus-2015 Admission Onwards

FIRST DEGREE PROGRAMME IN ZOOLOGY

Scheme of Instruction and Evaluation

Semster	Course Code	Study Components	Instructional Hrs/week		Credit	Duration of Univ. Exam	Evaluation		Total Credit
			T	P			CE	ESE	
I	EN1111	English I	5		4	3 Hrs	20%	80%	16
	1111	Additional language I	4		3	3 Hrs	20%	80%	
	EN 1121	Foundation course I	4		2	3 Hrs	20%	80%	
	CH1131.4	Complementary course I	2		2	3 Hrs	20%	80%	
		Complementary course I Practical of CH1131.4		2					
	BO1131	Complementary course II	2		2	3 Hrs	20%	80%	
		Complementary course II Practical of BO1131		2					
	ZO1141	Core Course I	3		3	3 Hrs	20%	80%	
		Core Course Practical of ZO1141		1					
II	EN1211	English II	4		3	3 Hrs	20%	80%	17
	EN1212	English III	5		4	3 Hrs	20%	80%	
	1211	Additional language II	4		3	3 Hrs	20%	80%	
	CH1231.4	Complementary course III	2		2	3 Hrs	20%	80%	
		Complementary course III Practical of CH1231.4		2					
	BO1231	Complementary course IV	2		2	3 Hrs	20%	80%	
		Complementary course II Practical of BO1231		2					
	ZO1241	Core Course II	3		3	3 Hrs	20%	80%	
		Core Course Practical of ZO1241		1					
III	EN1311	English IV	5		4	3 Hrs	20%	80%	**17**
	EN1312	Additional language III	5		4	3 Hrs	20%	80%	
	CH1331	Complementary course V	3		3	3 Hrs	20%	80%	
	CH1331.4	Complementary course V Practical of CH1331.4		2					
	BO1331	Complementary course VI	3		3	3 Hrs	20%	80%	
	BO1332	Complementary course VI Practical of BO1331		2					
	ZO1341	Core Course III	3		3	3 Hrs	20%	80%	
	ZO1341	Core Course Practical of ZO1341		2					
IV	EN1411	English V	5		4	3 Hrs	20%	80%	**29**
	EN1411	Additional language II	5		4	3 Hrs	20%	80%	
	CH1431.4	Complementary course VII	3		3	3 Hrs	20%	80%	
	CH1432.4	Complementary course Practical of CH1131.4, CH1231.4, CH1331.4, CH1431.4.		2	4	3 Hrs	20%	80%	
	BO1431	Complementary course VIII	3		3	3 Hrs	20%	80%	
	BO1432	Complementary course Practical of BO1131, BO1231, BO1331, BO1431		2	4	3 Hrs	20%	80%	
	ZO1441	Core Course IV	3		3	3 Hrs	20%	80%	
	ZO1442	Core Course V Practical I, of ZO1141, ZO1241,ZO1341		2	4	3 Hrs	20%	80%	

CONTD/-

Scheme of Instruction and Evaluation

Semster	Course Code	Study Components	Instructional Hrs/week		Credit	Duration of Univ. Exam	Evaluation		Total Credit
			T	P			CE	ESE	
V	ZO1541	Core Course VI	4		4	3 Hrs	20%	80%	14
	ZO1542	Core CourseVII	4		4	3 Hrs	20%	80%	
	ZO1543	Core CourseVIII	5		4	3 Hrs	20%	80%	
	ZO1551	Open Course I	3		2	3 Hrs	20%	80%	
		Core Course Practical of ZO1441		6					
		Project		2		3 Hrs	20%	80%	
		Field study/ Study tour		1					
						3 Hrs	20%	80%	
VI	ZO1621	Foundation Course II	5		4	3 Hrs	20%	80%	27
	ZO1641	Core Course IX	4		4	3 Hrs	20%	80%	
	ZO1642	Core Course X	4		3	3 Hrs	20%	80%	
	ZO1651	Open Course II	3		2	3 Hrs	20%	80%	
	ZO1643	Core Course XI Practical II of ZO1441, ZO1541, ZO1542		2	4				
	ZO1644	Core Course XII Practical III of ZO1543, ZO1621		2	3	3 Hrs	20%	80%	
	ZO1645	Core Course XIII Practical IV of ZO1641, 1642		2	3				
	ZO1646	Project, Field Study & Study tour		3	4	3 Hrs	20%	80%	

FIRST DEGREE PROGRAMME IN ZOOLOGY
SCHEME OF INSTRUCTION OF CORE COURSES, FOUNDATION COURSE II & OPEN COURSES

Course code	Course Title	SemI			Sem II			Sem III			SemIV			Sem V			Sem VI			Total	
		Contact Hour		Credit	Contact Hour		Credit	Contact Hour		Credit	Contact Hour		Credit	Contact Hour		Credit	Contact Hour		Credit	Contac Hour	Credit
		T	P		T	P		T	P		T	P		T	P		T	P			
ZO1141	ANIMAL DIVERSITY I	3		3																3	3
ZO1241	ANIMAL DIVERSITY II				3		3													3	3
ZO1341	METHODOLOGY & PERSPECTIVES OF ZOOLOGY							3		3										3	3
ZO1441	CELL BIOLOGY										3		3							3	3
ZO1442	PRACTICAL I, OF ZO1141,1241,1341		1			1			2			2	4							6	4
ZO1541	GENETICS & BIOTECHNOLOGY													4		4				4	4
ZO1542	IMMUNOLOGY & MICROBIOLOGY													4		4				4	4
ZO1543	PHYSIOLOGY AND BIOLOGICAL CHEMISTRY													5		4				5	4
ZO1551	OPEN COURSE													3		2				3	2
ZO1621	GENERAL INFORMATICS, BIOINFORMATICS AND MOLECULAR BIOLOGY																5		4	5	4
ZO1641	DEVELOPMENTAL BIOLOGY AND EXPERIMENTAL EMBRYOLOGY																4		4	4	4
ZO1642	ECOLOGY, ETHOLOGY, EVOLUTION AND ZOOGEOGRAPHY																4		3	4	3
ZO1651	OPEN COURSE – II																3		2	3	2
ZO1643	PRACTICAL –II CELL BIOLOGY, MOLECULAR BIOLOGY, IMMUNOLOGY & MICROBIOLOGY														2		2	2	2	4	4
ZO1644	PRACTICAL-III PHYSIOLOGY AND BIOLOGICAL CHEMISTRY AND BIOINFORMATICS														2			2	3	4	3
ZO1645	PRACTICAL –IV DEVELOPMENTAL BIOLOGY,ECOLOGYETHOLOGY, EVOLUTION AND ZOOGEOGRAPHY														2			2	3	4	3
ZO1646	ZOOLOGY PROJECT														2			3	4	6	4
	FIELD STUDY & STUDY TOUR														1						

First Degree Programme under CBCSS
Semester I
Zoology Core Course I
Animal Diversity I Course code – ZO1141

No. of Credits – 3 **Total hours 54**

Aim of the course

To provide the students with an in-depth knowledge of the diversity in form, structure and habits of invertebrates.

Objectives of the course

- To learn the basics of systematic and understand the hierarchy of different categories.
- To learn the diagnostic characters of different phyla through brief studies of examples.
- To obtain an overview of economically important invertebrate fauna.

Module I **4 hrs**

Introduction to Zoology: Taxonomy-Definition, history, new trends and importance, mention molecular taxonomy. Components of classification, Taxonomical hierarchy – taxon, category and rank, Linnaean hierarchy, nomenclature, principles of nomenclature. International Code of Zoological Nomenclature (ICZN), rules of nomenclature, requisite – uni, bi and trinomialism. Mention taxonomic aids.

ModuleII **6 hrs**

Kingdom Protista: General characters, structure, zoological importance and systematic position of *Actinophrys, Noctiluca, Paramecium* and *Opalina*. Parasitic protozoans- Morphology, life history, pathogenicity and prophyllaxis of *Entameoba histolytica* and *Plasmodium vivax.*

ModuleIII **6 hrs**

Kingdom Animalia: Outlines of classification – Subkingdom Mesozoa, Subkingdom Parazoa, Subkingdom Eumetazoa. Levels of organization– cellular, tissue, organ. Divisions of Eumetazoa- Radiata, Bilateria, Acoelomata, Pseudocoelomata, Eucoelomata, Protostomia, Deuterostomia.

Sub kingdom Mesozoa- General characters, eg. *Rhopalura.*

Sub kingdom Parazoa- General characters, Mention the classes of Porifera- Calcispongia, eg.*Sycon*; Hydrospongia, eg. *Euplectella;* Desmospongia, eg. *Spongilla.*

General topic: Canal system in sponges.

Module IV

Subkingdom Eumetazoa **4hrs**

Phylum Coelenterata: General characters (self study). Classes- Hydrozoa eg. *Obelia,Physalia*; Scyphozoa eg. *Aurelia* ; Anthozoa eg. *Madrepora*.

General topic: Polymorphism in coelenterates, Coral and Coral Reef.

Module V **8 hrs**

Phylum Platyhelminthes: General characters (self study). Classes- Turbellaria eg. *Planocera*; Trematoda eg. *Fasciola* ; Cestoda, eg. *Taenia solium*.

Phylum Nematoda: General characters (self study), Parasitic nematodes- eg. *Ascaris, Ancylostoma, Enterobius, Wuchereria* [Morphology, life history, pathogenicity and prophyllaxis], *Caenorhabdites elegans* (Brief account)**.**

Phylum Annelida: General characters (self study). Classes Polychaeta eg. *Nereis*(mention *heteronereis*), Oligochaeta eg. *Earthworm*, Hirudinea eg. *Leech.*

ModuleVI **16 hrs**

Phylum Arthropoda: General characters (self study), **Type- *Penaeus***. Mention the classes. eg. Cockroach, *Limulus, Eeupagurus, Sacculina*, Honey bee, *Daphnia, Artemia, Drosophila, Mosquito-mouth parts.* Study of crop pests: Pest of paddy-*Leptocorisa,Spodoptera,Nilapaarvata*; Pest of coconut- *Oryctes,Rhynchophorus,Eriophyes* .

Phylum Onychophora: General characters, eg. *Peripatus* (Evolutionary significance).

General topic: Sericulture

Module VII **10 hrs**

Phylum Mollusca: General characters (self study), Classes- Monoplacophora, eg. *Neopilina;* Amphineura, eg. *Chiton;* Aplecophora, eg. *Neomenia* , Gastropoda eg. *Pila;* Scaphopoda, eg. *Dentalium*; Pelicypoda eg. *Perna* Cephalopoda, eg. *Sepia, Octopus*.

General topic- Economic importance of mollusca, Pearl culture, Mussel culture.

Phylum Echinodermata: General characters (self study), Classes- Asteroidea, eg. *Asterias;* Ophiuroidea, eg. *Ophiothrix;* Echinoidea, eg. *Echinus*; Holothuroidea, eg. *Sea cucumber*, Crinoidea, eg. *Sea lily*. General Topic:Water vascular system.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Barnes, R.D. (1987). Invertebrate Zoology. W. B. Sunders. New Delhi.
- Barrington E.J.W. (1967). Invertebrate Structure and Function. ELBS and Nelson, London.
- Bhaskaran.S.S. Nonchordate Zoology, Manjusha Publications.
- Brusca, R.C . and G. J. Brusca. (1940). Invertebrates. SinauerAssociates, Sunderland, M.A.
- Dhami, P.S and Dhami, J. K. (1979). Invertebrate zoology. R. Chand &Co. New Delhi.
- Ekambaranatha Ayyar M. (1990). A Manual of Zoology. Vol. 1.Invertebrata- Part 1 & Part11. S. Viswanathan Printers and Publishers.Pvt. Ltd.
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- Jordan, E.L and Verma, P.S. (2000). Invertebrate Zoology. S. Chand and Co Ltd. New Delhi.
- Kotpal, R.L, Agarwal, S.K. and R.P. Khetarpal. (2002). Modern text book of Zoology Invertebrates.
- Majpuria, T.C. Invertebrate Zoology. Pradeep publication, Jalandar.
- Marshall, A. J. and Williams, W. D. (1972). Text book of zoology vol. 1 Invertibrates. ELBS & MacMillan, London.
- Nigam, S. (1978). Invertebrate Zoology. S. Nigam& Co.
- Parker, T.J and Haswell, W. A. (1962). Text book of Zoology. Vol.I Invertebrate. LBS and MacMillan, London.
- Pearse, V., Pearse, J., Buchsbaum, M. and Buchsbaum, R. (1987). Living Invertebrates. Blackwell Scientific Publications, California.
- Ruppert, E.E., Fox, R. and Barnes, R.D., (2004). Invertebrate Zoology. Thomson Books/Cole, U.S.A.
- The New Encyclopedia Britannica. Macropedia. 15th Ed. 1998. Encyclopedia Britannica Inc. Chicago.
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First Degree Programme under CBCSS
Semester II
Zoology Core Course II
Animal Diversity II
Course Code – ZO1241

No. of credits – 3 **Total hours 54**

Aim of the course

To provide the students with an in-depth knowledge of the diversity in form, structure and habits of vertebrates.

