SYSTEMATICS, EVOLUTION & ZOOGEOGRAPHY

Programme	B.Sc. Zoology				
Type of Course	Major				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total hours
	4	4			60
Pre-requisites	+2 /VHSC Biology or equivalent online courses				
Course objectives	The course is designed to develop an understanding in principles of Systematics, theories, evidences, and trends of evolution , process of speciation, various zoogeographical realms and their characteristics.				

Course outcomes

CO	CO statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe the concept of taxonomy and systematics and their importance, the basic trends in taxonomy, the concept of ICZN, different systems of nomenclature; and the principles and techniques of molecular systematics,	U	F&C	
CO2	Explain the concept of organic evolution and various theories associated with it and the origin of life, the Major events in evolutionary timescale and the reason for Mass extinction and its consequences	U	F&C	
CO3	Describe the various theories on evolution, the concept of species and speciation; and the factors leading to speciation	U	F&C	
CO4	Identify and describe major zoogeographical realms, understanding the factors contributing to their delineation, the principles of island biogeography, including the effects of island size, distance, and isolation on species diversity	R&U	F&C	
CO5	Present seminars and debates on Evolutionary principles,	Ap	C&P	
CO6	Differentiate between the evolutionary principles and the mythological features and stories, identify the pseudoscience elements in general beilief.	Ap	C&M	
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Question paper pattern for external examination: Module 1 : short answer 2x 3 = 6marks, paragraph 1x 6 = 6marks, Essay1 x10 = 10 marks; Module 2 : short answer 2x 3= 6marks, paragraph 2 x 6 = 12marks, Essay x10 = marks; Module 3 : short answer 2x 3=6marks, paragraph 3x 6 = 18marks ; Module 4 : short answer 4 x 3= 12marks, paragraph2 x 6 = 12marks.

Module 1: Systematics (10hrs)

Unit 1: Taxonomy(6hrs) - Historical account natural and classical. Taxonomy and Systematics, Taxonomic hierarchy. Obligatory categories of classification. Species concept. Modern trends in Systematics. Modern Taxonomic Trends: Chemotaxonomy, Cytotaxonomy, Molecular taxonomy, Cladistics, Numerical taxonomy, Bar coding techniques.

Unit 2: Classification and Nomenclature (4hrs) -Two and Five kingdom classification, merits and demerits. Cavalier-Smith's Eight kingdom classification; International Code of Zoological Nomenclature.-Binomial, Trinomial Nomenclature, merits and demerits, ethics.

Module 2: Principles of Evolution (14hrs)

Unit 1: Introduction (2hrs) -Concept of evolution, Evolution as the process of change, history of evolutionary thought -Lamarck, Darwin, and Wallace.

Unit 2: Theories on origin of life (3hrs)- concept of organic evolution, Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, concept of Oparin - Haldane, Miller-Urey Experiments. Evolution of Prokaryotes- origin of eukaryotic cells-
Unit 3: Geological Timescale (2hrs) - Major events in evolutionary timescale, .Anthropocene. Mass extinction and its consequences.
Unit 4: Evidences of evolution (7hrs)- comparative morphology and anatomy, homologous organs, divergent evolution and adaptive radiation, analogous organs, convergent evolution and parallel evolution, vestigial organs, atavism, connecting links. Evidences from comparative physiology and biochemistry, embryological evidences, Von Baer's rule, Biogenetic law, paleontological evidence, Geological Timescale-evolution of horse, Archaeopteryx.

Module 3: Theories of evolution & speciation (14hrs)
Unit 1: Theories on Evolution(6hrs)- Lamarck's theory- postulates, with examples. criticism, Neo-Lamarckism, present status:
Darwin's theory -postulates, with examples, criticism, neo-Darwinism. Supplementary theories of Darwin-Sexual selection, Artificial selection.
Mutation theory of De Vries: Weizmann's theory of germplasm. The synthetic theory of evolution.
Unit 2: Species concept(3hrs)- Phylogenetic & Biological species concept. General characteristics and subdivisions-subspecies, semi species, sibling species, cline and deme.
Unit 3: Speciation(5hrs) —Phyletic, quantum and Gradual speciation. Methods of natural speciation. Allopatric, parapatric and sympatric. Isolation & Isolating mechanisms-Geographic and Reproductive isolations

