KUNTHAVAI NAACCHIYAAR GOVERNMENT ARTS COLLEGE FOR WOMEN
An Autonomous College Affiliated to Bharathidasan University
(Re-Accredited by NAAC with 'B' Grade by NAAC)
Thanjavur -613 007, Tamil Nadu, India.

PG & RESEARCH DEPARTMENT OF ZOOLOGY

TNSCHE REVAMPED CURRICULUM
CBCS & OBE
Scheme of Instruction and Syllabus for

B.Sc., ZOOLOGY
(I to VI Semester)

(Effective from 2023 - 2024 and onwards)

PG & RESEARCH DEPARTMENT OF ZOOLOGY

KUNTHAVAI NAACCHIYAAR GOVERNMENT ARTS COLLEGE FOR WOMEN (AUTONOMOUS)

THANJAVUR – 613 007, TAMIL NADU, INDIA

Kunthavai Naacchiyaar Govt. Arts College for Women (Autonomous), Thanjavur - 7.
UG Programme B.Sc. ZOOLOGY Course Structure under CBCS
(Applicable to candidate from the academic year 2023 - 2024 TANSCHE onwards)

Semester	Part	Course	Subject Code	Title of the Paper	Inst. Hrs.	Credit	Exam. Hrs	Marks		Total
								Int.	Ext.	
I	I	LC I	23K1T1	Tamil	6	3	3	25	75	100
	II	ELC I	23K1E1	English	6	3	3	25	75	100
	III	CC I	23K1Z01	Invertebrata	5	5	3	25	75	100
		CC II (P)	23K1Z02P	Practical- I- Invertebrata	3	3	3	25	75	100
		EC1	23K1ZECB1:1	Elective Botany - I	4	4	3	25	75	100
			23K1ZECB1:2	Fundamentals of Botany- I						
		EC 2 (P)		Elective Botany Practical	2	-	-	-	-	-
	IV	SEC 1	23K1ZSEC1	Ornamental fish farming And Management	2	2	3	25	75	100
		SEC FC	23K1ZFC	Economic Zoology	2	2	3	25	75	100
					30	22	-	-	-	700
II	I	LCII	23K2T2	Tamil	6	3	3	25	75	100
	II	ELCII	23K2E2	English	6	3	3	25	75	100
	III	CC III	23K2Z03	Chordata	5	5	3	25	75	100
		CC IV (P)	23K2Z04P	Practical - II - Chordata	3	3	3	25	75	100
		EC 2(P)	23K2ZECB2P	Elective Botany Practical	2	2	3	25	75	100
		EC3	23K2ZECB3:1	Elective Botany - II	4	3	3	25	75	100
			23K2ZECB3:2	Fundamentals of Botany- II						
	IV	SEC2	23K2ZSEC2	Biocomposting for Entrepreneurship	2	2	3	25	75	100
		SEC3	23K2ZSEC3	Aquarium Keeping	2	2	3	25	75	100
					30	23				800
III	I	LCIII	23K3T3	Tamil	6	3	3	25	75	100
	II	ELCIII	23K3E3	English	6	3	3	25	75	100
	III	CC V	23K3Z05	Cell Biology and Genetics	5	5	3	25	75	100
		CC VI (P)	23K3Z06P	Practical - III- Cell Biology and Genetics	3	3	3	25	75	100
		EC IV	23K3B/P/ZECCH4:1	Elective Chemistry - I	4	4	3	25	75	100
			23K3B/P/ZECCH4:2	Chemistry for Physical And Biological Sciences - I						
		EC V		Volumetric and Organic Analysis Practical	2	-	-	-	-	-
	IV	SEC 4	23K3ZSEC4	Bioinstrumentation	1	1	3	25	75	100
		SEC5	23K3ZSEC5	Basic Course in Ornithology	2	2	3	25	75	100
		EVS		Environmental Studies	1	-	-	-	-	-
		ECC1	23K3ZECC1:1	Economic Entomology	-	3	3	-	100	100
			23K3ZECC1:2	MOOC (Value Added)			-	-	-	-
		ECC2	23K3ECCZ2	Add on Course	-	4	-	-	-	-
					30	21	-	-	-	700

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	CC-VII	23KP3Z07	Genetics And Evolution	6	5	3	25	75	100
	CC-VIII	23KP3Z08	Animal Physiology	6	5	3	25	75	100
	CC-IX	23KP3Z09P	Practical -III- Genetics And Evolution, Animal Physiology And Medical Laboratory Techniques	6	5	3	25	75	100
III	CC-X	23KP3Z10	Medical Laboratory Techniques	6	4	3	25	75	100
	EC-V	23KP3ZECZ5:1	Stem cell Biology	3	3	3	25	75	100
		23KP3ZECZ5:2	Sericulture						
	SEC-II	23KP3ZSEC2	Dairy Farming	3	2	3	25	75	100
		23KP3I	Internship/Industrial Activity	-	2	-	-	-	-
	ECC3	23KP3ZECC3:1	Environmental Toxicology	-	3	3	-	100	100
		23KP3ZECC3:2	MOOC			-	-	-	-
				30	**26**	-	-	-	**600**
IV	CC-XI	23KP4Z11	Immunology	6	5	3	25	75	100
	CC-XII	23KP4Z12	Ecology	6	5	3	25	75	100
	Project Work	23KP4ZPW	Project with Viva voice	10	7	-	-	-	100
	EC VI	23KP4ZECZ6:1	Aquaculture	4	3	3	25	75	100
		23KP4ZECZ6:2	Vermiculture						
	SEC III	23KP4ZSEC3	Intellectual Property Rights	4	2	3	25	75	100
	Ext. Activity	23KP4EA	Extension Activity	-	1	-	-	-	-
				30	**23**	-	-	-	**500**
				120	**91**	-	-	-	**2200**