Objectives of the course

- To learn the general characteristics and classification of different classes of vertebrates.
- To understand the vertebrate evolutionary tree.
- To understand general aspects of applied interest.

Module I **5 hrs**

Phylum Chordata: Chordate characters and their classification into three Sub phyla (self study). **Subphylum Urochordata**- General characters, Class Larvacea eg. *Oikopleura* ; Class Ascidiacea eg. *Ascidia* (Mention -Ascidian tadpole larva, Retrogressive metamorphosis) and Class Thaliacea eg. *Salpa.* **Subphylum Cephalochordata-** General characters, eg. *Amphioxus* (Mention feeding behaviour).

Module II **6 hrs**

Subphylum Vertebrata: General characters, **Division 1 Agnatha** -General characters, Class Cyclostomata eg.*Petromyzo*n, Class Ostracodermi; **Division 2 Gnathostomata** –General characters, Classification into Super class Pisces and Tetrapoda. **Super class Pisces**- General characters and classification, **Class Placodermi, Class Chondrichthyes**- Sub class Elasmobranchii eg. *Shark,* Sub class Holocephali eg.*Chimaera***; Class Osteichthyes-** Sub class Choanichthyes- Order1 Crossoptergii eg *Latimeria*, Order 2 Dipnoi eg.*Protopteru*s, Subclass Actinopterygii-Super order Chondrostei eg *Acipenser.* Super order Holostei eg *Lepidosteus*, Super order Teleostei eg *Anabas, Clarius, Saccobranchus, Ophiocephalus, Echeneis*.

General topic: Accessory respiratory organs in fishes, Dipnoians.

ModuleIII **4 hrs**

Super class Tetrapoda: Salient features**, Class Amphibia -** General characters (self study). Classification**-** Order Urodela eg. *Amblystoma***,** Order Anura eg. *Hyla* ,Order Apoda eg. *Ichthyophis.*

General topic: Parental care in Amphibia.

Module IV **9hrs**

Class Reptilia - General characters (self study). Classification - Subclass Anapsida -

Order Chelonia eg. *Chelone*; Subclass Parapsida eg *Ichthyosaurus*; Subclass Diapsida- Order Rhynchocephalia eg. *Sphenodon*, Order Squamata- Suborder Lacertilia eg.*Chamaeleon*, *Draco, Hemidactylus*, Suborder Ophidia eg. (Poisonous snakes) *Naja*, *Vipera, Bungarus, Enhydrina*; (Non poisonous snakes) *Ptyas, Lycodon*, *Dryophis, Typhlops* and *Eryx johni*, Suborder Crocodilia eg. *Crocodilus, Alligator*; Subclass Synapsida eg *Cynognathus.*

General topic: Identification of poisonous and nonpoisonous snakes; Venom, mode of action and its uses.

Module V **5hrs**

Class Aves- General characters (self study). Classification- Subclass Archeornithes eg: *Archeopteryx*; Subclass Neornithes- Super order Paleognathae eg. *Sruthio* and *Emu*; Super order Neognathae eg. Pigeon (External features, Feathers).

General topic: Migration in birds. Flightless birds, Flight adaptations in birds.

Module VI **19hrs**

Class Mammalia – Detailed study: Anatomy of *Homo sapiens.* General characters and classification of Class Mammalia - Subclass Prototheria eg. *Tachyglossus;* Subclass Metatheria eg. *Macropus*; Subclass Eutheria - Order Insectivora eg. *Paraechinus,* Order Dermoptera eg. *Galeopithecus,* Order Chiroptera eg.*Pteropus*, Order Primates eg. *Loris*, Order Carnivora eg. *Panthera leo*, Order Cetacea eg. *Delphinus*, Order Perissodactyla eg. *Equus,* Order Artiodactyla eg . *Camelus*, Order Proboscidia eg. *Elephas.* Order Sirenia eg. *Dugong*, Order Hyracoidea eg. *Procavia*, Order Rodentia eg.*Rattus*, Order Lagomorpha eg. *Oryctolagus*, Order Edentata eg. *Dasypus novemcinctus* (Armadillo), Order Pholidota eg. *Manis*, Order Tubilidentata eg. *Orycteropus.*

General topic: Dentition in mammals, Egg laying mammals, Aquatic adaptations in mammals.

Module VII **5 Hrs**

Comparative account of Brain and Arterial system of pisces, amphibian, reptiles, aves and human.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Bhaskaran, K. K. and Biju Kumar, A. (2003). Chordate Zoology. Manjusha Publications. Calicut.
- Ekambaranath Iyer. (2000). A Manual of Zoology. Vol. II S. Viswanathan and Co.
- Jordan E. L. and P. S. Verma. (2002). Chordate Zoology. S. Chand and Co. New Delhi
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First Degree Programme under CBCSS

Semester III
Zoology Core Course III
Methodology and Perspectives of Zoology
Course code – ZO1341

No. of Credits – 3 **Total hours 54**

Aim of the course

To introduce the methodology and perspectives of Science in general so as to enable the students to systematically pursue Zoology in relation to other disciplines that come under the rubric of science.

Objectives of the course

- To learn the fundamental characteristics of science as a human enterprise
- To understand how science works
- To study to apply scientific methods independently

Module– I **10 Hrs**.

Introduction to Science:

Science- Definition, Major branches (Physical, Life and Earth science) Fields of science in biology, Scientific Methods (observation, prediction, experiment, hypothesis, consistency, theory) Scientific theory, Scientific Law, Scientific Revolution, Scientific naming, Scientific temper, Empiricism, Hypothetico deductive and inductive models, Simulation and virtual testing, Evidences and Proofs Impact of science in human life - Positive and negative aspects. Types of knowledge: Practical, Theoretical and Scientific knowledge; Information,Pseudoscience.

Module – II **10 Hrs**

Experimentation in science:

Design of experiments-observation, data collection, nature and types of data (typical examples), treatment of data, data interpretation, significance of statistical tools in data interpretation. Experimentation: Selection of controls, Observational requirements, Instrumental requirements. Types of experiments: Experiment to test a hypothesis, to measure a variable or to gather data by preliminary and explorative experiments.

Observations: Direct and indirect observations, Controlled and uncontrolled observations, Human and machine observations.

Sampling methods: Qualitative sample, Quantitative sample, Random sample, Non random samples. Ethics in science: (brief account only), publications and patents, plagiarism .

Module III

Data collection and presentation : **14 Hrs**

Introduction to Biostatistics: Variable and attribute; Population vs. Sample; Census vs. Sample survey; Arrangement of data; Frequency distribution.

Graphical presentation of data: Line diagram; Bar diagram; Pie chart; Histogram.

Measures of central tendency: Arithmetic mean; Mode; Median.

Measures of dispersion: Variance; Standard deviation; Standard error of mean; Standard score.

Testing of hypothesis and goodness of fit: Null hypothesis, Level of significance, Probability, Normal distribution, Error of inference, Student's t-test, Paired t-test, Fisher's t-test, Chi-square test.

Module – IV **12 Hrs**

Methods in Biological Science and Solutions:

Microscopes: Principle, Types of microscopes- Dissection microscope, Light microscope, Dark field microscope, Fluorescent microscope, Phase contrast microscope, Electron microscope (SEM, TEM); Microtome (Different Types), Embedding, sectioning and staining techniques of light microscopy; Preservation of biological specimens: Taxidermy, Fossils, Dead animals (formalin); Photometry: Colorimetry and Spectrophotometry, Principle, Working and uses.
Autoradiography: Principle, mechanism, and significance; Centrifugation: Principle and their applications; Chromatography: Principle and uses.

Module V **8 Hrs**

Nature and scope of Zoology:

Branches of Zoology, Opportunities as Zoologist, Institutes of Zoological and Scientific importance in India- Location, major achievements and present activities (academic and scientific) [Zoological Survey of India, Central Marine Fisheries Research Institute, Central Institute of Fisheries Technology, Rajiv Gandhi Centre for Biotechnology, Bioinformatics Centre and Library, Indian Institute of Science, Stem Cell Institute, National Institute of Immunology, Centre for Cellular & Molecular Biology, Centre for DNA Fingerprinting and Diagnostics, Central Drug Research Institute].

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Aggarwal, S.K. (2008) Foundation course in Biology. Ane Books India, New Delhi.
- Arora PN and PK Malhotra (1996) Biostatistics, Himalaya Publishing House.
- Bajpai, P. K. (2008) Biological instrumentation and methodology. S. Chand and Company Ltd.
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- Debbie Holmes, Peter Moody and Diana Dine. (2006) Research methods for the biosciences, International students' edition. Oxford university press.
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- Norman,T.J. Bailey (2007) Statistical methods in biology, 3rd edition. Cambridge university press.
- Sokal & Rohif(1973) Introduction to Biostatistics – Toppan Co Japan
- Veerbala Rastogi. (2008) Fundamentals of biostatistics. Ane books India, Chennai.

First Degree Programme under CBCSS
Semester IV
Zoology Core course IV
Cell Biology
Course code – ZO1441

No. of credits – 3 **Total hours 54**

Aim of the course

To educate the student on the fundamental structure, biochemistry and function of the cell.

Objectives of the course

- To study the ultra-structure of prokaryotic and eukaryotic cells

Module I **30 hrs**

History, development and scope of cell biology, discovery of cells; cell theory and its modern version (self study).

Cell and its components: Basic types of cells- prokaryotic and eukaryotic, nature and comparison (self study)

Ultra structural organization and functions: Plasma membrane- ultra structure- fluid mosaic model, functions of plasma membrane, trans-membrane transport.

Cell communication- cell signaling and signal transduction, basic elements involved**.**

Mitochondria- structure, functions, mention oxidative phosphorylation and electro transport chain.

Endoplasmic reticulum - morphology, types, functions and formation.

Golgi bodies - morphology, types, functions (role in secretion) and formation.

Lysosomes- morphology, mention major groups of enzymes, classification, polymorphism and functions.

Microbodies - morphology, major enzymes, peroxisomes and glyoxisomes functions.

Ribosomes - different types, subunits, functions**.**

Proteosomes - structure, ubiquitin - tagged protein degradation.

Centrioles and basal bodies- structure and functions.

Cytoskeleton- microtubules, microfilaments and intermediate filaments- examples and functions.

Interphase nucleus - gross structure and functions**;** nuclear envelope- pores and pore complexes; nuclear lamina, formation of NE**;** nucleoplasm- nature and importance**.**

Nucleolus - structure, nucleolar cycle, nucleolar organizer and functions.

Chromatin - euchromatin and heterochromatin, nucleosomes, unit fibre, solenoid fibre, and higher order of organization, condensation and coiling.

Chromosome - structure of a typical metaphase chromosome; giant chromosomes- polytene chromosomes, lamp brush chromosomes; endomitosis.

Module II **8hrs**

Cell Division**:** cell cycle- G_1, S, G_2, and M phases (mention G_0, and D_0 stages and their significances); amitosis (brief account only). Mitosis (self study). Meiosis: description of all stages, synaptonemal complex, significance

Module III **3 hrs**

Biology of cancer: characteristics of cancer cells, dedifferentiation of cancer cells, theories of cancer, carcinogenesis, oncogenes and tumor suppressor genes

Module IV **3 hrs**

Aging: cellular and other changes, apoptosis, causes of aging, mention free radicals and superoxide dismutase (SOD).

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Alberts, B. *et al*. Molecular Biology of the Cell. Garland Pubg. Inc., New York
- Beker, W. M. *et. al*. (2004) The World of Cell. Pearson Edn., Singapore
- Bhaskaran, K. K. & Biju Kumar, A. Cell Biology, Genetics & Molecular Biology. Manjusha
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- De Roberties, E. D. P. *et al*. Cell and Molecular Biology TMH
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- Karp G. (2005). Cell and Molecular Biology. 4 e, John Wiley & Sons, Inc.
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- Verma, P. S. & Agarwal, V. K. Cytology. S. Chand & Co.
- Vijayakumaran Nair, K. & Jayaprakash, M. Cell Biology, Genetics, Molecular Biology. Academica, TVM.
- Watson, J.D. *et al*., Molecular Biology of the Gene, 4e, Benjamin Cummings

First Degree Programme under CBCSS
Zoology Core Course V
Practical - I

Practical I - Methodology and Perspectives of Zoology, Animal Diversity I and II

Course Code – ZO1442

No. of credits – 4

Aim of the course

To provide a hands on training experience in anatomy through simple dissection and mountings

Objectives of the course

- To familiarize students with conventional organ system in common, easily available animals.
- To emphasize the adage that 'seeing is believing' typical examples and economically important specimen (preserved) to be studied.