Module IV Zoogeography (10hrs)
Unit 1: Introduction (1hr)- Concept of Zoogeography, historical events of Zoogeography; Factors controlling distribution of animals.
Unit 2: Animal distribution (3hrs) – Geographical distribution- Cosmopolitan, discontinuous, isolated, Bipolar- with examples. Methods of animal distribution. Barriers to animal distribution.
Unit 3: Zoogeographical realms (4hrs) - -Physical features, sub-regions of realms, Faunal characteristics of the realm. Palaearctic, Nearctic, Neotropical, Ethiopian, Oriental & Australian. Mention Wallace line, webers line &Wallacea.
Unit 4: Biogeographical zones of India (1hr)-Trans-Himalayan, Himalayan, North-Eastern Zone, semi-arid zone, desert zone, Gangetic plain, Deccan plateau zone, Western ghats, Coastal zone, Island Zone.
Unit 5: Insular fauna (1hr) - concept- faunal characteristics ; Continental islands-British isles, Sri Lanka: Oceanic islands-Galapagoes islands-: Ancient Islands- Madagascar

Module 5: Open ended (12hrs)
The teacher can design student activities like assignments, seminars, debates collection of notes/reference materials related to the topics of module 2&3,, organizing mass education programmes on evolutionary principles by the students for the school students and general public of their locality through offline or online modes etc

References

- The Zoogeography: The geographical distribution of animals. Darlington, P.J.
- Introduction to Zoogeography. Illies, J. Macmillan.

- International Commission for Zoological Nomenclature (ICZN): 1999 International Codeof Zoological Nomenclature. (available online free: www.iczn.org).
- Theory and Practice of Animal Taxonomy, Kapoor, V.C.
- Principles of Systematics Zoology. Mayer, E
- Principles of Animal Taxonomy, Simpson, G.C
- Readings in Indian Zoogeography (Vol.1) Tiwari, S.
- Principles of Evolution, Peter R. Grant and B. Rosemary Grant
- Evolutionary Biology, Eli C. Minkoff

The Selfish Gene, Richard Dawkins

Online Sources

1
2
3

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1		3					3						
CO 2		3					3						
CO 3		3					3						
CO 4	3	3					3						
CO 5				4	3			3					
CO6					3						3		

PRACTICES IN ENTOMOLOGY, POULTRY SCIENCE AND DAIRY SCIENCE

Programme	B.Sc. Zoology				
Type of Course	Major				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total hours
	4	3		2	75
Pre-requisites	+2 /VHSC Biology or the following online courses 1. https://onlinecourses.swayam2.ac.in/cec20_ge23/preview 2. https://asutoshcollege.in/new-web/six-months-certificate-course-in-apiculture-and-sericulture.html				
Course objectives	The course is designed to develop an understanding in overall aspects of Sericulture, Apiculture, Dairy and Poultry Science and enable the student to do simple experiments regarding these.				

Course outcomes

CO	CO statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe the process of Apiculture; different species of Honey Bees; the importance of health and hygiene in Beekeeping; the economic importance of Apiculture	U	F&C	
CO2	Describe various stages of Sericulture; different species of Silk moths; the importance of health and hygiene in Sericulture; the economic importance of Sericulture	U	F&C	
CO3	Enlist various traps and other physical means to control insect pests	U	F&C	
CO4	identify different breeds of cattle and fowls for various purposes, different appliances and parts of cattle and poultry rearing houses	R	F	
CO5	Acquire the skills to maintain Bee hives, Silk worm rearing houses and insect traps in a scientific way.	Ap	C&P	
CO6	Compare different species of honey bees and silkworms for their rearing characteristics	U	F&C	

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Question paper pattern for external examination: Module 1 : short answer 3x 3 = 9marks, paragraph 1x 6 = 6marks, Essay1 x10 = 10 marks; Module 2 : short answer 2x 3= 6marks, paragraph 2 x 6 = 12marks, Essay x10 = marks; Module 3 : short answer 2 x 3=6 marks,

paragraph 2x 6 = 12marks ; Module 4 : short answer 3 x 3= 9 marks, paragraph3 x 6 = 18marks.