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Signature of the HOD 20/9/23

IV	I	LC IV	23K4T4	Tamil	6	3	3	25	75	100
	II	ELC IV	23K4E4	English	6	3	3	25	75	100
	III	CC VII	23K4Z07	Developmental Biology	4	4	3	25	75	100
		CC VIII	23K4Z08P	Practical -IV- Developmental Biology	3	3	3	25	75	100
		EC V (P)	23K4B/P/ZECCH5P	Volumetric and Organic Analysis practical's	2	2	3	25	75	100
		EC VI	23K4B/P/ZECCH6:1	Elective Chemistry - II	4	3	3	25	75	100
			23K4B/P/ZECCH6:2	Chemistry for Physical And Biological Sciences - II						
	IV	SEC 6	23K4ZSEC6	Biophysics and Biostatistics	2	2	3	25	75	100
		SEC 7	23K4ZSEC7	Medical Laboratory Techniques	2	2	3	25	75	100
		EVS	23K4EVS	Environmental Studies	1	2	3	25	75	100
		ECC3	23K4ZECC3:1	Medical Zoology	-	3	3	-	100	100
			23K4ZECC3:2	MOOC (value Added)			-	-	-	-
					30	**24**	-	-	-	**900**
V	III	CC IX	23K5Z09	Evolutionary Biology	6	5	3	25	75	100
		CC X	23K5Z10	Animal Physiology	6	5	3	25	75	100
		CC XI	23K5Z11	Environmental Biology	6	5	3	25	75	100
		CC XII	23K5Z12P	Practical -V- Evolutionary Biology, Animal Physiology And Environmental Biology	6	4	3	25	75	100
		ECVII	23K5ZECZ7:1	Animal Behaviour	4	3	3	25	75	100
			23K5ZECZ7:2	Nanobiology						
	IV	VE	23K5VE	Value education	2	2	3	25	75	100
			23K5I	Summer Internship / industrial Visit / Field Visit	-	2	-	-	-	100
					30	**26**	-	-	-	**600**
VI	III	CC XIII	23K6Z13	Animal Biotechnology& Microbiology	7	6	3	25	75	100
		CC XIV	23K6Z14	Immunology	7	6	3	25	75	100
		CCXV	23K6Z15P	Practical - VI- Animal Biotechnology& Microbiology And Immunology	7	6	3	25	75	100
		EC VIII	23K6ZECZ8:1	Wild life Conservation and Management	7	3	3	25	75	100
			23K6ZECZ8:2	Human Reproductive Biology						
	IV	SEC 8/PCS	23K6ZSEC8	Food, Nutrition and Health	2	2	3	25	75	100
	V	Extn. Act.	23K6EA	Extension	-	1	-	-	-	-
				Total	**30**	**24**				**500**
				Grand Total	**180**	**140**				**4,200**

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SEMESTER - I

Course Code CC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K1Z01	**INVERTEBRATA**	**Core**	**Y**	**-**	**-**	**-**	**5**	**5**	**25**	**75**	**100**

Learning Objectives	
CO1	To understand the basic concepts of lower animals and observe the structure and functions.
CO2	To illustrate and examine the systemic and functional morphology of various group of invertebrates.
CO3	To differentiate and classify the various groups of animal modes of life and to estimate the biodiversity.
CO4	To compare and distinguish the general and specific characteristics of reproduction in lower animals.
CO5	To infer and integrate the parasitic and economic importance of invertebrate animals

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	Protozoa: Introduction- General characters and classification of Phylum Protozoa up to classes. Type study - *Paramecium*. Host-parasitic interactions in *Plasmodium*. Nutrition in protozoa. Porifera: Introduction - General characters and classification up to Classes. Type study - Ascon - Canal system in sponges.	12	CO1
II	Coelenterata: Introduction - General characters and classification up to classes. Type study - *Obelia*. Polymorphism in Hydrozoa Economic importance of corals. Platyhelminthes: Introduction - General characters and classification of up to classes. Type study –*Taenia solium*. Aschelminthes: General characters Type study - *Ascaris lumbricoides*. Parasitic adaptations in Nematodes.	12	CO2
III	Annelida: Introduction-General characters and classification up to Classes. Type study –*Nereis*. Arthropoda: Introduction - General characters and classification of Phylum Arthropoda up to Classes. Detailed study: *Penaeus indicus*. Larval forms in Crustacea. Affinities of *Peripatus.*	12	CO3
IV	Mollusca: Introduction- General characters and classification of Phylum Mollusca up to Classes. Detailed study: *Pila globosa*. Foot in Mollusca, Echinodermata: Introduction - General characters and classification of Phylum Echinodermata up to Classes. Detailed study: *Asterias.* Water vascular system and Larval forms of Echinoderms.	12	CO4