Methodology and Perspectives of Zoology

1. Preparation of Normal and Molar solutions
2. Preparation of Buffers (Acidic, Neutral and Alkaline Buffers)

Study of the following instruments (Any four)

1. Compound microscope
2. Centrifuge
3. Colorimeter
4. Microtome
5. pH Meter

Animal Diversity I

Minor Practicals - Any four.

1. Nereis – parapodium
2. Earthworm – body setae
3. Cockroach – salivary apparatus in situ
4. Cockroach – mouth parts
5. Honey bee – mouth parts / mosquito - mouth parts
6. Prawn – appendages (Any Three- Maxillipeds1,2,3, Chelate leg, First abdominal appendage)

Major Practical – (Any Two)

1. Earthworm – nervous system
2. Cockroach – nervous system
3. Prawn – nervous system

Taxonomy

Identification , Classification up to class and brief note of the following specimens.

1. Protista – *Actinophrys, Noctiluca, Pramecium, Opalina* – any 2
2. Phylum Porifera – *Euplectella, Spongilla*- any 1
3. Phylum Cnidaria – *Hydra, Obelia, Physalia, Aurelia,* Sea anemone, Madrepora – any 3
4. Phylum Nematoda – *Ascaris*- male and female (entire)
5. Phylum Platyhelminthes – *Bipalium, Fasciola, Teania solium* – any 1
6. Phylum Annelida – Earthworm*, Nereis*, Leech, *Aphrodite, Arenicola* – any 1
7. Phylum Onychophora – *Peripatus*
8. Phylum Arthropoda – Cockroach, *Limulus, Eupagurus, Sacculina*, Honey bee, *Lepisma,* Scorpion – any 3
9. Phylum Mollusca – Chiton, *Pila*, *Xancus, Dentalium*, *Perna*, *Mytilus, Teredo*, *Sepia, Octopus.* – any 2
10. Phylum Echinodermata – Starfish, Brittle star, Sea urchin, Sea cucumber, Sea lily – any 2

Animal Diversity II

Minor practical

1. Fishes - Placoid scales of *Scoloidon* and cycloid and ctenoid scales of *Anabas*
2. Fish - Brain [Demonstration only]

Major practical

1. Fish – Viscera [Demonstration Only] Flag label the parts and write notes.
2. Fish – Alimentary canal [Demonstration Only] Flag label the parts and write notes.

Osteology

Identify and write notes of the following bones.

Human limb bones, girdles, typical vertebra, atlas, axis, thoracic and lumbar vertebrae and lower jaw.

Turtle - carapace and plastron.

Taxonomy

Identification , classification up to order and brief note of the following specimens.

1. Prochordates –*Amphioxus (entire)*
2. Pisces - 2 cartilaginous fishes, 2 fishes with accessory respiratory organs, 2 edible fishes, 2 culture fishes and 2 Cat fishes.
3. Amphibia - any 3 (representing the three orders).
4. Reptilia - 2 poisonous and 2 non -poisonous snakes, *Draco, Chamaelon*
5. Aves - Different feathers, Pigeon.
6. Mammals - Bat

Compulsory assignment for practical

Animal Diversity I (20% of practical CE)

Each student shall take photographs of one invertebrate, identify, collect sufficient data regarding the animal and submit a detailed printed report including taxonomy for evaluation to class tutor.

Animal Diversity II (20% of practical CE)

Each student shall take photographs of one vertebrate, identify, collect sufficient data regarding the animal and submit a detailed printed report including taxonomy for evaluation to class tutor.

First Degree Programme under CBCSS
Semester V
Zoology Core Course VI
Genetics and Biotechnology
Course Code – ZO1541

No. of credits – 4 **Total hours 72**

Aim of the course

To educate the students on the underlying genetic mechanism operating in man and state of the art bio-techniques

Objectives of the course

- To learn the mechanism of crossing over and inheritance patterns in man.
- To understand the principles and techniques involved in DNA technology and get an overview of modern techniques like PCR, Hybridoma technology, gene therapy and human cloning

Genetics **37hrs**

Module 1 **8hrs**

Introduction: Mendel and his experiments, Correlation between Mendel's theory and chromosome behaviour (self study); Genetic terminology-gene, allele, genotype, phenotype, genome; wild type and mutant type, test cross, back cross and reciprocal cross.

Interaction of genes: Allelic-incomplete dominance (flower colour in 4 'O'clock plant), lethal (yellow coat colour mice) and co-dominance (human ABO blood group system); Non allelic-complementary gene action (flower colour in sweet pea), Co-epistasis (comb pattern in fowl), dominant (feather coat in fowl) and recessive (coat colour in mice), polygenic action (skin colour in human), pleiotropism (sickle cell anaemia in human). Multiple alleles- ABO Blood group system, Rh group and its inheritance.

Module II **8hrs**

Linkage and crossing over: Linkage- Linked genes, linkage groups, Views of Sutton, Bateson, Morgan on linkage, Chromosome theory of linkage; Kinds of linkage- Complete (Drosophila bent wing shaven abdomen),Incomplete linkage (Drosophila-purple eye and vestigial wing);significance of linkage: **Crossing over**- Mechanism of meiotic crossing over, kinds of crossing over, factors affecting crossing over, significance crossing over; Chromosome mapping-Cross over value, two point test cross, Three point test cross (brief account only), basic steps of construction of gene map.

Sex Linkage: Characteristics of sex linked inheritance, sex linked inheritance of man (colour blindness and haemophilia), incompletely sex linked genes, holandric genes (hypertrichosis in man), sex limited genes(plumage pattern of birds) and sex influenced genes(baldness in man).

Module III **8hrs**

Sex Determination: Sex determining mechanism-Sex chromosomal mechanism (XX-XY, XX-XO, ZZ-ZW), Genic balance theory, Environmental factors on sex determination, Hormonal control of sex differentiation; Mention Barr bodies, Dosage compensation, Lyon hypothesis, Sex mosaicism, Gynandromorph and Hermaphrodite; Sex determination in man (Role of Y chromosome).

Module IV **6hrs**

Mutation: Chromosomal mutations – structural aberrations, numerical aberrations; Induced mutation (physical, chemical); Significance of mutation.

Module V **3hrs**

Cytoplasmic inheritance: Mitochondrial DNA, kappa particles in paramecium, maternal effects in Drosophila.

Module VI **4hrs**

Human Genetics: Karyotyping, normal chromosome compliment, pedigree analysis, chromosomal anomalies in man, autosomal (eg. Down syndrome, Edwards syndrome), allosomal (eg. Klinefelters syndrome, Turner's syndrome)

Biochemical genetics**:** Human biochemical genetics, biochemical pathway of phenyl alanine, tyrosine metabolism in normal man. Disorders-Phenylketonuria, Alkaptonuria, Tyrosinosis and Albinism.

Biotechnology **35 hrs**

Module VII **9hrs**

Introduction-Scope of biotechnology, Branches of biotechnology.

Genetic engineering and recombinant DNA technology: History, Procedure of genetic engineering , (restriction endonucleases, ligases), major steps in cutting and joining of DNA , Vectors - plasmids, cosmid, bacteriophage; probes, linkers, host cells, method of recombinant DNA formation-transformation, transfection and non bacterial transformation.

Module VIII **6hrs**

Genomic library, construction of genomic library and cDNA library, Polymerase Chain Reaction-basic steps and applications of PCR, DNA sequencing (Sanger method, Automated sequencing), patenting DNA sequences.

Module IX **5hrs**

Blotting Techniques: Southern, Northern and Western blotting, DNA fingerprinting.

Module X **6hrs**

Human Genome Project, hybridoma technology and monoclonal antibodies; gene transfer techniques (chemical treatment, electroporation, lipofection, microinjection, retro viral vector method, embryonic stem cell method and shot gun method); transgenic microbes, plants and animals.

Module XI **4hrs**

Gene therapy: somatic gene therapy and germ line gene therapy; gene doping and its implications; DNA vaccines; Human cloning –therapeutic and reproductive cloning.

Module XII **5hrs**

Practical applications of biotechnology-in medicine, agriculture, industry, pollution control, forensics and judiciary. Potential hazards of biotechnology. Bio-ethics - problems and solutions.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

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First Degree Programme under CBCSS
Semester V
Zoology Core course VII
Immunology and Microbiology
Course code – ZO1542

No. of credits – 4 **Total hours 72**

Aim of the course

To update the student on the scope and importance of clinical immunology and create an awareness about the inherent dangers of microbes

Objectives of the course

- To enable the student to understand the principles and mechanisms of immunology
- To learn the malfunctioning and disorders of the immune system
- To get a broad understanding of microbes and their economic importance with special reference to pathogenic forms.

Immunology **42 hrs**

Module I **2hrs**

Introduction: History, development and scope.

Module II **3hrs**

Immunity: Definition, classification of immunity. Innate (non-specific)– species, racial and individual IM with examples, acquired (specific)– active IM (natural and artificial) with examples, passive IM (natural and artificial) examples.

Module III **6hrs**

Immune system: Organs and tissues of the immune system. Primary (central) - thymus, bone marrow, bursa of fabricii; secondary (peripheral)- spleen, lymph nodes, MALT etc. Cells lymphocytes – T cells and B cells – formation, development and maturation; plasma cells and null cells – natural killer cells, killer cells, lymphokine - activated killer cells; phagocytes / macrophages; antigen presenting cells – macrophages, B-lymphocytes, dendrite cells, Langerhans cells; follicular dentrite cells, neutrophils, eosinophils, basophils, mast cells. Mitogens – mention only

Module IV **14hrs**

Antigens (immunogens) (Ag): Definition, complete antigens, haptens, antigenic determinants or epitopes; antibodies (Immoglobulins)- definition, general structure of Ig, Ig determinants, physico-chemical properties of Ig, classes of Ig- G, M, A, D, E; mention abnormal Igs;antigen – antibody reactions**-** mechanism (mention zone phenomenon), precipitationreactions, agglutination reactions, complement fixation, neutralization, opsonisation (brief accounts only)

Complement system: Definition, general features, major histocompatibility complex (MHC) (brief account only). Immune response- definition, types of immune responses- humoral immune response (antigen mediated immunity - AMI) and cellular immune response (cell mediated immunity - CMI) in detail.

Module V **17 hrs**

Hyper sensitivity / allergy: Definitions, classification- types I, II and III (Brief accounts only); immuno deficiency diseases (ID)- definition, primary IDs, disorders of immune mechanism (humoral, cellular and combined IDs), disorders of complements, disorders of phagocytosis, mention one example each, secondary IDs - mention example.

Acquired Immune Deficiency Syndrome (AIDS), Auto immunity-definition, mechanism, mention AI diseases; transplantation immunity-definition, classification of transplants, graft versus host reactions, graft rejection, mechanism of graft rejection, factors affecting graft survival.
Immunisation and vaccination- definitions, vaccines; types of immunization- active immunization- killed and live attenuated vaccines, microbial extracts, vaccine conjugates, toxoids, recombined vaccines, DNA vaccines; passive immunization- pooled normal human Igs, specific Igs (hyper antisera); combined immunization

Microbiology **30 hrs**
Module VI **14hrs**
Introduction: History, development and scope Importance of microbes in various ways- beneficial, harmful and ecological.
Classification of microbes/ particles: Broad classification- Viruses, different groups, examples; mention viroids and prions, *Mycoplasmas, Rickettsiae* and *Chlamydiae*; Bacteria:1. Archaea – significance of extreme life forms (*Methanoarchaea*, extreme halophiles and thermophiles); Eubacteria (=Bacteria), Major groups of Eubacteria; Modern methods classification of Eubacteria - Nonphotosynthetic proteobacteria:- (Fermentative Rods and Vibrios) ex. *Vibrio, Pasteurella* (oxidative rods and cocci) eg. *Pseudomonas, Azotobacter, Rhizobium;* Chemo-lithotrophic bacteria:- eg. nitrifying, sulphur and iron bacteria; Firmicutes (eg. Staphylococcus) and Actinobacteria (Coryneform bacteria); Phototrophic bacteria (Cyanobacteria); Algae-(brief study) Protista- different groups- examples: *Plasmodium* ; Fungi- Mention different groups – example *Candida.* Structure of a bacteriophage and a typical bacterium

Module VII **4 hrs**
Applied microbiology: various fields: emphasis on environmental, agricultural, medical, biotechnological, industrial and strategic fields

Module VIII **12hrs**
Symbiotic microbes: microbes with other microbes, microbes with plants microbes with animals; microbe – human host interactions, normal human microbiota of various organs- mention any 3 examples, pathogenic microbes – mention any 3 examples, microbial toxins – mention any 2 examples.
Microbial diseases in man (skin, respiratory system etc.)- viral – chicken pox, measles, cold, herpes, hepatitis, poliomyelitis; bacterial – diphtheria, pneumonia, leprosy, ornithosis; fungal – aspergillosis, candidiasis and others – malaria