Module 1: Apiculture (12Hrs)

Unit 1:Introduction to Apiculture: (2hrs)- Brief history, Apiculture worldwide and in India and its Scope; Traditional, Modern and Urban or Backyard Beekeeping; species of Honey Bees used in Beekeeping; Role of Central Honey Bee Research and Training Institute.

Unit 2: Biology of Honey bees (2 hrs)- Morphology, Life History and Social Behaviour of Honey Bees of Honey Bees.

Unit 3: Rearing of Honey Bees (5hrs) -:Standard tools used in Apiculture, types of bee hives; Basic requirements for Beekeeping.Honey Bee Enemies and Diseases, Management, Preventive and control measures of diseases.

Unit 4: Economy and Entrepreneurship(3hrs)- Bee products; Composition and uses of honey; Honey extraction and handling; Economic importance and marketing aspects of bee products; Role of Govt. and Non-Govt. agencies in promoting apiculture in Kerala; Present status and scope of apiculture in Kerala.

Module 2: Sericulture and Lac culture(14hrs)

Unit 1:Introduction to Sericulture (2hrs) - Origin and history of Sericulture. Sericulture in India and other countries. Present status of sericulture. Scope of sericulture. Types of silkworms and their distribution. Mulberry and non-mulberry sericulture.

Unit 2: Silkworm Biology and Rearing (7hrs)- A brief introduction to mulberry cultivation and mulberry varieties. Commercial varieties of mulberry, Mulberry plantation establishment and cultivation practices. Life cycle of *Bombyx mori*. Structure of silk gland and secretion of silk. Rearing house and rearing appliances. Disinfectants. Silkworm rearing technology: Early age and Late age rearing. Types of mountages. Spinning, harvesting and storage of cocoons.

Unit 3: Diseases of silkworms (1hr)– Viral, Bacterial, Fungal and Protozoan; Control measures.

Unit 4: Entrepreneurship in Sericulture(2hrs)- :Prospects of Sericulture in Kerala, potential in mulberry and non-mulberry sericulture. Employment in Sericulture and Govt. Schemes for financial Assistance.

Unit 5 Lac culture (3hrs)- Morphology and life cycle of Lac insect lac host plants, different strains of lac insects, cultivation, inoculation, harvesting and propagation of lac, composition and uses of lac.; Enemies of lac insect and their control. Scope for cultivating lac in Kerala. Recent advances in lac culture research.

Module 3: Traps and other physical methods to control insect pests (6 hrs)

Unit 1 : Insect traps (5hrs) – Passive traps: Window flight trap, barrier trap, Malaise trap, cone trap, pan trap, bucket trap, Aquqtic arthropod trap: Aquatic interception traps, Aquatic emergence trap; Aerial rotary and suction traps; coloured trap, USB based traps: Active traps: Light traps- different types, parts of a light trap, sticky traps, pheromone trap, bait traps.

Unit 2 : Other methods(1hr): Sweeping : aerial nets, sweep nets; beating cards and sheets; netting sieving,

Module:4 Dairy Science and Poultry production(13hrs)

Unit 1: Dairy cattle breeding (3hrs)- Diffeent breeds fof cattle grown for different purposes; Inbreeding, Outbreeding, Cross breeding, Grading up. Breeding systems suitable to enhance milk production in India (Cross breeding of cattle and Grading up of buffaloes).Multi-ovulation and Embryo transfer technique. Cloning and Transgenic animals

Unit 2:Dairy processing (3hrs)– Milk collection, transportation & Grading of milk – Standardization – Pasteurization – Homogenisation of milk - packaging of milk- Common adulterants in milk and their detection techniques- Nutritive value of milk ICMR recommendation of nutrients.

Unit 3: Current status of Indian poultry industry (3hrs)- avian biology and welfare; breeds and varieties of poultry, poultry breeding and genetics.
Unit 4: Physical requirements of incubation and hatchery management(4hrs)- summer and winter management of poultry; artificial insemination; Common poultry diseases and management; Management of hatchery and poultry waste; economics of poultry production.

Module 5: PRACTICALS (1 CREDIT, 30 Hrs)
MANDATORY EXPERIMENTS

1. To study the different species and castes of Honey Bees.
2. Familiarise Bee keeping instruments and Bee hives.
3. Familiarise Silkworm rearing appliances.
4. Construction of any two types of insect traps: light trap/ sticky trap/ pan trap/ malaise trap

Of the remaining experiments any 4 can be selected by the Institution from the following list. Two experiments other than the listed should be selected by the Supervising teacher and introduced to the students.