V	Insect pollinators- predators - parasites. Insects associated with human diseases: Mosquitoes, housefly, bed bug, human head louse. Insects associated with household materials: Ants, Termites, Silver fish. Insect pests: Pest of rice: Rice stem borer (*Scirpophaga incertulas*) – Pest of Sugarcane: The shoot borer (*Chilo infuscatellus*) – Pest of coconut: The rhinoceros beetle (*Oryctes rhinoceros*) Pest of cotton: The spotted bollworm (*Earias insulana*) – Pests of vegetables: Brinjal-The shoot and fruit borer (*Leucinodes orbonalis*) – Cauliflower: Pests of fruits: Citrus butterfly (*Papilio demoleus*) – Pest of stored products: The rice weevil (*Sitophilus oryzae*). Principles of Integrated Pest Management.	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the basic concepts of invertebrate animals and recall its structure and functions.	PO1
CO2	Illustrate and examine the systemic and functional morphology of various groups of invertebrata.	PO1, PO2
CO3	Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	PO4, PO6
CO4	To compare and distinguish the various physiological processes and organ systems in lower animals.	PO4, PO5, PO6
CO5	Infer and integrate the parasitic and economic importance of invertebrate animals.	PO3, PO8

Text Books (Latest Editions)	
1.	Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd
2.	Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.
3.	Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2.	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3.	Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
4.	Hyman L.H, 1955. The invertebrates - Vol. I to Vol. VII – Mc Graw Hill Book Co.

Web Resources		
1.	https://www.nationalgeographic.com/animals/invertebrates/	
2.	https://bit.ly/3kABzKa	
3.	https://www.nio.org/	
4.	https://greatbarrierreef.org/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1) B N

Course Code CCII	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K1Z02P	**PRACTICAL - I INVERTEBRATA**	**Core**	**Y**	**-**	**-**	**-**	**3**	**3**	**25**	**75**	**100**

Learning Objectives	
CO1	To identify the different groups of invertebrate animals by observing their external characteristics.
CO2	To understand the organs, organ system and their functions in lower animals.
CO3	To get knowledge about the different modes of life and their adaptation based on the environment.
CO4	Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates.

UNIT	Details	No. of Hours	Course Objectives
I	**Major Dissection:** Cockroach: Circulatory system, Nervous system, Reproductive system. Leech: Nervous System, Reproductive system. Earthworm: Nervous System, Reproductive system. *Pila globosa*: Nervous system. Prawn: Nervous system (including Appendages).	12	CO1
II	**Minor Dissection:** Cockroach: Digestive system. Earthworm: Viscera, Lateral hearts. *Pila globosa*: Digestive system (Including radula). Freshwater Mussel: Digestive system.	12	CO2
III	**Mounting:** Earthworm: Body setae; Pineal setae. *Pila globosa*: Radula. Freshwater muscle: Pedal ganglia.	12	CO3
IV	**Mounting:** Cockroach: Salivary apparatus, Mouth parts - Honey Bee, House fly and Mosquito mouth parts.	12	CO4

V	**Spotters: (i). Protozoa:** Amoeba, Paramecium, Paramecium Binary fission and Conjugation, Vorticella, *Endamoeba histolytica*, *Plasmodium vivax* **(ii). Porifera:** Sycon, Spongilla, Euspongia, Sycon - T.S & L.S, Spicules, Gemmule **(iii). Coelenterata:** Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula **(iv). Platyhelminthes:** Planaria, *Fasciola hepatica*, *Fasciola* larval forms – Miracidium, Redia, Cercaria, *Echinococcus granulosus*, *Taenia solium*, *Schistosoma haematobium* **(v). Nemathelminthes:** Ascaris(Male & Female), Drancunculus, Ancylostoma, Wuchereria **(vi). Annelida:** Nereis, Aphrodite, Chaetopteurs, Hirudinaria, Trochophore larva **(vii). Arthropoda:** Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male & female Anopheles and Culex, Mouthparts of Housefly and Butterfly. **(viii). Mollusca:** Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva **(ix). Echinodermata:** Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Identify and label the external features of different groups of invertebrate animals.	PO1
CO2	Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate animals.	PO1, PO2
CO3	Differentiate and compare the structure, function and mode of life of various groups of animals.	PO4, PO6
CO4	To compare and distinguish the dissected internal organs of lower animals.	PO4, PO5, PO6
CO5	Prepare and develop the mounting procedure of economically important invertebrates.	PO3, PO8

Text Books (Latest Editions)		
1.	Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai	
2.	Ganguly, Sinha an d A dhikari , 2 0 11 . Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.	
3.	Sinha, Chatterjee and Chattopadhyay, 2 0 1 4. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1 07 0 pp.	
4.	Lal ,S. S, 2016 . Practical Zoology Invertebrate, Rastogi Publications.	
5.	Verma, P. S. 2010. A Manual of Practical Zoology: Invertebates, S Chand, 4 97pp.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science.	
2.	Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition. Holt Saunders International Edition.	
3.	Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson	
4.	Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home.	
5.	Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut	
Web Resources		
1.	https://nbb.gov.in/	
2.	http://www.agshoney.com/training.htm	
3.	https://icar.org.in/	
4.	http://www.csrtimys.res.in/	
5.	http://csb.gov.in/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	

Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course Code SEC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K1ZSEC1	ORNAMENTAL FISH FARMING AND MANAGEMENT	SEC	Y	-	-	-	2	2	25	75	100
Learning Objectives											
CO1	To highlight the importance of ornamental fish culture in relation to entrepreneurship development.										
CO2	To enable the identification, culture and maintenance of commercially important ornamental fishes.										
CO3	To provide the knowledge on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming.										
UNIT	**Details**										
I	Introduction to ornamental fish keeping. Scope and importance of ornamental fish culture. Domestic and global scenario of ornamental fish trade and export potential. Commercially important ornamental fishes - Indigenous and exotic varieties.										
II	Biology of egg layers and live bearers. Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture. Breeding, hatchery and nursery management of egg layers (e.g. Goldfish) and live bearers (eg. Guppy).										
III	Aquarium design and construction; Accessories - aerators, filters and lighting. Aquarium plants and their propagation. Maintenance of aquarium and water quality management. Ornamental fish diseases, their prevention, control and treatment methods.										
IV	Conditioning, packing, transport and quarantine methods. Economics, trade regulations, domestic and export marketing strategies.										
V Practical	1) Identification of locally available ornamental fishes - Egg layers and live bearers. 2) Identification of locally available live feed organisms.										
References:	1. Swain SK., Sarangi N. and Ayyappan S. 2010. Ornamental fish farming. ICAR, New Delhi. 2. Living Jewels – A handbook on freshwater ornamental fish, MPEDA, Kochi. 3. Dey V.K.A. 1997. A handbook on aquafarming ornamental fishes. MPEDA, Kochi. 4. Ahilan, B., Felix N. and Santhanam R. 2008. Text book of aquaculture. Daya Publishing House, New Delhi.										

Web links	1. http://ecoursesonline.iasri.res.in/course/view.php?id=297 2. https://www.ofish.org/ 3.https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-culture/ 4. https://99businessideas.com/ornamental-fish-farming/
Course Outcome	**Course Outcome**
CO1	The students will be able to identify culture, maintain and market the commercially important ornamental fishes.
CO2	The knowledge and skills gained on the different aspects of ornamental fish keeping will enable the students to develop entrepreneurship potential and help in self-employment.

Course Code SEC FC	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K1ZFC	ECONOMIC ZOOLOGY	SEC FC	Y	-	-	-	2	2	25	75	100

Learning Objective	
CO1	To understand the culturing techniques and production methods of different farm animals.
CO2	To know the life history of animals and disease control methods used in farming.
CO3	To understand the concept of breeding, cross breeding and the importance of high yield varieties.
CO4	To know about the marketing strategies.
UNIT	Details
I	**Economic Entomology**: Apiculture: Species of honey bees – Social organisation of honey bee – selection of bees and location for apiary – Newton's bee hive – products of bee keeping – enemies and diseases of honey bees. Sericulture: Species of silkworm – life history of mulberry silkworm – Rearing of silkworm – pests and diseases of silkworm. Lac Culture: Introduction – Life history – Host plants – cultivation of Lac – Enemies of lac cultivation – Economic importance of Lac.
II	**Vermiculture:** Introduction: Types of earthworms – ecological classifications of earthworms – Physical, chemical and biological changes caused by earthworms in the soil – Natural enemies of earthworms. Vermicomposting: vermicomposting methods – factors affecting vermicomposting–Vermiculture unit. Harvesting of vermicompost – vermicast – advantages of vermicompost – vermiwash and its applications.
III	**Aquaculture:** Fresh water aquaculture: Carp culture – types of ponds – preparation – maintenance – harvesting and management. Integrated and composite culture. Prawn culture. Marine Aquaculture: Edible – pearl oyster culture. Ornamental fish culture: Aquarium fishes– Aquarium maintenance in home.
IV	**Poultry Farming:** Poultry industry in India – Poultry for sustainable food production and livelihood - Commercial poultry farming – Nutritive value of egg and meat- Broiler management (Definition; Housing and equipment; Brooding, feeding and health cover of broilers; Record keeping; Broiler integration) – Layer management (Brooder; Grower and layer management; Culling of layers; Marketing of eggs and meat). Women in backyard poultry farming.
V	**Dairy Farming:** Dairy farming – advantages of dairying – classification of breeds of cattle – Indigenous and exotic breeds – Selection of dairy cattle. Breeding – artificial insemination – Dairy cattle management – housing – water supply – cattle

	nutrition feeding standards – Common contagious diseases. Milk - Composition of milk – milk spoilage – pasteurization – Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.
Course Outcomes	**Course Outcomes**
	To identify the breeds and varieties of poultry, fish, bees, and cattle and understand the basic aspects of farming.
	To assess and integrate the available tools and techniques to increase the productivity in farms.
	To analyse the pros and cons of different methods of farming and marketing strategies of products.
	To evaluate the use of available resources in improving the breeds, vermicomposting, farm products etc..
Text Books	
1	Sastry, N.S.R., C.K.Thomas and R.A.Singh, 2015. Livestock Production Management, 4thEd.Kalyani Publishers, New Delhi.
2	ICAR, 2013. Hand book of Animal Husbandry, 4th Ed., ICAR Publication, Pusa, New Delhi.
3	Awasthi, V.B., 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers, India.
4	Vasanthraj David, B and Ramamurthy, VV., 2012. Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai.
5	Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
6	Shukla &Upadhyay, 2014. Economic Zoology, 5th edn. Rastogi Publication, Meerut New Delhi.
	Suggested Readings
1	Glenn Munroe, 2017. Manual of on-Farm vermicomposting and vermiculture, Holdanca Farms Ltd, Wallace, Nova Scotia.
2	Gupta, P.K., 2008. Vermicomposting for sustainable agriculture, 2nd Edition, Agrobios, India.
3	Abishek Shukla, D .,2009.A Hand Book of Economic Entomology, Vedamse Books, New Delhi .
4	Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.
5	Banerjee, G.C., 2006. Text book of Animal Husbandry 8thEd.Oxford and IBH Publishing Company Ltd., New Delhi.
6	Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.
Web Resources	
1	https://bit.ly/3tUTHBu
2	https://bit.ly/3hVv96q
3	https://bit.ly/39nztH1
4	https://bit.ly/3CzasVO
5	http://www.agshoney.com/training.htm