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

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- Chakraborty, P. A.: A Text book of Microbiology. New Central Book Agency, Kolkotta
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First Degree Programme
Semester V
Zoology Core Course VIII
Physiology and Biological chemistry
Course Code – ZO1543

No. of credits – 4 **Total hours 90**

Aim of the course

To improve the student's perspective of health and biology through in-depth study of human physiology

Objectives of the course

- To study the different systems and the inherent disorders/ deficiencies involved therein.
- To learn the structure and functions of bio-molecules and their role in metabolism

Physiology **60hrs**

Module I **6hrs**

Nutritional Physiology: Introduction, types of nutrition, mechanical and chemical changes of food in the alimentary canal**,** balanced diet, nutritional disorders – PEM , vitamin deficiency , deficiency of iron, iodine and calcium**,** lifestyle diseases**,** role of fibres, nervous and hormonal control of digestion

Module II **8hrs**

Circulatory Physiology: Blood- Composition and functions of blood plasma and formed elements, blood groups, mechanism of blood clotting, intrinsic and extrinsic pathways, disorders of blood clotting, anticoagulants**,** heartbeat, conducting system and pace maker, pulse and blood pressure, clinical significance, control of cardiac activity**,** common cardio vascular diseases – arteriosclerosis, atherosclerosis, Myocardial infarction**,** electrocardiogram, angiogram, angioplasty. Lymph and lymphatic system (brief account)

Module III **8hrs**

Respiratory Physiology: Gas exchange, respiratory pigments- structure of haemoglobin**,** transport of O_2- Oxyhaemoglobin curve, Bohr effect, transport of CO_2 -carbonic acid, carbamino haemoglobin, bicarbonate and chloride shift, regulation of respiration – neural and chemical; respiratory disturbances – apnoea, dyspnoea, hypoxia, hypo and hyper capnia, asphyxia, carbon monoxide poisoning, bronchitis, asthma. Physiological effects of smoking.

Module IV **8hrs**

Renal Physiology: Nephron – Structure, Urine formation, Role of hormone in urine formation and concentration, Counter-current multiplier system,Role of kidney in osmoregulation, composition of urine, abnormal constituents of urine, regulation of kidney functions, renal disorders – nephritis, haematurea, renal calculi, acidosis and alkalosis – Dialysis and kidney transplantation.

ModuleV **8 hrs**

Muscle Physiology: Brief account of types of muscles, fast and slow twitch muscles, red and white muscles. Ultra structure of striated muscle fibre, muscle proteins, simple muscle twitch, summation, tetanus, tonus, All or None law, fatigue, oxygen debt, rigor mortis. Physiological and biochemical events in muscle contraction.

Module VI **6 hrs**

Nerve Physiology: Neurons – structure, types of neuron (self study). Synapse and types of synapse, nerve impulse propagation, synaptic transmission. Reflex action, refractory period, neuro transmitters, electro encephalogram. Nerve disorders – epilepsy, Alzheimer's disease, Parkinson's disease.

Module VII **5 hrs**

Sensory Physiology: Structure of eye and ear (self study). 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

Module VIII **3hrs**

Reproductive physiology: Male and female reproductive organs (self study). Reproductive Cycles (role of hormones), puberty, adolescence, pregnancy, parturition, lactation and birth control.

Module IX **8hrs**

Endocrinology: Endocrine glands in man, hormones and disorders, feed-back mechanism, mechanism of hormonal activity.

Biological chemistry **30hrs**

Module X **8hrs**

Biomolecules in relation to animals: Micromolecules, macromolecules, water, buffer systems and importance;

Carbohydrates-structure, classification- monosaccharides (trioses, tetroses, pentoses, hexoses, aldoses, ketoses), disaccharides and polysaccharides (homo and hetero polysaccharides); biological functions of carbohydrates.

Lipids- classification- simple lipids, (neutral fats and waxes), conjugated lipids (phosphor lipids, sphingo lipids, glyco lipids, lecithins, cephalins, cerebrosides, gangliosides), derived lipids (fatty acids, steroids, prostaglandins), biological functions of lipids.

Proteins - classification of proteins, amino acids- basic structure, structure of proteinprimary, secondary, tertiary and quaternary structures, haemoglobin as atypical protein, biological functions of proteins.

Module XI **16hrs**

Metabolism in animals: Carbohydrate metabolism – glycogenesis, glycogenolysis, hexose monophosphate shunt, metabolic pathway of glucose- glycolysis, kreb's cycle, electron transport series, chemi-osmotic theory, energetic; hormonal control of carbohydrate metabolism.

Lipid metabolism – hydrolysis of lipid, beta oxidation, mention alpha and omega oxidation of fatty acids, hormonal control of lipid metabolism, hormonal control of lipid metabolism.

Protein metabolism – deamination, transamination, formation of urea, hormonal control of protein metabolism.

Module XII **6hrs**

Enzymes: Chemical nature, mechanism of enzyme action, factors affecting enzyme activity, kinetics of enzyme action, Michaelis – Menten equation, iso enzymes, co-enzyme, co-factors, enzyme activation and inhibition.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

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Physiology

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First Degree Programme under CBCSS
Semester VI
Zoology Foundation course II
General Informatics, Bioinformatics and Molecular Biology
Course code – ZO1621

No. of Credits - 4 **Total hours 90**

Aim of the course

To expand basic informatics skill and attitudes relevant to the emerging society and also to equip the student to effectively utilize the digital knowledge resources for the study of Zoology

Objectives of the course

- To review the basic concepts and functional knowledge in the field of informatics
- To create awareness about nature of the emerging digital knowledge society
- To create awareness about social issues and concerns in the use of digital technology
- To learn the nature, application and scope of Bioinformatics

General Informatics **34 hrs**

Module I **4hrs**

Overview of Information Technology: features of the modern Personal Computer and Peripherals, computer networks and internet, Introduction to Operating System- DOS/ Windows, Linux. Purchase of technology, license, guarantee, warranty.

Module II **12hrs**

Knowledge skills for Higher Education: Data information and knowledge, knowledge management – Internet as a knowledge repository, academic search techniques, creating your cyber presence, open access initiatives, open access publishing models. basic concepts of Intellectual property rights(IPR), copyrights, patents, plagiarism, Use of IT in teaching and learning, Case study of educational softwares. Academic services – INFLIBNET, NICNET, BRNET

Module III **10hrs**

Social Informatics : IT and society, Issues and Concerns, Digital divide, Methods to counter digital divide, IT and development, New opportunities and new threats.

Cyber ethics, Cyber crime, Software piracy, Cyber security, Cyber laws, Privacy issues, Cyber addictions, information overload.

Computer- Ergonomics and Health issues, Guide lines for proper usage of computers, Internet and mobile phones. IT and regional languages, IT for the disabled, Free software debate, E-Waste and Green computing.

Module IV **8hrs**

IT @ Service of society: e-governance application and state level, overview of IT application in medicine, healthcare, business, commerce, industry, defense, law, crime detection, publishing, communication, resource management, weather forecasting, education, film and media, futuristic IT – artificial Intelligence, virtual reality

Bioinformatics **16hrs**

Module V **8hrs**

Definition, Nature & Scope of Bioinformatics - Contrast between Bioinformatics and Computational Biology; Key Bio-sequences in Molecular Biology - DNA, RNA and Aminoacid sequences -Popular Databases in Bioinformatics - NCBI, DDJB, PDB, OMIM; BLAST & FASTA sequence file formats, Approach of Comparative Biology based on sequence comparison - The basic idea of sequence comparison (algorithms not required) - idea of scoring matrices

Module VI **8hrs**

The Blast search engine - important features - Idea of Multiple sequence alignment –Proteomics: Basic ideas of Protein Structure prediction- Concept of Homology Modeling- Idea of Molecular Phylogenetics - advantages and computational procedure (only description of use of a package such as Phylip)- Basic concepts of computer Aided Drug Discovery- General description of drug discovery pipeline- concept of Personalized medicine;

Bioinformatics tools: (i)Molecular Visualization Software - Rasmol (Basic features only) - (ii) ORF finding (iii) gene finding, (iii) BLAST (iv) Hydrophobicity Prediction (v) Single Nucleotide Polymorphism (SNP) prediction using GENSNIP

Molecular Biology **40 hrs**

Module VI 16hrs

Introduction: History, development and scope. Nature of genetic material: search for the genetic material, Griffith's experiment, transformation, contributions of Avery, Mac Leod and Mc Carty, Conrat & Stern's experiment with TMV, Hershey & Chase's experiment, transduction.

Composition and structure of nucleic acids - Watson - Crick model of DNA, clover leaf model of tRNA, different types of DNA and RNA; DNA replication in prokaryotes and eukaryotes - Semi-conservative method, Messelson & Stahl experiment, replication machinery and mechanism; modification and repair of DNA.

ModuleVII **15hrs**

Gene Expression: Contributions of Garrod, one gene – one enzyme hypothesis, one gene one polypeptide hypothesis, central dogma of Molecular Biology, central dogma reverse, colinearity of genes and gene products.

Genetic code - deciphering / cracking the GC, characteristics of GC, codon assignment and wobble hypothesis.

Mention contributions of Nirenberg and his associates, Khorana and his associates.

Transcription of RNAs - RNA polymerases, transcription factors, mechanism of transcription, post-transcriptional modifications of mRNA, rRNA and tRNA, reverse transcription, translation – machinery and mechanism; post translational modification of proteins; role of chaperones in protein normal folding and protection

Module VIII **5hrs**

Gene regulation: In prokaryotes (inducible and repressive systems); operon concept – Lac operon and Trp operon

Module IX **4hrs**

Bacterial Recombination: Transformation, conjugation and transduction (general and specialized transduction)

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

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- Jean M. Clavierie and Notredam. Bioinformatics, a beginners Guide,John Wiley, India.
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First Degree Programme
Semester VI
Zoology Core Course IX
Developmental Biology and Experimental Embryology
Course code – ZO1641

No. of credits – 4 **Total hours 72**

Aim of the course

To familiarize the student with the principle of developmental biology and provide him a bird's eye view of sophisticated embryological techniques

Objectives of the course

- To study the various stages involved in the developing embryo
- To study the initial developmental procedures involved in *Amphioxus*, Frog and chick
- To procure information on state- of- the art experimental procedures in embryology.

Developmental biology **57hrs**

Module I **4 hrs**

Introduction: Historical perspective (brief account), theories- Preformation, Epigenesis, Recapitulation and Germplasm. Subdivisions of Developmental biology. Spermatogenesis and oogenesis, structure of Graafian follicle, typical egg and sperm. Polarity of egg, egg envelops; classification of eggs based on different criteria.

Module II **8hrs**

Fertilization: Capacitation, agglutination, sperm penetration, activation of egg, amphimixis; physiological and biochemical changes during and after fertilization. Parthenogenesis- introduction, natural and artificial parthenogenesis, arrhenotoky and thelytoky, obligatory and facultative, significance of parthenogenesis.

Module III **9hrs**

Cleavage: Types of cleavage - holoblastic and meroblastic; patterns of cleavage – radial, bilateral, spiral, rotational; cell lineage in Planocera (brief account only). Morula formation in microlecithal, mesolecithal, macrolecithal eggs; blastulation - introduction, different types of blastula – stereo blastula, coeloblastula, discoblastula, periblastula, blastocyst. Presumptive organ forming areas and fate maps, eg. amphioxus, frog, construction of fate maps.

Module IV **3hrs**

Gastrulation: Introduction, brief account of morphogenetic movements – epiboly and emboly (invagination, involution, infiltration, ingression, delamination, convergence, divergence) concept of germ layers, derivatives of germ layers.

Module V **5 hrs**

Cell differentiation : Totipotency, pleuripotency and unipotency of embryonic cells. Determination and differentiation in embryon*i*c development. Gene action, drosophila as a model organism (brief account only), Homeotic genes and Hox genes.

ModuleVI **25hrs**

Development: Amphioxus - cleavage, blastulation, gastrulation, neurogenesis, notogenesis, mesoderm and coelom formation.

Frog -cleavage, blastulation, gastrulation, organogeny – development of brain, eye, heart; metamorphosis - ecological, morphological and physiological changes and hormonal control.

Chick - cleavage, blastulation, gastrulation, study of 24 hrs chick embryo; development of extra-embryonic membranes in chick.

Man - implantation, pregnancy, parturition, Lactation. Placentation in mammals – placenta, functions, classification based on type of foetal membrane, mode of implantation, nature of contact, distribution of chorionic villi and histological intimacy.

Module VII **3hrs**

Teratology: Definition, causes, infections, drugs and chemicals, metabolic imbalance, ionizing radiation, malnutrition, autoimmunization.