5. Identification of different species of Silkworms and their life cycles.
6. To test the quality of milk
7. Structure of Honey comb – Different types of cells for Queen, Workers and Drones.
8. Morphological peculiarities of Worker bees – Honey and pollen storage structures.
9. Construction of mini egg incubators using suitable materials.
10. Construction of bee hives (if original hive making is not possible, make miniature models using cardboards or other suitable materials)

FieldStudy: a) Visit to an apiary to study the bee keeping methods /b) Visit to Silk worm rearing centers to find the silk worm rearing/ c) Visit to Dairy and Poultry farms/.d Visit to insect pest control device – making units or industries. Prepare a detailed report based on the field visit, which is to be submitted at the time of end semester exam.

Virtual Labs (Suggestive sites)

1. https://agritech.tnau.ac.in/farm_enterprises/fe_api_castesofhoneybee.html#:~:text=Queen%20is%20a%20fertile%2C%20functional,drone%20is%20a%20male%20insect.&text=Queen%20and%20worker%20develop%20from,the%20queen%20or%20worker%20larvae.
2. https://agritech.tnau.ac.in/farm_enterprises/fe_api_beekeepingaccessories.html
3. https://agritech.tnau.ac.in/sericulture/seri_silkworm%20types.html
4. https://agritech.tnau.ac.in/sericulture/seri_silkworm1_rearing%20house.html
5. https://www.beemaniacs.com/2015/04/18/cells-cells-and-cells/
6. https://ir.library.oregonstate.edu/downloads/m613n331f
7. https://agritech.tnau.ac.in/farm_enterprises/fe_api_typesofhoneybee.html#:~:text=The%20Indian%20hive%20bee%2C%20Apis,%2C%20Melipona%20irridipennis%20(Meliponidae).

8. https://pureshmilk.com/blog/2019/06/21/simple-tests-at-home-to-check-the-purity-of-the-milk-you-consume/

References

- Ananthakrishnan, C.P., Khan, A.Q. and Padmanabhan, P.N. 1993. The technology of milk Processing — Shri Lakshmi Publications. 176 pages.
- Arora, R. and Dhaliwal, G. S. 2001. integrated Pest Management Concepts and Approaches –Kalyani Publishers ISBN 81-7663-904-4
- B David and T Ananthakrishnan. 2003. General and applied Entomology. 2nd Edition.ISBN: 9780070434356, 0070434352, Tata McGraw Hill. 1200 pages.
- B. V. David and V.V. Ramamurthy. 2016. Elements of Economic Entomology. 8thEdition. ISBN: 9780994869104, 099486910X, Brillion Publishing. 400 pages.
- G.C. Banerjee. 2019. Text Book of Animal Husbandry, 8th Edition. ISBN: 9788120412606. Oxford & IBH Publishing, New Delhi. 552 pages.
- Gursharan Singh, K.P. Srivastava, G.S. Dhaliwal. 2021. A Textbook of Applied Entomology – II Insects of Economic Importance. 4th Edition.ISBN :9788127267520, Kalyani Publishers.
- Hand Book of Animal Husbandry – ICAR Edition. ISBN -13 - 978-8171640867 1234pages
- Mahanta, D. K., Komal, J. and Sai Teja, K. S. 2022 Different Types of Insect Traps for Different Insects- Agriculture & Food E newsletter Volume 4(4)
- Omkar. 2017. Industrial Entomology. ISBN 978-981-10-3303-2, Springer Nature Singapore Pte Ltd. 469 pages
- Petersen. W.E. 2017. Dairy Science: Its Principles and Practice. 2nd Edition. Publisher – Lippincott & Company
- Sreenivasaiah., P. V., 2015. Textbook of Poultry Science. 1st Edition. Write & Print Publications, New Delhi