SEMESTER - II

Course Code CC III	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K2Z03	CHORDATA	Core	Y	-	-	-	5	5	25	75	100

Learning Objectives	
CO1	To understand the structures and distinct features of Phylum Chordates.
CO2	To understand and able to distinguish the characteristic features of each sub phylum and class.
CO3	To understand the economic importance of vertebrates
CO4	To know about the adaptations of vertebrates
CO5	To understand the evolutionary position of different groups of vertebrates

UNIT	Details	No. of Hours	Course Objectives
I	**General Characters and Classification of Phylum Chordata**: Origin of Chordata, Differences between non-chordates and chordates, General characters, Affinities and Systematic position of Hemichordata (*Balanoglossus*),Urochordata (*Ascidia*), Cephalochordata (*Amphioxus*).	12	CO1, CO2
II	**Prochordates and Agnatha**: Characteristics of subphylum vertebrata, Classification of Vertebrata upto Class level, Agnatha (*Petromyzon*), - Pisces (*Scoliodon sorrakowah*) General characters and classification, Origin of fishes, Affinities of Dipnoi - Types of scales and fins - Accessory respiratory organs - Air bladder - Parental care - Migration - Economic importance.	12	CO1, CO2, CO4, CO5
III	**Amphibia** : General characters and classification - Origin of Amphibia - Type study - *Rana hexadactyla* - Adaptive features of Anura, Urodela and Apoda - Neoteny in Urodela - Parental care in Amphibia.	12	CO1, CO2, CO3, CO4, CO5
IV	**Reptilia**: General characters and classification - Type study – (*Calotes versicolor (*endoskeleton of *Varanus*) - Origin of reptiles and effects of terrestrialisation, Extinct reptiles. Snakes of India. Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification.	12	CO1, CO2, CO4, CO5
V	**Aves and Mammalia :** Ayes: General characters and classification – Type study - *Columba livia* - Origin of birds, Flight adaptations, Migration. Mammalia: General characters and classification - Type study - Rabbit -	12	CO1, CO2, CO4, CO5

	Adaptive radiation in mammals - Egg laying mammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in mammals.		
	Total	**60**	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata.	PO1	
CO2	Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates.	PO1, PO2	
CO3	Analyse, compare and distinguish the developmental stages and describe the important biological process.	PO3, PO4, PO5	
CO4	Correlate the different modes of life and parental care among different vertebrates.	PO3, PO5, PO6	
CO5	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.	PO2, PO3, PO5, PO8	
Text Books (Latest Editions)			
1.	Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.		
2.	Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.		
3.	Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144008, 942.		
4.	Ganguly, Sinha,. Bharati Goswami and Adhikari, 2004. Biology of animals Vol.II - New central book Agency (p) Ltd.		
5.	Kotpal. R.L. A, Modern text book of Zoology Vertebrates- Rastogi publications. 2009		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.		
2.	Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.		
3.	Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.		
4.	Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra – 282 003, 477 pp.		
5.	Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp.		
Web Resources			
1.	http://tolweb.org/Chordata/2499		

2.	https://www.nhm.ac.uk	
3.	https://bit.ly/3Av1Ejg	
4.	https://bit.ly/3kqTfYz	
5	https://www.vedantu.com/biology/mammalia	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3		S	S	S	S	S		S
CO 4			S	S	S	M		
CO 5			S		S			S

S-Strong(3) M-Medium (2) L-Low (1)

	Course Name	**Category**	**L**	**T**	**P**	**S**	**Credit**	**Marks**

Course Code CC IV									CIA	External	Total
23K2Z04P	**PRACTICAL - 1I - CHORDATA**	**Core**	**Y**	**-**	**-**	**-**	**3**	**3**	**25**	**75**	**100**

Learning Objectives	
CO1	To understand the structures and distinct features of phylum chordata.
CO2	To understand and able to distinguish the characteristic features of each subphylum and class.
CO3	To understand and compare the structure of various internal organs in different classes of vertebrates.
CO4	To know about the classification, adaptations and affinities of chordate animals.

UNIT	Details	No. of Hours	Course Objectives
I	**Dissections**: Frog (Demo) / Fish: External features, Digestive system, Arterial system, Venous system, 5th Cranial nerve,9th and 10th cranial nerves, Male and female urinogenital system.	12	CO1
II	**Mounting**: Fish: Placoid and Ctenoid scales, Frog: Hyoid apparatus and Brain (Demo).	12	CO2
III	**Osteology**: Frog: Skull and lower jaw, Vertebral column, Pectoral Girdle, Pelvic girdle, Forelimb, Hindlimb. Chelonia – Anapsid skull, Pigeon - skull and lower jaw, synsacrum.	12	CO3
IV	**Specimen and Slides** :**(i) Hemichordata:** Balanoglossus, Tornaria larva **(ii). Protochordata:** Amphioxus, Amphioxus T.S. through pharynx **(iii). Cyclostomata:** Petromyzon, Myxine, Ammocoetus larva **(iv). Pisces:** Sphyrna Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus, Scales: Placoid, Cycloid, Ctenoid **(v). Amphibia:** Ichthyophis, Amblystoma, Siren, Hyla, Rachophous, Bufo,Rana, Axolotal larva **(vi). Reptilia:** Draco, Chemaeleon, Gecko, Uromastix, Vipera russelli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas. **(vii). Aves:** Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; Collection and	12	CO4

	study of different types of feathers: Quill, Contour, Filoplume, Down **(viii). Mammalia:** Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog		
V	**Embryology**: Stages in the development of Amphioxus, Frog and Chick- Placenta in shark and mammals.	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata.	PO1
CO2	Explain the structural organization of various organs and systems in different classes of vertebrates.	PO1, PO2
CO3	Analyse, compare and distinguish the morphological features and developmental stages of chordates	PO4, PO6
CO4	Dissect and explain various organs and internal systems in different vertebrates and correlate its function.	PO4, PO5, PO6
CO5	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.	PO3, PO8