Module VIII **15hrs**

Experimental embryology: Spemann's constriction experiments, organizers and embryonic induction – kinds of embryonic induction,primary, secondary and tertiary organizers; transplantation experiments in amphibian- involving optic cup, nuclear transplantation . In vitro fertilization and embryo transfer experiments in farm animals, In vitro fertilization and embryo transfer experiments in man and test tube babies; cloning experiments in mammals (Sheep); prenatal diagnosis and sex determination methods – amniocentesis, alpha-foeto protein (AFP) estimation, chorionic villus sampling, ultrasound scanning. Embryonic and adult stem cell, significance and applications, stem cell therapy.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

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First Degree Programme
Semester VI
Zoology Core Course X
Ecology, Ethology, Evolution and Zoogeography
Course Code – ZO1642

No. of credits – 3 **Total hours 72**

Aim of the course

To enhance the student's concept of nature and her resources and appreciating the process and product of organic evolution

Objectives of the course

- To learn the principles, applications and management of environmental science.
- To study the inherent morphological and physiological bases of behavioural pattern exhibited by vertebrates.
- To get an exhaustive knowledge of organic evolution with special reference to man.

Ecology **24hrs**

Module I **3 hrs**

Components of ecosystem: Environmental factors - abiotic factors, light, temperature, soil, water, air; biotic factors- autotrophs, phagotrophs and saprotrophs; ecosystem interaction and inter-relationship between biotic and abiotic factors.

Module II **4 hrs**

Biogeochemical cycles: Basic types of biogeochemical cycles - gaseous cycle-carbon and nitrogen cycles, mention sedimentary cycles (P and S), recycling pathways and recycle index. Limiting Factors**-** basic concepts- Leibig's law of minimum, Shelford's law of tolerance, combined concept of limiting factors, Light and temperature as limiting factors.

Module III **5hrs**

Habitat Ecology: Biosphere classification- lithosphere, hydrosphere and atmosphere –physical features, fauna and their adaptations of aquatic, terrestrial and marine habitats (self study).

Population ecology: Properties of population- density, natality, mortality, age distribution, biotc potential, environmental resistance and carrying capacity, population growth forms, J and S shaped curves, emigration, immigration and migration, population fluctuation.

Community ecology**:** Definition and characters, species diversity; stratification; dominance; ecotone and edge effect; ecological indicators; community periodicity, succession (self study)

Module IV **4 hrs**

Anthropogenic impact on ecosystem**:** Ionizing radiation and radioisotopes, ionizing radiation and human health, radiation accidents and other exposures, disposal of radioactive wastes, pesticides like DDT, endosulphan, furadan, insect repellants , e-wastes. Monitoring of pollutants – physical, chemical and biological.

Module V **3 hrs**

Wild life conservation and management**:** Significance, causes of extinction, concepts of threatened species, red data book, IUCN, WWF, CITES, Green Environment and Green peace; protected areas, biosphere reserves, national parks and sanctuaries in India, forests in India, desertification, deforestation, carbon trading; importance of mangroves in coastal ecosystems- conservation and management (self study)

Module VI **5 hrs**

Environmental biotechnology**:** Biotechnological methods of pollution detection, bioremediation, biotechnology and biodegradation, genetically engineered microbes in bio-treatment of waste, eco-friendly bioproducts for environmental health, bio-piracy, bio-pesticides and bio-fertilizers, organic farming and its merits. Green chemistry – designing a Green synthesis, basic principles of Green chemistry.

Ethology **12hrs**

Module VII **12hrs**

History and scope of ethology: Motivation- models of motivation (Lorenz's psychohydraulic model and Deutsch's model); learning- types of learning (imprinting, habituation, conditioned reflex, unconditioned reflex, latent learning); neural mechanisms in behaviour role of hypothalamus and other brain centers, hormones and behavior; sociobiology- social groups –merits and demerits, properties of organized societies, social groups in mammals, social stress. Pheromones and chemical communications, human pheromones.

Evolution **26hrs**

Module VIII **4 Hrs**

Theories of organic evolution: Lamarck's theory, it's criticism (Weisman's germplasm theory) Darwin's theory of natural selection (mention the contributions of Wallace). Mutation theory (self study)

Module IX **4hrs**

Geological timescale, fossils, fossilization, paleontological evidences of evolution, fossil dating and significance of fossils.

Module X **12hrs**

Modern concept of organic evolution: (Neo Darwinism) - genetic basis of evolution- gene pool, gene frequency, mutation, role of mutation in evolution, neutral mutation (Kimura), genetic drift, genetic equilibrium; factors affecting genetic equilibrium and Hardy –Weinberg law.

Natural selection: types of selection (brief account of the observation in *Biston betularia*), isolation and isolating mechanisms; speciation- sympatric speciation and allopatric speciation. Hybridization-adaptive radiation with special reference to Darwin's finches.

Module XI **6 hrs**

Evolution of man: Organic and cultural, examples of trends in human evolution, fossil menbrief accounts of Parapithecus, Propliopithecus, Dryopithecus, Ramapithecus, Australopithecus, Neanderthal, Cromagnon and Modern man.

Zoogeography **10 hrs**

Module XII **4hrs**

Animal Distribution**:** Geographic distribution of animals-cosmopolitan distribution, discontinuous distribution, bipolar distribution and isolated distribution, factors affecting animal distribution, barriers to animal distribution- physical and biological barriers.

Module XIII **6hrs**

Zoogeographical Realms**: (**Brief account of each realm mention the areas included, physical features and fauna) Palaearctic region, Australian region, Ethiopian region, Nearctic region, Oriental region and Neotropical region. Biogeographial classification of India- Western Ghats, Eastern Ghats and Himalayas. Insular Fauna**:** Brief account of oceanic islands and continental islands (with one example each)

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Ahluwalia, V. K. and Malhotra, S. (2006). Environmental science. Ane Books Pvt. Ltd.
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- Chatterji.A.K., Introduction to Environmental biotechnology, Prentice Hall of India
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- Varma P.S. and Agarwal V.K. (1993). Environmental Biology. S. Chand and Company
- Volpe E.P. (1985). Understanding Evolution. Ind. Repr. Universal Book Stall.

First Degree Programme
Zoology Core course XI
Practical II - Cell Biology, Genetics, Biotechnology, Immunology and Microbiology
Course Code – ZO1643

No. of credits – 4

Aim of the course

To expertise the student to carry out routine hematological and microbiological techniques

Objectives of the course

1) To prepare and observe chromosomal arrangements during cell division
2) To study chromosomal aberrations in man
3) To gain of broad knowledge of conventional biotechnological procedures
4) To perform routine blood analysis.

Cell Biology [Any six]

1. Staining of prokaryotic cells: (a) *Lactobacillus* from curd (b) Nitrogen fixing bacteria (*Rhizobium*) from root nodules of legumes
2. Staining of eukaryotic cells: buccal epithelial cells (observe Barr body)
3. Study of cell organelles
4. Mitosis: stages in onion (*Allium cepa*) root meristem (squash preparation)
5. Calculation of mitotic index and metaphase index in root meristem of *Allium cepa*
6. Meiosis: stages in testis of grass hopper (demonstration only)
7. Giant chromosomes in Diptera: (*Drosophila Chironomus* larvae) salivary gland cells (Demonstration only)

Genetics [Any five]

1. Study of monohybrid cross using coloured beads.
2. Study of normal chromosome compliment and karyotype of man.
3. Study of genetic syndromes and abnormal karyotypes of man
   (Klinefelter's syndrome, Turner's syndrome, Down syndrome and Edward syndrome).
4. Study of Barr body and its significance (in stained buccal epithelial cells).
5. Construction of Pedigree chart.
6. Study of phenotypic characters of male and female Drosophila.

Biotechnology [Any two]
1. Estimation of DNA by diphenylamine method.
2. Polymerase Chain Reaction
3. Southern blotting and Northern blotting
4. Gene cloning

(Demonstration in the Department / Visit to research institute / CD display)

Immunology [Any two] and Microbiology[Two]
1. Collection of blood and study of the effect of anticoagulant.
2. Total and differential count of blood cells.
3. ABO and Rh systems of blood grouping.
4. Microscopic observation and study of stained preparations of any two microbes

First Degree Programme
Zoology Core Course XII
Practical III - Physiology and Biological Chemistry, Molecular Biology and Bioinformatics.
Course Code - ZO1644

No. of credits – 3

Aim of the course

To demonstrate basic principles in physiology

Objectives of the course

- To learn clinical procedures for blood & urine analysis
- To make the student skillful in simple biochemical laboratory procedures.

Physiology and Biological Chemistry Practicals: [1-11,Compulsory]

1. Kymograph apparatus and explanation of simple muscle twitch.[Demonstration]
2. Measurement of oxygen consumption of cockroach using Fen's respirometer.[Experiment set up]
3. Study of tonicity of blood cells
4. Paper chromatographic separation of amino acids
5. Estimation of haemoglobin of blood using Haemoglobinometer.
6. Effect of temperature / pH on salivary amylase activity
7. Qualitative tests of sugars.
8. Qualitative tests of proteins.
9. Detection of abnormal constituents (glucose and albumin) in urine[two test each].
10. Detection of excretory products – ammonia (Nessler's test), urea (Ammonia generation/ Biuret test) and uric acid (Phosphotungstic acid test)
11. Preparation of blood smear and study of blood cells of man.

12-14 [Any one]

12. Isolation of casein from milk.
13. Estimation of protein by Lowry's method
14. Digestion of starch and separation of maltose by dialysis.

Bioinformatics and Molecular Biology:

1. Graphical representation of data (Histograms, Frequency polygen, Pie diagram)
2. Calculation of Mean, median, mode and standard deviation of given data by discrete series-Direct method.
3. Molecular Biology: Spotters(Watson - Crick model of DNA, clover leaf model of tRNA, DNA replication)

First Degree Programme
Zoology Core Course XIII
Practical IV - Developmental Biology , Ecology, Ethology, Evolution and Zoogeography
Course Code – ZO1645

No. of credits - 3

Developmental Biology and Experimental Embryology

1. Study of different types of eggs-Amphioxus, frog, chick, man- based on models/charts [Any three].
2. Study of blastula- Amphioxus, frog- slide / model [Any one]
3. Study of gastrula – Amphioxus/frog-yolk plug stage - slide / model.[Any one]
4. Mounting, sketch and label of 24hrs/48hrs chick blastoderm.[Any one]
5. Study of placenta(model/ specimen) – any two types.
6. Sperm motility in a fish /zebra fish
7. Embryonic development of the egg of zebra fish (demonstration only)

Ecology (1-13 Compulsory)

1. Estimation of dissolved oxygen
2. Estimation of CO2
3. Primary productivity using dark and light bottle
4. Turbidity using Secchi disc
5. Estimation of hardness of three different water samples.
6. Extraction of soil organisms- Berlese funnel, Baerman's funnel [Any one]
7. Construction of food web
8. Study of ecological adaptations – any three
9. Study of marine plankton – any three
10. Measurement of pH of different water samples using pH meter, pH paper and indicator solution.

Ethology

11. Alarm pheromones in ants.

Evolution

12. Photo of Darwin and Lamark - Identify the scientist and mention the contribution.

Zoogeography

13. Study different zoogeographical realms with fauna.

First Degree Programme
Semester V
Zoology Open Course I
Public Health and Hygiene
Course Code – ZO1551.1

No. of credits – 2 **Total hours 54**

Aim of the course

To make the student aware of the essentials of public health and sanitation thereby warding off diseases and uplifting the living standards of the community

Objectives of the course

- To learn the principles of nutrition and dietetics
- To understand the ill effects of modern lifestyle
- To study the advantages of being hygienic

Module I **6hrs**

Introduction: Scope and importance of the study; balanced diet, diet control for diabetics, cholesterol etc., concept of energy, calories, daily food intake as per occupation, pregnancy and lactation. Dietary requirements of infants, pre-school ,children, school children, adults and geriatric care. Malnutrition and over nutrition – obesity and weight control; defects of modern food habits – fast food, soft drinks, ice-creams and broiler chicken.

Module II **4hrs**

Adulteration of food: food hygiene – hygiene of milk, meat, fish, eggs, fruits and vegetables, common food adulterants – harmful effects and their detection, food additives, fortification of food; Food Adulteration Act and its stringent implementation

Module III **18hrs**

Health Hazards: Health dynamicity – definition, factors influencing health, health as a medium of socio-economic development. Diseases – Common food borne and water borne diseases (gastroenteritis, jaundice, cholera, salmonellosis, travellers' diarrhoea and *Escherichia coli* infection, typhoid) – mode of transmission, causative agents, symptoms, prevention and control. Sexually transmitted infections– AIDS, genital herpes, hepatitis B, syphilis, gonorrhoea – causative agents, symptoms,modes of transmission and prevention.

Dengue, chikunguniya, rat fever (general methods of mosquito control and the need to prevent mosquito breeding in and around our homes).