Online Sources

1. https://www.vedantu.com/biology/apiculture-and-sericulture

2. https://elearning.icar.gov.in/eLearning_ContentDisplayUG.aspx?CourseCode=7UV3MOEAK1USxrGrYOy7VQ==&CourseName=AabP6XqFFfb5/FvzYT1aGGZAlW05pNbzZ1x4ZpuEo2OXSkGj/DaCsEk/HLGqrq6CbisPvpLgM4vZ7EWBwZLlPjc1awujk2II9I0w21IPwEM=
3. https://agritech.tnau.ac.in/animal_husbandry/animhus_index.html
4. https://vetstudy.journeywithasr.com/p/bvsc-and-ah-1st-year-notes_2.html
5. https://www.vedantu.com/biology/poultry-farming
6. https://www.drprofessionals.in/2021/05/livestock-production-management.html#google_vignette

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1		3					3						
CO 2		3					3						
CO 3		3					3						
CO 4	3						3						
CO 5				3					3				
CO6		3					3						

ANIMAL DIVERSITY, REPRODUCTIVE BIOLOGY AND DEVELOPMENTAL BIOLOGY

Programme	B.Sc. Zoology				
Type of Course	Minor				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total hours
	4	3		2	75
Pre-requisites	+2 /VHSC Biology or equivalent online courses				
Course objectives	The course aims to develop an outlook on the Animal diversity, Human reproduction, causes of infertility in humans and assisted reproductive and Prenatal Diagnostic technologies and basic concepts of animal embryology.				

Course outcomes (CO)

CO	CO statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Enumerate the salient features and examples of Phylum - Rhizopoda, Dinoflagellata, Apicomplexa, Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Arthropoda, Onychophora, Mollusca, Echinodermata, and the structural organization of *Penaeus* sp.	U	F&C	
CO2	Describe the characteristic features and classification of phylum Chordata with examples and, the structural organization of *Oryctolagus cuniculus*	U	F&C	
CO3	Explain the structuraland functional features of human reproductive system and the process of fertilization, pregnancy, gestation, placentation, parturition and lactation in humans, Assisted Reproductive technologies and Pre Natal Diagnostic techniques	U	F&C	
CO4	Enumerate the types of eggs and cleavage, the different types of blastula, morphogenetic movements during gastrulationand germ layers and their derivatives	U	F&C	
CO5	Perform experiments like mounting of specialized organs of selected non-chordates and chordates, and dissections of specimens by standard laboratory protocols	Ap	C&P	
CO6	Prepare field study report on observing local biodiversity	C	C&P	
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Question paper pattern for external examination: ***Module 1*** *: short answer 2 x 3 = 6marks, paragraph 2 x 6 = 12 marks;* ***Module 2*** *: short answer 2 x 3= 6 marks, paragraph 3x 6 = 18 marks, Essay 1 x10 = 10 marks;* ***Module 3*** *: short answer 2 x 3= 6marks, paragraph 1 x 6 = 6 marks , Essay 1 x10 = 10 marks ;* ***Module 4*** *: short answer 4 x 3= 9 marks, paragraph 2x 6 = 12marks.*

Module 1 Protists and Non-chordates (12hrs)

Unit 1: Kingdom Protista (2 hrs) - General characters.;

Phylum Dinoflagellata: e.g. *Noctiluca*

Phylum Ciliophora: e.g. *Vorticella*

Phylum Apicomplexa: e.g. *Plasmodium* (exclude life cycle)

Unit 2: Kingdom Animalia Part I : Non-chordata(10hrs)

Salient features of phyla, classification down to classes (7 hrs)

Phylum Porifera: e.g. *Leucosolenia*
Phylum Cnidaria: e.g. *Obelia, Sea anemone*
Phylum Platyhelminthes: e.g.*Fasciola*
Phylum Nematoda: e.g. *Ascaris*
Phylum Annelida: e.g.: *Hirudinaria*
Phylum Arthropoda: e.g.: *Limulus, Sacculina, Eupagurus*

Type: *Penaeus* sp. Morphology, digestive system, excretory system, sense organs (statocyst and compound eye), reproductive system (Exclude details of larval stages) (3 hrs)

Phylum Onychophora: e.g.: *Peripatus*
Phylum Mollusca: e.g. *Perna, Teredo, Pinctada*
Phylum Echinodermata: e.g. *Asterias, Holothuria*

MODULE 2. Kingdom Animalia Part II : Chordata (12hrs)

Unit 1:Chordata Classification (8hrs)

Salient features, Mention classes)
Subphylum Urochordata e.g. *Ascidia*
Subphylum Cephalochordata e.g. *Branchiostoma*
Subphylum Vertebrata:

Division I:Agnathae.g. *Petromyzon*
Division II: Gnathostomata

Super class: Pisces

Class: Chondrichthyes: e.g. *Narcine*
Class: Osteichthyes: e.g. *Echeneis, Hippocampus, Scomberomorus, Brama, Sahyadriadenisonii*(Miss Kerala)

Super class: Tetrapoda

ClassAmphibia:e.g.*Ichthyophis,Salamandra,Rhacophorus,Duttaphrynus,*Mention*Nasikabatrachussahyadrensis*
Class Reptilia: e.g. *Chamaeleo, Chelone, Naja, Bungarus, Daboia*
Class Avese.g.*Columba*
Class Mammalia eg.*Pteropus*

Unit 2: Chordata Type: *Oryctolagus cuniculus*(4 hrs)

External features, skeletal system, digestive system, sense organs and nervous system. [Exclude skin, skull bones, respiratory system, circulatory system, autonomous nervous system and endocrine system].

Section B: REPRODUCTIVE BIOLOGY AND DEVELOPMENTAL BIOLOGY

Module 3. Human Reproductive system and Reproductive Biology(7hrs)

Unit 1: Male reproductive system (1 hr)- Structure of testis, semen production and composition.

Unit 2: Female reproductive system (2hrs) - Structure of ovary and graafian follicle, ovulation.Mention corpus haemorrhagicum, corpus luteum and corpus albicans. Accessory reproductive organs.Secondary sexual characteristics. Menstrual cycle and its hormonal control.

Unit 3: Gametogenesis (2 hrs) - Spermatogenesis and oogenesis.

Unit 4: Fertilization (2hrs) -Fertilizin and anti-fertilizin, capacitation, agglutination, spermpenetration, activation of egg and amphimixis. Physiological and biochemical changes during and after fertilization. Pregnancy, Gestation, Placentation, parturition and lactation.

Unit 5: Infertility and Assisted reproductive techniques (4hrs)- Infertility: Causes and problems in male and female; Infertility management: collection, preservation and storage of semen and ova, artificial insemination; Cryopreservation and embryo transfer: Collection, care and preservation of embryos; In vitro fertilization (IVF) and embryo transfer: Major

steps; Test tube babies; Assisted Reproductive Techniques (ART): GIFT, ZIFT, ICSI, oocyte donation and embryo donation; surrogacy

Unit 1- Prenatal diagnosis (2 hours) Different methods: Ultrasonography, amniocentesis, chorionic villus sampling and alpha-foetoprotein estimation; female foeticide: ethical issues and laws (Mention PNDT Act

MODULE 4. Developmental Biology (8hrs)

Unit 1: Introduction to Embryology (1 hr) -Embryology v/s Developmental biology. Mention phases in development. Cell differentiation, totipotency, pluripotency, de-differentiaton and redifferentiation.

Unit 2: Types of eggs (2 hrs) -Classification of eggs with examples based on: Amount of yolk (micro-, meso-& macrolecithal); Distribution of yolk (iso-, centro- and telolecithal); Presence orabsence of shell (cleidoic & non cleidoic); Types of development (determinate and indeterminate).Egg membranes: primary, secondary and tertiary; functions of egg envelopes.

Unit 3: Cleavage and Blastulation (2hrs)- Types of cleavage with examples based on: Plane of cleavage (Meridional, Vertical, Equatorial and Latitudinal); Amount of yolk (Holoblastic and Meroblastic); Types of development (Determinate and Indeterminate); Pattern of arrangement of blastomeres (Radial and Spiral).Different types of blastula.

Unit 4: Gastrulation (3hrs) -

Basic Cell movements (Morphogenetic movements) in gastrulation (Invagination, Involution, Ingression, Delamination and Epiboly-Brief account only). Germ layers and derivatives.