Text Books (Latest Editions)	
1.	Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.
2.	Verma P. S, 2000.AManual of Practical Zoology: Chordates, S. Chand Limited, 627pp.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Robert William Hegner, 2015. Practical Zoology, Biblio Life, 522pp.
2.	Young, J, Z., 1972. The life of vertebrates. Oxford Uni. London.
Web Resources	
1.	https://www.youtube.com/watch?v=b04hc_kOY10
2.	https://bit.ly/3CzTEy8
3.	http://tolweb.org/Chordata/2499
4.	https://www.nhm.ac.uk/
5.	https://bit.ly/3Av1Ejg

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1**

Course Code SEC2	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K2ZSEC2	**BIOCOMPOSTING FOR ENTREPRENEURSHIP**	**SEC**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**
Learning Objectives											
CO1	To highlight the importance of Bio composting for entrepreneurship in waste management.										
CO2	To enable students for setting up Bio compost units and bins for waste reduction.										
UNIT	**Details**										
I	Bio composting – Definition, types and ecological importance.										
II	Types of Bio composting technology – Field pits/ground heaps/ tank/large-scale/batch and continuous methods.										
III	Preparation of Bio compost pit and bed using different amendments										
IV	Applications of Bio compost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc.										
V	Economics of establishment of a small bio compost unit – project report proposal for Self Help Group (Income and employment generation).										
Practical	1 .Preparation procedures for Bio compost pit.										
	2. Selection of Bio compost material, separation of Compostable and Non-compostable materials.										
	3. Packing and marketing of Biocompost.										
	4. Field visit to Biocomposting unit.										
Course outcomes											
CO1	The students will gain knowledge about the process of Bio composting.										
CO2	Students will be able to demonstrate Bio composting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc.										
CO3	To gain knowledge about the economic cost of establishing small Bio compost units as a cottage industry.										
References											
1	Bikas R. Pati& Santi M. Mandal (2016). Recent trends in composting technology.										
2	Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termor shuizen, A.J. (Editors) 2016. Handbook for Composting and Compost Use in Organic Horticulture. Bio Greenhouse COST Action FA 1105, www.biogreenhouse.org										

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Course Code SEC 3	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K2ZSEC3	**AQUARIUM KEEPING**	**SEC**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**
Learning Objectives											
CO1	To create knowledge on self-employment opportunity of ornamental fishes										
CO2	To provide the knowledge of ornamental fishes and their equipment										
CO3	To understand the different breeding techniques of ornamental fishes										
UNIT	**Details**										
I	Introduction and scope - Aquarium fish keeping as hobby and cottage industry. Commercial aspects like national and international market. To create knowledge on self-employment opportunity.										
II	External morphology of a typical fish. Exotic and endemic varieties of ornamental fishes.										
III	Aquarium preparation and maintenance - Kinds of tanks, tank setting, biological filter and aeration, water management, planting, lighting and feeds. Budget for setting up an Aquarium Fish Farm as a Cottage Industry.										
IV	Live fish transport- handling, feeding and forwarding techniques of fish. Fish Diseases and their control.										
V	Breeding – Common characters and sexual dimorphism of Fresh water and Marine aquarium ornamental fish varieties such as Guppies, Mollies, Sword tails, Platy, Siamese fighters and Gold fish, Butterfly fish, Blue morph and Anemone fish.										
Course Outcome	**Course Outcome**										
	Students to learn about different ornamental fishes and identify the diseases of them										
	To develop entrepreneur potential in the field of aquarium and get self-employment.										
REFERENCE BOOKS											
1	Santhanam, P., Sukumaran, N. & P. Natarajan, A manual of freshwater aquaculture (1987), Reprint 1999, Oxford & IBH Publishing Company Pvt., Ltd., New Delhi.										
2	Cliff Harrison, A colour guide to Tropical Fish (1980), Chartwell Books, INC, Cerkshire, printed in Hon Kong.										
3	O'Connell, R. F., The freshwater aquarium (1977), Arco Publishing Company, INC New York.										
4	JingranV.G. 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi										

SEMESTER – III

Course Code CCV	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K3Z05	**CELL BIOLOGY AND GENETICS**	**Core**	**Y**	**-**	**-**	**-**	**5**	**5**	**25**	**75**	**100**

Learning Objectives	
CO1	To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
CO2	To understand how these cellular components are used to generate and utilize energy in cells.
CO3	To understand the cellular components underlying mitotic cell division.
CO4	To understand the structure and functions of nucleic acids in the cell.