Lifestyle habits – excessive usage of T.V., computer, mobile phones, two wheelers, and their impacts on health. Lack of physical exercise and its deleterious effects on the body and mind

Module IV **6hrs**

Health Education: Definition, objectives, principles and methods of health education, ill effects of smoking, alcoholism and drug abuse (emphasis should be given to pan masala, amphetamines, hashish, opium, brown sugar, pethedine). Population control and family welfare, use of contraceptives. Blood donation –basics of ABO, blood grouping including Rh factor. Genetic incompatibility and consanguineous marriages.

Module V **12hrs**

Mental Health: Definition by WHO and necessity of mental well being, major depressive disorders, substance abuse, schizophrenia, obsessive compulsive disorders, domestic violence, causes for lost years of healthy life, strategies for prevention and possible interventions, childhood mental disorders and illnesses, gulf widow syndrome, stress reduction and management (importance of yoga)

Module VI **8hrs**

Hygiene: Definition, personal hygiene- body odour, oral hygiene, grooming, feminine hygiene, sleep hygiene, hand washing, toiletry. Social hygiene – clean living movements, occupational hygiene, food and cooking hygiene, medical hygiene, excessive hygiene.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Jatin V. Modi and Renjith S. Chawan. Essentials of Public Health and Sanitation – Part I- IV
- Murray, C. J. L. and A.D. Lopez. (1996). The Global Burden Of Disease. World Health Organization.
- Park, J.E. and Park, K. Textbook of Community Health for Nurses.
- Swaminathan S. Principles of Nutrition and Dietetics.

First Degree Programme
Semester V
Zoology Open Course I
Human Health and Sex Education
Course Code – ZO1551.2

No. of credits – 2 **Total hours 54**

Aim of the course

To redress problem associated with health and sex thereby promoting fitness and well being.

Objectives of the course

- To make the student understand the importance of good health.
- To educate the student on clean sexual habits thereby warding off sexually transmitted diseases.

Module I **14hrs**

Introduction to health, health as a state of wellbeing, health awareness, Immunity, immunization and vaccination, factors affecting health- food, balanced diet, food supplements, pathogens, pollution, sleep, exercise and stress. Physical health, reproductive health, adolescence, senescence. Mental health- mental illness and disabilities, symptoms and prevention of mental illness; alcoholism, tobacco addiction, de-addiction, lifestyle diseases. Community health- health centres, role of health centres. Spiritual health, yoga and meditation.

Module II **8hrs**

Human reproductive system: Male reproductive system- structural details of testis and accessory structures, functions of testis, semen, hormonal control. Female reproductive system- structure of ovary, accessory structures, puberty, reproductive cycles and hormonal control, menstrual cycle, gestation period, hysterectomy, menopause.

Module III **7hrs**

Events of human reproduction: Gametogenesis- spermatogenesis and oogenesis, ovulation, fertilization, embryonic development, parturition

Module IV **12hrs**

Human intervention in reproduction: Contraception and birth control-barrier method, hormonal methods, natural methods, sterilization, termination of pregnancy. Infertility-male and female infertility, causes and treatment for infertility. Assisted Reproductive Techniques- IVF, GIFT, ZIFT, Donor Insemination (DI). Artificial Insemination by Donor (AID), Artificial Insemination by

Husband or partner (AIH). Surrogacy, SUZI (sub-zonal insemination), MIST (micro insemination sperm transfer)

Module V **6hrs**

Sexually transmitted diseases: Syphilis, genital warts, chlamydia, chancroid, trichomoniasis, gonorrhea, genital herpes, AIDS

Module VI **7hrs**

Sex education: Adolescent sexual activity, teenage pregnancy, sexual harassment, sexual awareness and policies (legal aspects), lesbian and gay sex, bisexual, transgender youth, adolescent stress management

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Common sexual problems and solutions by Dr. Prakash Kothari, UBS Publishers and Distributors Ltd.
- Mac E. Hadley. Endocrinology. Pearson Education, Singapore.
- Taylor, D.J., Green, N.P.O., Stout G. W. Biological Science. (Editor R. Soper) 3rd Edition, Cambridge University Press.
- The Complete Manual of Fitness and Well-being. The Reader's Digest Association, Inc. Pleasantville, New York / Montreal.
- Guyton & Hall.Textbook of Medical Physiology.

First Degree Programme
Semester V
Zoology Open Course I
Human diseases and their management
Course Code – ZO1551.3

No. of credits – 2 **Total hours 54**

Aim of the course

To instill in the students the need to manage communicable diseases thereby creating a healthy society

Objectives of the course

- To learn the various modes and agents of disease transmission
- To learn the causative factors of non communicable diseases

Module I **6 hrs**

Introduction- Health – WHO definition, important of individual health. Lifestyle choice for healthier life: Diet and health, exercise and health, alcohol, tobacco and drugs, sex and health, computers and health, mobile phone and health, psychological health

Module II **6 hrs**

Viral Infections: Brief account of virus, chickenpox, poliomyelitis, rabies, yellow fever, dengue fever, mumps, influenza, measles, encephalitis, hepatitis, HIV infection and AIDS – causes, symptoms, prevention and cure.

Module III **6hrs**

Bacterial Infections: Brief account of bacteria, dysentery, cholera, tuberculosis, tetanus, diphtheria, septicemia, scarlet fever, typhoid, plague; STD and leprosy – causes, symptoms, prevention and cure.

Module IV **6hrs**

Protozoan Infections: Brief account of protozoans - amoebiasis, leishmaniasis, trichomonasis, malaria - causes, symptoms, prevention and cure.

Module V **6hrs**

Worm Infections: Brief account of platyhelminthes and nematods, cysticercosis, taeniasis, ascariasis, ancylostomiasis, encephalitis, enterobiasis and dracanculosis – causes, symptoms, prevention and cure.

Module VI **6hrs**

Vector borne diseases**:** Vector – identification of vectors – dengu, filaria, kala azar, Japanese encephalitis, chikungunya- causes, symptoms, prevention and cure.

Module VII **6 hrs**

Mental health: Meaning, definition, history, characteristics of a mentally healthy person. Types of mental illness – causes, symptoms and prevention – major mental illness (schizophrenia, paranoia), minor mental Illnesses (anxiety, phobia, obsessive compulsive neuroses)

ModuleVIII **10hrs**

Basic viewing techniques- endoscopy; Examination techniques: Blood- total count, differential count**,** ESR, blood clotting test, routine blood chemistry, blood cholesterol test, hormone tests; urine- routine, urine chemistry; cell and tissue test, pap test, biopsy, histopathology; genetic tests- amniocentosis, chorionic villi sampling; imaging techniques- X – ray, ultrasound scanning, CT scan, MRI scanning;

Module IX **2hrs**

Role of yoga in management of common diseases.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Abraham Verghese. (1996). Introduction to Psychiatry. BI Publication Pvt. Ltd.
- Anderson, G. M. Communicable Disease Control,. Macmillan, New York.
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- Chauhan, S. S. Mental Hygiene – A Science of Adjustment, Allied Publishers.
- Carol.D.Tamparo. Diseases of Human body
- Deepak Kumar. (2001). Diseases and Medicines in India: A historical Overview.
- Mangal, S., K. (2004). Introduction to Abnormal Psychology. Sterling Publishers.
- Mary L M, Mark Zelman, Paul Holdway; Human Diseases – A Systematic Approach.
- Park, K. (2005). Textbook of Prevention and Social Medicine, Jebelpur, Banarids.
- Park, J., E., and Park, K. Textbook of Preventive and Social Medicine.

- Swami Styananda Saraswathi, Swami Karam: Yogic Management of Common Diseases.

First Degree Programme
Semester VI
Zoology Open Course II
Economic Zoology - Vermiculture and Apiculture
Course Code – ZO1651.1

No. of credit – 2 **Total hours 54**

Aim of the course

To promote self employment and self reliance among educated youth

Objectives of the course

- To learn the basic procedure and methodology of vermiculture
- To learn the scope and methodology of apiculture.

Vermiculture 24hrs

Module I **6hrs**

Introduction: definition and scope of vermiculture. Nature and species of earthworms: habit categories – epigeic, endogeic and anecic, indigenous and exotic species (*Eudrillus eugeniae/Eisenia foetidae/Perionyx excavatus/ Lampito mauritii*), identification of the above four species based on morphological characters.

Module II **10hrs**

Methodology of vermicomposting: step by step methodology – containers for culturing, raw materials required, preparation of bed, environmental pre-requisites, feeding, harvesting, and storage of vermicompost. Advantages of composting, precautions to be taken to prevent attack by pests and pathogens.

Module III **8hrs**

Vermicompost profile and applied aspects: physical, chemical and biological parameters of vermicast, vermin enrichment, economic uses of vermiculture (biofertilizer, waste disposal, vermiwash, poultry feed, vermi-remediation etc.

Apiculture **30hrs**

Module IV **8hrs**

Introduction and Scope: Definition and significance of the study. Caste system and Social behavior; common species of honeybees used, organization of bee colony, social life and adaptations of honeybees.

Module V **12hrs**

Bee keeping methods and equipments: indigenous methods, extraction appliances, extraction of honey from the comb and processing, management and maintenance of an apiary, bee pastures

Module VI **10hrs**

Diseases and economics: diseases (bacterial, fungal, protozoan, acarine, brood diseases), preventive and curative measures. Use of honey, bees wax, bee venom, nutrient profile of honey, marketing strategies.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

1. Cherian & Ramachandran Bee keeping in *South Indian* Govt. Press, Madras.
2. Gupta, K.C. Romance of bee keeping. Khadi Paristhan, Calicut.
3. Mary Appelhof. Worms eat my Garbage.
4. Mishra R.C. Perspectives in Indian Apiculture
5. Sathe, T.V. Vermiculture and Organic farming.

First Degree Programme
Semester VI
Zoology Open Course II
Ornamental Fresh water fish production
Course Code – ZO1651.2

No. of credits - 2 **Total hours 54**

Aim of the course

To make the student aware of the vast potentials involved in ornamental fish farming and trading

Objectives of the course

- To learn the scientific method of setting an aquarium
- To learn the culture breeding and marketing techniques of common indigenous ornamental fishes

Module 1 **7hrs**

Importance and history of aquarium fish keeping. Design and construction of aquaria: aquarium fabrication- shape, size, volume, type of glass tank, cutting of glass, preparation of glass tank, strengthening and supporting of tank, fitting of tanks into room settings; aquarium floor setting – type and size of pebbles, gravels, granites used for bed setting and its advantages. Filters- biological, chemical and mechanical. Aquarium accessories like aerators, decorative, lighting, heating and feeding trays.

Module II **4 hrs**

Water quality management in aquarium systems – sources of water, containers, storage, temperature, pH, dissolved carbon dioxide, ammonia, hardness, turbidity and ozone in aquarium.

Module III **3 hrs**

Aquarium plants: Uses of aquarium plants, different varieties of plants like submerged plants (tubers, rooted plants, cutting plants) and emerged plants.

Module IV **12hrs**

Fresh water ornamental fishes : Common ornamental fishes- indigenous and exotic species; Identification and biology of the common ornamental fishes. *Cyprinus carpio* (koi carp), *Molliensia*

sphenops (black molly lyre tail), *Poecilia reticulata* (guppy), *Poecilia latipinna*, *Xiphophorous helleri* (red sword tail) *Xiphophorous maculates* (red platy) *Pterophyllum scalare altum* (angel fish) *Carassius auratus* (red oranda*) Betta splendens* (Siamese fighting fish) *Trichogaster leeri* (pearl gourami). Live bearers and egg layers. Sexual dimorphism in ornamental fishes.

Module V **8hrs**

Breeding and rearing of common ornamental fishes. Conditions for breeding- pH, temperature and sex ratio. Brood stock management- selection of brooders, maintenance and management of brood stocks. Selective breeding and hybridization techniques. Induced breeding. Colour enhancement techniques.

Module VI **8hrs**

Aquarium maintenance- Setting up of a freshwater community tank and its maintenance. Food and feeding - live feed and formulated feed. Preparation and culture of live feed (Artemia, Infusoria, Spirulina). Control of algal growth, snails and other predators. Common disease of ornamental aquarium fishes - their causative agents - virus, bacteria, fungi, protozoa and nematode; symptoms, treatment and prophylactic measures.

Module VII **12hrs**

Indigenous ornamental fishes - Common indigenous ornamental fishes. Identification and biology of the common ornamental fishes. Cyprinids :*Puntius denisonii* (red line torpedo fish),*Puntius fasciatus* (melan barb), *Puntius filamentosus* (Indian tiger barb), *Puntius curmuca* (red tailed silver shark), *Danio malabaricus* (Malabar danio); Loaches: *Nemacheilus triangularis* (Zodiac loach), *Lepidocephalus thermalis* (Malabar loach); Cichlids: *Etroplus maculatus* (yellow and orange chromides), *E . suratensis* (pearl spot), Anabantids: *Anabas testudineus* (climbing perch) and Catfishes : *Horabagrus brachysoma* (Yellowish catfish), *H . nigricollaris* (White collared imperial catfish).