Module 5: PRACTICALS (1 CREDIT, 30 Hrs)

MANDATORY EXPERIMENTS

1. Spotters

A. Animal Diversity

Phylum Dinoflagellata : *Noctiluca*
Phylum Porifera : *Leucosolenia*
Phylum Cnidaria : *Obelia, Physalia,*
Phylum Platyhelminthes : *Fasciola*
Phylum Nematoda : *Ascaris*
Phylum Annelida : *Hirudinaria.*
Phylum Arthropoda : *Eupagarus, Limulus, Sacculina*
Phylum Onychophora : *Peripatus*
Phylum Mollusca : *Sepia, Pinctada, Perna*
Phylum Echinodermata : *Asterias, Holothuria.*
Phylum Chordata
Protochordates : *Ascidia/ Branchiostoma.*
Cyclostomata : *Petromyzon.*
Superclass: Pisces : *Narcine, Echeneis, Hippocampus, Scomberomorus, Brama*(Any 3)
Class Amphibia : *Ichthyophis, Axolotl* larva*, Rhacophorus*(Any 2)
Class Reptilia : *Chamaeleo, Daboia, Bungarus*
Class Aves : *Columba*
Class Mammalia : *Pteropus*or any other Bat.

B. Osteology : Rabbit : Skull showing Dentition, Pectoral and Pelvic girdle

2. Mounting:

Penaeus: Appendages (minor)
Cockroach: Salivary apparatus (major).
Honeybee: Mouth parts (minor).
Shark: Placoid scales (minor).

3. **Dissections :**
   Penaeus : Nervous system (major)
   Sardinella : Alimentary canal (major)
4. **Spotters – Developmental Biology**
   - Types of eggs (Insect, Amphioxus, frog, chick, and human- use slides/diagrams/models).
   - Cleavage in frog (use slides / diagrams/models).
   - Types of Blastula (use slides / diagrams/models).
   - Gastrula of frog or any organism (use slides / diagrams/models).

II. Two experiments related to Reproductive biology or Developmental biology other than the listed should be designed by the Faculty and introduced/demonstrated to the students.

Field study: Explore the local Biodiversity and submit a diversity register of animals belonging to a minimum of **ten classes**, at the time of semester end practical examination.

Virtual Labs (Suggestive sites)

REFERENCES

- Buchsbaum, R., Buchsbaum, M., Pearse, J. & Pearse V. (2013). Animals without Backbones: An Introduction to the Invertebrates. University of Chicago Press, USA.
- Dhami, P. S. &Dhami, J. K.: Invertebrate Zoology. R. Chand & Co, New Delhi.
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- EkambaranathaAyyar, M. & Ananthakrishnan, T. N. (2009) Manual of Zoology, Chordata, Vol. II (Part I& II), ISBN-10: 8187156384, S. Viswanathan Pvt. Ltd., Madras.
- Jordan E.L. & Verma, P.S. (2010)ChordateZoology, ASIN: B00QUYL0ZY,Kindle Edition, S. chand& Co.1092 pages
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ONLINE SOURCES

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Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1		3					3						
CO 2		3					3						
CO 3		3					3						
CO 4		3					3						
CO 5				3					3				
CO6						3		2					3

PHYSIOLOGY OF BEHAVIOUR AND SENSES

Programme	B.Sc. Zoology				
Type of Course	Minor				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total hours
	4	3		2	75
Pre-requisites	+2 /VHSC or equivalent online courses				
Course objectives					

Course outcome	CO statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe the physiological control of thirst and hunger, factors affecting hunger and thirst, etc.	U	F&C	
CO2	Explain importance of sex hormones, causes of stress, and the list of hormones influencing sexual behaviour	U	F&C	
CO3	Predict the nature of defects caused by the damage or deformity of different parts of eye and ear	Ap	F&C	
CO4	Describe the sensory pathways for the guatatory, olfactory, thermosensory, pain sensations	U	F&C	
CO5	Attain skill in doing experiments related to sensory functioning	Ap	P	
CO6	Prepare report on visiting institutions like, hospitals to study the sensory perception analysis procedures	Ap	P	
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Question paper pattern for external examination: ***Module 1*** *: short answer 2x 3 =6 marks, paragraph 1 x 6 = 6marks;* ***Module 2*** *: short answer 3x 3= 9marks, paragraph 2 x 6 = 12marks,; Essay1 x10 =10 marks* ***Module 3*** *: short answer2 x 3=6 marks, paragraph 2 x 6 =12 marks Essay 1x10 = 10 marks; Module 4 : short answer 2 x 3= 6 marks, paragraph 3 x 6 = 18 marks,*

Module 1: Module 1: Physiological basis of hunger and thirst (10Hrs)

Unit 1: Physiology of Hunger (6hrs)- Neural control of food intake - Role of the hypothalamus, Neural centers that influence; Mechanical process of feeding.; Factors that regulate the quantity of food intake, role of hormones (effect of Cholecystokinin, Peptide YY, GLP, and Ghrelin).; Short-term regulation of food intake, intermediate and long-term effects of food intake.; (Effect of blood concentrations of glucose, amino acids, lipids on hunger and feeding), temperature regulation of food intake.; Obesity - causes and treatment, eating disorders (Bulimia, Anorexia, Inanition, Cachexia, Picca).