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**History of Cell Biology**, Tools and Techniques of Cell Biology- Cell Fractionation, Homogenization, Centrifugation, Histological techniques. Microscopes - Types - Light, Phase contrast, SEM, TEM. Cell theory Ultra structure of Plant & Animal cell - Cytoplasm - Structure and Composition, Function - Extra Cytoplasmic Structure - Cilia Flagella - Cytoplasmic Inclusions.	12	CO1, CO2
II	**Cell components** - Plasma Membrane: Ultra Structure - Different Models - Functions - Ultrastructure, Composition and Function of Endoplasmic reticulum, Ribosomes, Golgi Complex, Lysosomes, Centrioles, Microtubules Microfilaments, Mitochondria and Microsomes, Nucleus - Ultrastructure, Composition and Functions - Nuclear Membrane - Nucleoplasm - Chromosomes - Heterochromatin and Euchromatin - Nucleolus - Nucleolus Cycle - DNA and RNAs - Protein Synthesis & regulation.	12	CO1, CO2, CO4, CO5
III	**Cell Divisions and Cell Cycle** - Amitosis, Mitosis and Meiosis and their Significance - Cancer, Biology – Characteristics of cancer cells, types, theories on Carcinogenesis, Ageing of Cells – Apoptosis and Stem cell studies.	12	CO1,CO2

IV	**Mendelian Genetics and Inheritance:** Mendelian genetics: Mendelian experiments, laws of Mendel, Inheritance: Polygenic inheritance- skin colour, ABO blood groups, Extra chromosomal inheritance- skin colour; multiple alleles- ABO blood groups, sex linked inheritance– eye colour in Drosophila, colour blindness and haemophilia in man. Linkage and Crossing over: molecular mechanism, kinds, Chromosome mapping.	12	CO4
V	**Cytogenetics**: Variation in chromosome number and structure, Gene mutation: types, molecular basis of mutation, radiation and chemical agents as mutagens; Human and Microbial Genetics- chromosomal abnormalities in humans, Eugenics, Euphenics, and Euthenics. Bacterial genetics: Conjugation, transformation, transduction.	12	CO4

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	To understand and recall the basic structure, origin and development of cell organelles.	PO1
CO2	To integrate and assess the biochemical, cytological and histological tools to infer cellular basis of organization.	PO1, PO2, PO3
CO3	To analyze and differentiate organisms based on structure, composition and inter and intra cellular interactions.	PO3, PO4, PO5
CO4	To explain the role of cells and cell organelles in various biological processes.	PO2, PO3, PO5, PO6, PO8
CO5	To construct and simulate the role of different cytological tools to explain the structure and complexity of cells and cell organelles.	PO3, PO4, PO5, PO6, PO7, PO8

Text Books (Latest Editions)

1.	Ambrose, E.J. and Dorothy, M. Easty, 1970. Cell Biology, Thomas Nelson & Sons Ltd., 500 pp.
2.	Kumar P. and Mina U. (2018) Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., Pathfinder Publication. p.608.
3.	Veer Bala Rastogi, Introductory cytology. Kedar Nath Ram Nath. Meerut 250 001.
4.	Verma, P.S. and V. K.Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S.Chand & co., New Delhi - 110 055, 567 pp.
5.	Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. (2018) Essential Cell Biology 5th Edn.,(paperback) W.W. Norton & Company p.864.
2.	Burke, Jack. D., 1970. Cell Biology, Scientific Book Agency, Calcutta.
3.	Challoner J. (2015) The Cell: A visual tour of the building block of life, The University of Chicago Press and Ivy Press Ltd., p.193.
4.	Cohn, N. S., 1979, Elements of Cytology, Freeman Book Co., New Delhi – 110007, 495 pp
5.	Cooper G.M. (2019) The Cell – A Molecular Approach, 8th Edn., Sinauer Associates Inc., Oxford University Press p.813.
Web Resources	
1.	http://www.microscopemaster.com/organelles.html
2.	https://bit.ly/3tXwDSB
3.	https://bit.ly/3tWNpRX
4.	https://bit.ly/3AuYR9M

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2		S	S	S	S			S
CO 3		S	S	S	S	S		S
CO 4		S	M			M		
CO 5				S	S	S		S

S-Strong(3) M-Medium (2) L-Low (1)

Course Code CC VI	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K3Z06P	**PRACTICAL - III CELL BIOLOGY AND GENETICS**	**Core**	**Y**	**-**	**-**	**-**	**3**	**3**	**25**	**75**	**100**

Learning Objectives	
CO1	To encourage students to interpret the organization of genomic material and to research theories of genetic inheritance.
CO2	To impart the skills required to prepare samples of genetic molecules and to determine their purity, structure and characteristics and to analyze genomic preparations.
CO3	To study the changes in genetic material and to predict and consider the consequences of those changes.
CO4	To encourage students to report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	Preparation and Identification of slides of Mitotic divisions with onion root tips. Preparation and Identification of different stages of Meiosis in Grasshopper Testes. Identification and study of different stages of Mitosis and Meiosis. Buccal epithelium (Barr body) preparation.	12	CO1
II	Staining and observation of polytene chromosomes in salivary glands of chironomous larva. Karyotyping (with the help of photographs) – normal male and female karyotypes and study of karyotypes of different genetic syndromes. Verification of the Mendelian laws of inheritance using coloured beads. Observation on genetic traits.	12	CO2

III	1) Culturing and Handling of Drosophila: a) Media Preparation b) Cleaning and Sterilization of bottles c) Handling of Drosophila (2) Morphology and Sexual dimorphism, Study of at least five types of Drosophila, Body color mutant- Ebony body and Yellow body. Wing mutant- Curly wing and Vestigial wing. Eye color mutant- Bar eye, White eye, Sepia eye. Mounting of Sex Comb of Drosophila melanogaster.	12	CO3
IV	ABO blood grouping and Rh typing. Genetic problems on Multiple alleles, Pedigree analysis. Observation of normal and malignant cells.	12	CO4
V	Study of flower colour in Antirrhinum/ Mirabilis. Coat colour in Mice. Comb pattern in Poultry. Blood Typing. Biometrical Computation of: Mean Median and Mode, Variance, Standard Deviation. Problems on: Student's 't' test and Chi square test. Genetic problems on Multiple alleles, Gene Interactions (Complemetary/ Supplementary/ Dominant Epistasis gene interactions). Genetic Problems on Linkage and Crossing over: 03 Prs. a) Drosophila. b) Maize. c) Human (Sex Linkage).	12	CO5
	Total	**60**	