Assignment:

Students are to visit ornamental fish hatchery/ pet shop and submit a report with photos.

References

- Arumugam. N. (2008). Aqua culture, Saras publications, Tamil Nadu, India.
- Axelord, H.R. (1967). Breeding aquarium fishes, T F H Publications.
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- Dick Mills and Gwynne Vevers, (1982). The Practical encyclopedia of fresh water ,Tropical Aquarium fishes, Salamander Books limited, London.
- Gahlawat, S.K., et.al. (2007). Manual of experimental Ichthyology, Daya publishing House, Delhi.
- Gerhard Brunner, (1973). Aquarium plants, T F H Publications, Inc. Ltd., Hongkong.
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- Jorgen Hansen, (1979). Making your own aquarium, Bell and Hyman Ltd., London.
- Ramachandran. A., (2002). Breeding, Farming and management of ornamental fishes. School of Industrial Fisheries, Cochin University of Science and Technology, Cochin-16.
- Saroj. K. Swain, (2003). Aquarium cave and maintenance, Publ. CIFA, ICAR, Orissa, India.
- Tom Lovell (1998). Nutrition and feeding of fish second Ed. Kluwer Academic publishers.
- Talwar.P.K., and Jhingran.A.G.,(1991). Inland fishes Oxford and IBH Publishing Co. PVT LTD, New Delhi.

First Degree Programme
Semester VI
Zoology Open Course II
Human Nutrition
Course Code – ZO1651.3

No. of credits – 2 **Total hours 54**

Aim of the course

To make aware the students about the importance of nutrition in maintaining health.

Objectives of the course

- To cultivate proper feeding habits.
- To learn the proper and scientific value of different food items.

Module I **20 hrs**

Introduction and scope. Carbohydrates, Proteins and Lipids – Carbohydrates : Functions, classification, food sources, storage in body, biomedical importance. Brief outline of metabolism : glycogenesis & glycogenolysis (in brief), glycolysis, citric acid cycle. Clinical significance.

Proteins - Functions, classification, food sources, composition, essential & non-essential amino acids, protein deficiency. biomedical importance. Metabolism: Transformation, Decarboxylation, Ammonia formation & transport, Urea cycle. Clinical significance

Fats & oils: Function of fats, classification, food sources, composition, saturated and unsaturated fatty acids, biomedical importance, essential fatty acids. Brief out line of metabolism : Beta oxidation of fatty acids, Ketosis, Cholesterol. Clinical significance.

Module II **15 hrs**

Vitamins and minerals - sources and functions, deficiency status. Minerals - macro & micronutrients. - functions, sources. Bioavailability and deficiency of Calcium, Iron, Iodine, Sodium & Potassium (very brief account). Water - as a nutrient, function, sources, requirement, water balance & effect of deficiency.

Module III **5 hrs**

Calorific values of food – Basal metabolic rate, energy requirements of man, women, infants and children.

Module IV **15 hrs**

Nutritional value of foods- cereals, fruits, milk, egg, meat, fish. Balanced diet, Nutrition in pregnancy - Physiological stages of pregnancy, nutritional requirements, food selection, complication of pregnancy. Nutrition during lactation - Physiology of lactation, nutritional requirements. Nutrition during infancy - growth & development, nutritional requirements, breast feeding, infant formula, introduction of supplementary foods. Nutrition during early childhood (Toddler/Preschool)- Growth & nutrient need, nutrition related problems, feeding patterns. Nutrition of school children- Nutritional requirement, importance of snacks, school lunch. Nutrition during adolescence - Growth & nutrient needs, food choices, eating habits, factors influencing nutritional need. Nutrition during adulthood - Nutritional requirements, feeding pattern. Geriatric nutrition: Factors affecting food intake and nutrient use, nutrient needs, nutrition related problems.

Nutritional value of foods- cereals, fruits, milk, egg, meat, fish. Balanced diet, Malnutrition.

Module V **5 hrs**

Interrelationship between nutrition & health : - Visible symptoms of goods health; Use of food in body - Digestion, Absorption, transport & utilization; Role of fibres in human nutrition; Effect of cooking & heat processing on the nutritive value of foods; Processed supplementary foods; Food sanitation in hygiene.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

Reference:

- Gopalan.C, BS. Ramasastri & SC Balasubramanian: 1971, Nutritive value of Indian foods. National Institute of Nutrition, Hyderabad.
- Gopalan.D & K. Vijaya raghavan 1971, Nutrition atlas of India, ICMR, New Delhi.
- Ghosh.S 1981, The feeding care of infants and young children, UNICEF, New Delhi.
- Mudambi.SR ,1995. Fudementals of food and nutrition. New age international, New Delhi.
- Swaminathan.M, 1989. Handbook of food and nutrition. Bappco, Bangalore.
- Swaminathan.M, 1974. Essentials of food and nutrition. Vol I & II, Ganesh and Co. Madras.

First Degree Programme
Semester VI
Zoology Project and Field study
Course Code – ZOI646

No. of credit – 4

Project

Aim of the course

To develop an aptitude for research in Zoology

Objective of the course

To inculcate proficiency to identify appropriate research topic and presentation

Specifications

Topics of biological interest can be selected for the project. Project is to be done by a group not exceeding 5 students. Every student should submit typed (A4 paper, 12 Font, 1.5 Space), spirally bind project report duly attested by the supervising teacher and the Head of the Department on the day of practical examination before a board of two Examiners for ESE. The viva-voce based on the project is conducted individually. Project topic once chosen shall not be repeated by any later batches of students. List of projects submitted year wise is to be maintained in a register and submitted before the examiners if requested.

The project report may contain the following sections:

1. Preliminary (Title page, declaration, certificate of the supervising teacher, content etc.)
2. Introduction with relevant literature review and objective
3. Materials and Methods
4. Result
5. Discussion
6. Conclusion / Summary
7. References.

Field Study and Study tour

A total of eighteen hours (1hour/week) has to be allotted to field study in the fifth semester. Study tour of minimum 4 days is compulsory. Students are directed to visit one research institute and one wild life sanctuary / museum / zoo, preferably with in the state of Kerala. Scientifically prepared hand written study tour report along with photographs of candidate at the places of visit must be submitted by each student for ESE on the day of the examination of project evaluation.

UNIVERSITY OF KERALA

First Degree Programme in Zoology

Choice Based Credit and Semester System

Zoology Complementary Course

Zoology Complementary Course

FIRST DEGREE PROGRAMME
SCHEME OF INSTRUCTION OF ZOOLOGY COMPLEMENTARY COURSE

Course code	Course Title	**Sem I**			**Sem II**			**Sem III**			**Sem IV**					Evaluation	
		Contact Hour		Credit	Contact Hour		Credit	Contact Hour		Credit	Contact Hour		Credit	Total Credit	Duration of Examination	CE	ESE
		T	**P**		**T**	**P**		**T**	**P**		**T**	**P**					
ZO1131	ANIMAL DIVERSITY I	2		2										2	3Hrs	20%	80%
ZO1231	ANIMAL DIVERSITY II				2		2							2	3Hrs	20%	80%
ZO1331	FUNCTIONAL ZOOLOGY							3		3				3	3Hrs	20%	80%
ZO1431	APPLIED ZOOLOGY										3		3	3	3Hrs	20%	80%
ZO1432	PRACTICAL OF ZO 1131,1231, 1331 &1431		2			2			2			2		4	3 Hrs	20%	80%

First Degree Programme
Semester I
Zoology Complementary Course I
Animal Diversity I

Course Code – ZO1131 **Total hours: 36**
No. of credits - 2

Aim of the Course

To inculcate in the student a love and understanding of the fascinating world of invertebrates

Objectives of the course

- Impart to the student a concrete idea of the evolution, hierarchy and classification of invertebrate phyla
- Understanding the basics of systematics by learning the diagnostic and general characters of various groups
- Getting an overview of typical examples in each phyla
- To study the economic importance of invertebrates with the special reference to insect pests

Module I **5 hrs**

Introduction: Classification of organisms- two kingdom system, three kingdom system, four kingdom system, five kingdom system.

Kingdom Protista- General features and classification: Phylum Dinoflagellata eg. *Noctiluca;* Phylum Parabasalia eg. *Trichonympha*; Phylum Ciliophora eg. *Paramecium;* Phylum Rhizopoda *eg. Entamoeba* – life history

Module II **5 hrs**

Kingdom Animalia : Salient features, levels of organization- cellular, tissue, organ and organsystem. Branches- Mesozoa, Parazoa and Eumetazoa-radiata and bilateria- Protostomia and Deuterostomia; acoelomata, pseudo coelomata and eucoelomata- schizocoela and enterocoela; body segmentation- metamerism and pseudometamerism.

Phylum Porifera: General characters (self study), classification up to classes- Class Calcarea eg. *Sycon,* Class Hexactinellida eg. *Euplectella*, Class. Desmospongiae eg. *Spongilla.*

Phylum Cnidaria: General Characters (self study), classification up to classes, Class Hydrozoa eg. *Obelia, Physalia* (mention polymorphism); Class Scyphozoa eg. *Aurelia* (mention larval stage); class Anthozoa eg. *Sea anemone*

Module III **10 hrs**

Phylum Platyhelminthes: General characters (self study), classification up to classes- Class Turbellaria eg. *Bipalium,* Class Cestoda eg. *Taenia Solium*, Class Trematoda e.g. *Fasciola*.

Phylum Nematoda: General characters (self study), classification up to classes- Class Secernentea (Phasmida);eg. *Ascaris,* Class Adenophorea (Aphasmida); eg. *Trichinella.* Human nematode parasites.

Phylum Annelida : General characters (self study), classification up to classes - Class Polychaeta eg. *Nereis* (mention parapodium, heteronereis); Class Oligochaeta eg. Earthworm (mention vermiculture); Class Hirudinea eg. *Hirudinaria.*
Phylum Mollusca: General characters (self study), classification up to classes-Class Aplacohophora - eg. *Neomenia;* Class Monoplacophora e.g. *Neopilina*; Class Bivalvia eg. Pearl oyster; Class Gastropoda eg. *Pila;* Class Cephalopoda eg. *Sepia*; class Scaphopoda eg.*Dentalium*. Economic importance of molluscs.
Phylum Onychophora: General characters, eg. *Peripatus*- evolutionary significance.

Module IV **13 hrs**
Phylum Arthropoda: General characters (self study), classification up to classes-Suphylum Trilobitomorpha- Class Merostomata eg. *Limulus*; Class Arachnida eg. Scorpion; Class Pycnogonida eg. Nymphon; Subphylum Mandibulata- Class Crustacea **eg. Prawn (detailed study**), *Sacculina*; Class Chilopoda eg. *Scolopendra;* Class Symphyla e.g.*Scutigeralla*; Class Diplopoda eg.*Spirostreptus*; Class Pauropoda eg. *Pauropus*; Class Insecta eg. Cockroach (self study- external characters mouth parts, digestive system); Mosquitoes-*Anopheles*, *Culex* and *Aedes* – pathogenicity of mosquitoes. Pest of paddy - *Leptocorisa* and *Spodoptera*, Coconut palm *Oryctes rhinoceros* and Eriophid mite, stored food grains -*Sitophylus oryzae* and *Tribolium.*

Module V **3 hrs**
Phylum Echinodermata: General characters (self study), classification- Class Asteroidea eg. sea star, Class Ophiuroidea eg. brittle star, Class Echinoidea eg. sea urchin, Class. Holothuroidea eg. Sea cucumber, Class Crinoidea eg. sea lily (mention larval stages)

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Brusca R.C. and Brusca G.J. (1990) Invertebrates. Sinauer Associates, Sunderland,MA
- Chandler, A.C. and Read. Parasitology.
- Hickman C.P. and Roberts L.S. (1994) Animal Diversity. Wm. C. Brown, Dubuque,IA
- Pearse V and Pearse J, Buchsbaum M and Buchsbaum R. (1987) Living Invertebrates. Blackwell scientific Publications, California.
- Ruppert E.E., Fox R and Barnes R.D. (2004) Invertebrate Zoology. Thomson Books.Cole. USA.

First Degree Programme
Semester II
Zoology Complementary Course II
Animal Diversity II

Course Code – ZO1231 **Total hours 36**
No. of credits – 2
Aim of the course
To inculcate in the student a fascination for nature and learn the bionomics of vertebrates.
Objectives of the course
- Learn the evolution, hierarchy and classification of different classes of chordates
- To get an overview of the morphology and physiology of typical examples.
- To study the adaptations and economic importance of specific vertebrates.