Unit 2: Physiological basis of thirst (4Hrs)- Peripheral factors in water regulation. Central factors in water regulation (cellular dehydration thirst and hypovolemic thirst).; Angiotensin and thirst, Dehydration and water toxicity

Module 2: Physiological basis of emotions and sexual behaviour (14Hrs)

Unit 1: Neural basis of emotion& Stress physiology (5hrs)-Role of frontal lobes.; Behavioural functions of the hypothalamus and associated limbic structures, Reward centers, Rage – its association with punishment centers, placidity and tameness.; Functions of Amygdala. ; Stress physiology: Stress and strain- Environmental stressors

Unit 2: Physiology of sexual behaviour (9hrs) - Hormones and sexual development – Foetal hormones and the development of reproductive organs, Sex differences in the brain, Perinatal hormones and behavioural development, Puberty: hormones and development of secondary sexual characteristics.; Effects of gonadal hormones on adults – Male reproduction-related

behaviour and testosterone, Female reproduction-related behaviour and gonadal hormones. ; Neural mechanisms of sexual behaviour – Structural differences between the male hypothalamus and female hypothalamus, the hypothalamus and male sexual behaviour, the hypothalamus and female sexual behaviour**,**

Module 3: Physiology of Vision and Hearing (10Hrs)

Unit 1: Vision (5hrs) - Structure of the human eye, Organization of the retina and visual pathways.; Functioning of the eye, visual coding, chemistry of vision, transduction in the retina, theories of colour vision, visual perception.;Visual defects (myopia, hypermetropia, presbyopia, astigmatism, cataract, colour blindness, nyctalopia).

Unit 2: Auditory System (5Hrs) - Characteristics of sound &audible sound frequency ; Anatomy of the auditory system.; Auditory pathways, auditory perception and hearing abnormalities.; statoreceptors**.**

Module 4: Gustatory, Olfactory and cutaneous system (11Hrs)

Unit 1: Physiology of taste (3hrs) - Anatomy of taste buds and its function, primary sensations of taste (agents and site of sensation), taste thresholds and intensity discrimination, taste preferences and control of the diet; Taste pathways and transmission of signals into the central nervous system.

Unit 2: Physiology of smell (2hrs) - Organization of the olfactory membrane, sense of smell and stimulation of the olfactory cells; Categorizing smell, the transmission of smell signals into the central nervous system.

Unit 3: Cutaneous senses (6hrs) - Classification – the mechanoreceptive somatic senses (tactile and position), thermo-receptive senses (heat and cold) and pain sense.; Detection and transmission of tactile sensations – tactile receptors, detection of vibration, tickling and itch; Sensory pathways for transmitting somatic signals into the central nervous system,; Somatosensory cortex, position senses, position sensory receptors.; Thermal sensations - thermal receptors, their excitation and transmission of thermal signals; Pain – purpose, types, pain receptors, pain suppressive system, pain sensation**.**

Module 5: PRACTICALS (1 CREDIT, 30 Hrs)

1.Identification of parts of Eye using charts, models etc.
2. Identification of parts of Ear using charts, models etc.
3. Identification of visual defects myopia, hypermetropia, presbyopia, astigmatism, cataract, nyctalopia
4. Identification of colourblindness using Ishihara chart.
5. Practise of stress releasing excercises.

Two experiments other than the listed should be designed by the Supervising teacher and introduced to the students.

Institutional visit to Hospitals or other Medical centers to study the procedures to detect visual or auditory defects in children (not more than one day)

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Online Sources

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	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1		3					3						
CO 2		3					3						
CO 3					3		3						
CO 4		3					3						
CO 5				3					3				
CO 6				3				3					

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High