Module I **10 hrs**
Phylum Chordata: Salient features of the phylum Chordata (self study), classification up to classes- Subphylum Urochordata eg. *Ascidia*- general characters, external features and retrogressive metamorphosis; Subphylum Cephalochordata- General characters, eg. Amphioxus.
Module II **10 hrs**
Subphylum Vertebrata: General characters (self study), classification- Super class Agnatha eg. *Petromyzon;* Super class Pisces eg. *Scoliodon, Narcine, Anguilla, Echeneis, Hippocampus, Etroplus, Mackerel, Sardine, Pomfret*; Super class Tetrapoda- Class Amphibia- General characters and eg. *Ichthyophis, Rhacophorus, Amblystoma*-axolotl larva.

Module III **9 hrs**
Class Reptilia: General characters (self study), eg. *Calotes, Draco, Chameleon, Chelone,* snakes-general features, non poisonous snakes eg. *Lycodon, Ptyas* (external features and peculiarities of examples), poisonous snakes eg. *Naja*, Viper*, Bungarus*, *Enhydrina* (characteristic features), identification of poisonous and non poisonous snakes, different types of venom, mode of action.
Module IV **7 hrs**
Class Aves: General characters (self study), flightless birds- eg. Ostrich and Kiwi, flying birds eg.Pigeon- mention different types of feathers and pea fowl. Flight adaptations of birds. Class Mammalia- General characters (self study), eg. Echidna, Kangaroo, Bat, Loris, Tiger and Whale.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Dhami, P.S. and Dhami, J.K. Vertebrate Zoology. R. Chand and Co.
- Ekambaranatha Ayyar, M. and Ananthakrishnan, T.N. A Manual of Zoology. Vol II
- Green N.P.O., et al (2000) Biological Science. Cambridge University Press.
- Jordan, E.L and Verma, P.S. Vertebrate Zoology.S. Chand and Co.
- Kotpal, R.L. (2002) Modern Text Book of Zoology: Vertebrates. Rastogi Publishers

• Mayer E. (1980) Principles of Systematic Zoology. Tat Mc Graw Hill Publishing Co. New Delhi.
•The New Encyclopedia Britannica, Macropedia, (1998). Encyclopedia Britannica

First Degree Programme
Semester III
Zoology Complementary Course III
Functional Zoology

Course Code – ZO1331 **Total hours 54**
No. of credits – 3

Aim of the course
To familiarize students on the physiology of their own body and urge them to take precautionary measures to safeguard their health.

Objectives of the course
•To study the structure and function of each system in the human body.
•To study the etiology of common physiological disorders, syndromes and diseases.

Module I **4 hrs**
Nutrition: Types of nutrition – autotrophy and heterotrophy. Outline classification of food components. Brief mention of malnutrition disorders. Vitamins - physiological role and disorders (deficiency diseases).

Module II **6 hrs**
Respiration: Respiratory pigments and their functions with special emphasis on haemoglobin, transport of oxygen and carbon dioxide. Neural and hormonal control of respiration in man. Respiratory disturbances – brief mention of Apnoea, Dyspnoea, Hypoxia, Hypo and Hypercapnia, Asphyxia and Carbon monoxide poisoning. Physiological effects of smoking.

Module III **8 hrs**
Circulation : Blood-composition and functions, blood groups, mechanism of blood clotting (intrinsic and extrinsic pathways), anticoagulants, disorders of blood clotting –haemophilia and thrombosis. Heart - neurogenic and myogenic, peculiarities of cardiac muscle. Heart beat, pace maker. Blood pressure, ECG, cardiovascular disorders- arteriosclerosis, myocardial infarction, and hypertension; angiogram and angioplasty.

Module IV **6 hrs**
Excretion and osmoregulation: Classification of animals based on excretory wastes. Human nephron - structure and urine formation - ultrafiltration, selective reabsorption, tubular secretion and countercurrent mechanism; hormonal control of renal function; composition of urine. Kidney diseases - proteinuria, uremia, acidosis and alkalosis; dialysis.

Module V **6 hrs**
Neurophysiology: Neurone-structure, nerve impulse -resting potential, action potential and latent period; synapse and synaptic transmission- All or none law, refractory period, neurotransmitters. Saltatory transmission and EEG.

Module VI **8 hrs**

Muscle Physiology: Ultra-structure of a striated muscle fibre, mechanism of muscle contraction, brief mention of muscle twitch, summation, tetanus and tonus, all or none law, fatigue, oxygen debt and rigor mortis.

Module VII **8 hrs**

Endocrinology: List the various endocrine glands and their corresponding hormones, brief description of hormonal influence, action and hormonal disorders- goitre, cretinism exophthalmic goitre, diabetes mellitus, diabetes insipidus, dwarfism, gigantism and acromegaly. Role of Hormones in reproductive cycle.

Module VIII **8 hrs**

Immunology: Types of immunity-innate, acquired, active, passive, humoral and cell mediated. Cells, tissues and organs of immune system- lymphocytes, lymphoid tissue and organs (Lymph nodes, spleen, bone marrow, thymus and mucosa associated lymphoid tissue). Antigens. Antibodies- structure and function of immunoglobulin, classes of immunoglobulins. Hypersensitivity and allergy; immunization-passive and active; vaccination. AIDS and its etiology.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Eckert R and Randall D (1987) Animal physiology, CBS Publishers and Distributors,
- Ganong, W.F. (2002) Lange Review of Medical Physiology. Mc G H.
- Ganong, W.F. (2003) Review of medical physiology, Mc Graw-Hill, New Delhi.
- Goyal, K.A. & Sastry, K.V. :Animal Physiology. 6e 2002, Rastogi Publishers.
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- Joshi, K.R. (2003) Immunology. Agro.
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- Nagabhushanan R, Kobardar M.S. and Sarojini R (1983) A textbook of animal physiology. Oxford IBH publishing Co. New Delhi.
- Roitt J (2000) Immunology. W. Freeman, Oxford.
- Schimdt-Nielson K (2002) Animal Physiology. Prentice Hall India Ltd. Sebastian M.M. (1990). Animal Physiology. Madona Books, Kottayam.
- Withers P.X. (1992) Comparative animal physiology. Saunders College Publishing, New Delhi.

First Degree Programme
Semester IV
Zoology Complementary Course IV
Applied Zoology

Course code – ZO1431 **Total hours 54**
No. of credits – 3

Aim of the course

To introduce the methodology and perspectives of applied branches of zoology with a view of educating youngsters on the possibilities of self employment

Objectives of the course

- To learn the basic principles involved in the culture and breeding of common edible and ornamental fishes of Kerala and the art of aquarium keeping.
- To get a basic understanding of human genomics and reproductive biology including stem cell research and prenatal diagnostic techniques

Module I **17 hrs**

Aquaculture: Traditional methods of aquaculture, fishing crafts and gears, common fishes used for culture in Kerala, *Catla, Etroplus, Tilapia* and *Mugi*l; capture fishes- *Sardine, Mackerel*.

Pond culture: Construction, maintenance and management; carp culture, shrimp culture, shellfish culture, composite fish culture and pearl culture

Ornamental fish culture: Fresh water ornamental fishes – biology, breeding habits, spawning, hatching and rearing techniques.

Construction and maintenance of aquarium: Construction of home aquarium, materials used, setting up of freshwater aquaria, aquarium plants, ornamental objects, cleaning the aquarium, maintenance of water quality, control of snail and algal growth.

Module II **10 hrs**

Sericulture: Brief account of morphology and life history of silkworm, varieties of silkworm, rearing technique, mulberry cultivation, diseases and pests of silkworm. Processing of cocoon, reeling and marketing of silk.

Apiculture: Species of honey bees, social organization of honey bees, apiary management and maintenance, bee keeping equipments, bee pasturage, honey and bees wax and their uses.

Module III **8 hrs**

Live Stock Management**:** Poultry farming, poultry breeds: mention American, Asiatic, Mediterranean, English and indigenous breeds. Poultry breeding and poultry products; rearing of chicks, growers, layers, broilers, ducks, turkeys and quails; diseases of poultry.

Dairy farming: Types, loose housing system and conventional barn system; advantages and limitations of dairy farming; establishment of dairy farm and choosing suitable dairy animals, feed, diseases of dairy animals.

Module IV **7 hrs**

Human Genetics: Normal chromosome complements; karyotype study, pedigree analysis. Syndromes- autosomal syndromes (Down's syndrome and Edwards syndromes), sex chromosomal syndromes (Turners syndrome and Klinefelter's syndrome), genetic disorders- single gene disorders (sickle cell anemia and phenyl ketonuria), multifactorial disorders (cleft lip, and cleft palate), genetic counseling.

Module V **12 hrs**

Developmental Biology and Biotechnology :Types of egg; fertilization; types and pattern of cleavages, blastulation - different types of blastula, gastrulation- morphogenetic movements (epiboly and emboly); brief description of organizers and embryonic induction. Cloning experiments in animals and man. Embryonic stem cell research. Prenatal diagnostic techniques- amniocentesis, chorionic villus sampling, ultrasound scanning. Test tube babies, gene cloning, human genome project, human gene therapy.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Bard, J (1986). Handbook of Tropical Aquaculture.
- Gardner, E.J(1983). Human heredity, John Wiley and Sons, New York
- Hawkins, A.D (1981). Aquarium Systems, Academic Press
- Lewin, B (1983). Genes, John Wiley and Sons, New York.
- Mishra, R.C (2002). Perspectives in Indian Apiculture, Agro
- Philips, E.F(2003). Bee Keeping, Agro
- Santhanam, R. A. Manual of Aquaculture.
- Shukla and Upadyay (2002). Economic Entomology.
- Tembhare, D.B (1997). Modern Entomology, Himalaya Publishing House.
- Zuka, R.l and Hamiyn (1971). Aquarium fishes and plants

First Degree Programme
Zoology Complementary Course V
Practical I -Animal Diversity I &II, Functional Zoology and Applied Zoology
Course Code – ZO1432

No. of credits – 4

Aim of the course

To provide an hands- on training experience in anatomy through simple dissections and mountings

Objectives of the course

· To familiarize students with conventional organ system in common, easily available animals.
· To emphasize the adage that 'seeing is believing' typical examples and economically important specimen (preserved) to be studied.
· To study and carry out routine clinical analysis of blood and urine

Animal Diversity I & II

Study specimens

1. Protista : *Noctiluca, Paramecium, Entamoeba, Trichonympha* [any 3]
2. Porifera : *Sycon*
3. Cnidaria : *Obelia, Aurelia,* Sea anemone (Adamsia)
4. Platyhelminthes : *Bipalium, Fasciola, Taenia solium*
5. Nematoda : *Ascaris, Ancylostoma*
6. Annelida : *Nereis, Hirudinaria*
7. Arthropoda : *Limulus*, Scorpion, *Scolopendra, Sacculina,Leptocorisa* , *Oryctes*, Larval stages of prawn [any 5]
8. Mollusca : Freshwater mussel, *Sepia, Pila*
9. Echinodermata : Starfish, Sea urchin, Brittle star, Sea cucumber, sea lily [any 3]
10. Chordates : *Branchiostoma (entire), Ascidia, Petromyzon*

Scoliodon, Narcine, Echeneis, Hippocampus, Anguilla [any 3]

Icthyophis, Amblystoma, Rhacophorus [any 2]

Chamaeleon, Bungarus, Naja, Vipera, Chelone [any 4]

Pigeon – different types of feathers

Pteropus

Minor Practicals (Mounting) – any three

1. Earthworm : Setae
2. *Penaeus* : Appendages(Maxillipeds, Chelate, First abdominal- any three)
3. Cockroach :Mouth parts
4. Nereis : Parapodium
5. Shark : Placoid scales

Major Practicals(Dissection) – any two

1.Earthworm : Alimentary canal and associated glands (Demonstration, Flag labeling of parts.

2.Penaeus : Nervous system

3.Cockroach : Alimentary canal

Osteology

Study of the skeleton of frog

1. Vertebrae (typical, 8th, 9th and urostyle)
2. Limb girdles: pectoral girdle with sternum, pelvic girdle.

Functional and Applied Zoology

Functional Zoology [1-4, Compulsory]

1. Preparation of human blood smear to study the different types of WBCs.
2. Human blood grouping: ABO and Rh Systems.
3. Urine analysis for abnormal constituents: albumin and glucose.
4. Study of slides/models of different types of eggs (frog, chick), blastula of frog and gastrula of frog.

Applied Zoology[1-2, Compulsory]

1. Study of beneficial insects *Apis* (worker, drone and queen), *Bombyx* (life cycle, silk)
2. Study of the following items of economic importance: *Perna, Pinctada, Penaeus, Sardinella.*

Human Genetics[1-2, Compulsory]

Study of the following using charts/photographs

1. Study of normal human karyotype.
2. Study of abnormal human karyotypes. [Klinefelter's, Turner's, Down's and Edward's syndrome]