Course Code SEC4	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K3ZSEC4	**BIOINSTRUMENTATION**	**SEC**	**Y**	**-**	**-**	**-**	**1**	**1**	**25**	**75**	**100**

Course outcomes	**Course outcomes**
CO1	To induce interest in the use of various biological instrumentation and employ them for the study of cells, tissues and genetic material.
CO2	To help students to map the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
CO3	To study the working principle of different bioinstrumentation and their applications.
CO4	To enable students to design experiments and justify them with the underlying principles of bioinstrumentation.
UNIT	**Details**
I	**Good Laboratory Practices** : Guide lines, Laboratory symbols; Cleaning and sterilization of lab ware and reagents; handling and care of laboratory animals; Laminar flow hood: types and use; Concepts of molecular weight, atomic weight, preparation of solutions of a particular molarity and percentage; Buffers: definition and preparation of buffers, pH meter; Safety and ethical issues in laboratory settings
II	**Microscopy** - Light microscope, SEM, TEM, Atomic force microscope; Cryopreservation - principle and procedure; Fluorescence activated cell sorting; X-ray crystallography.
III	**Centrifugation**-working principle and types of centrifugation; Spectrophotometry; Mass spectrometry; Chromatography - principle and types of chromatography.
IV	**Biomedical Instrumentation** : ESR measurement, haemoglobin measurement, blood pressure, blood flow, ECG, cardiac pacemakers; X- ray imaging, CT scan and NMR imaging; Ultrasound imaging; medical applications of laser; Biosensors - glucose biosensor, alcohol biosensor, artificial retina, environmental biosensors, cantilever-based biosensors, DNA biosensor
V	**Molecular Techniques** : Isolation of DNA, RNA and proteins; Electrophoresis of DNA and proteins; Polymerase chain reaction; ELISA; Immunofluorescence; Fluorescent in situ hybridization; Southern and Western blotting.
Text Books	

1	Sabari Ghosal and Anupama Sharma Avasthi, 2018. Fundamentals of Bioanalytical Techniques and Instrumentation, 2nd Ed., Phi Learning Pvt. Ltd., New Delhi, India.
2	Veerakumari L., 2015. Bioinstrumentation, MJP Publishers, Chennai, India.
3	Prakash Singh Bisen, Anjana Sharma, 2012. Introduction to Instrumentation in Life Sciences, CRC Press, Taylor & Francis Group, New York, USA.
4	Gupta P.C., 2010. Biological Instrumentation and Methodology (Tools & Techniques), S. Chand & Company Limited, New Delhi, India.
5	Ghatak K. L., 2010. Techniques and Methods in Biology, Phi Learning Pvt. Ltd., New Delhi, India.
Suggested Readings	
1	Sue Carson, Heather Miller, Melissa Srougi and Scott Witherow, 2019.Molecular Biology Techniques: A Classroom Laboratory Manual, AcademicPress, New York, USA.
2	Aysha Divan, Janice Royds, 2013. Tools and Techniques in Biomolecular Science, Oxford Univeristy Press, UK.
3	Gordon M.H., Macrae R., 2012. Instrumental Analysis in the Biological Sciences, Blackie & Son Ltd., UK
4	Leonard Davis, Mark Dibner and James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., New York, USA.
5	Wilson, K.M. and Walker, J.M., 2010. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.
Web Resources	
1	https://bit.ly/3i5flym
2	https://pbiol.rsb.org.uk
3	https://www.nature.com/subjects/biological-techniques
4	https://www.ibiology.org
Course outcomes	**Course outcomes**
CO1	To describe and explain the steps in the use of various biological instrumentation that are used in the study of different animal specimens
CO2	To relate the applications of biological techniques and employ them for the study of cells, tissues and genetic material.
CO3	To correlate and appraise the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
CO4	To compare the working principle of different bioinstrumentation and to summarize their applications.
CO5	To devise experiments and justify them with the understanding of the underlying principles of bioinstrumentation that is ecofriendly, ethical and has national and global relevance.

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Course Code	Course Name	Category	L	T	P	S	Credit	Marks

SEC5									CIA	External	Total
23K3ZSEC5	**BASIC COURSE IN ORNITHOLOGY**	**SEC**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
CO1	To equip students with the required knowledge to understand the taxonomic position and role played by birds in the ecosystem, their importance to humans and their evolution
CO2	To enable students to comprehend the biological evolution of birds and their structural adaptations
CO3	To enable students to understand and learn aspects of bird behavior
CO4	To enable students to learn about the breeding biology of birds
CO5	To equip students with a knowledge of macro ecology of birds, bird populations and communities, bird diseases, bird conservation and on the role of citizen science in ornithology.
UNIT	**Details**
I	Introduction to Ornithology; Bird Lore; Birds and Humans; Classification of Birds, Bird Evolution and Speciation; Endemism
II	External Morphology of the Bird; Structure of bird feather, Internal Structure of the Bird; Adaptations to Flight
III	Bird Behaviour: Foraging, Roosting, Vocalization, Imprinting, Feather care, Bird Intelligence, Social Behaviour, Mixed Species Flocks, Migration
IV	Breeding Biology: Differential investment of sexes; territoriality, courtship and display behaviour, nesting, eggs, incubation and care of young, brood parasitism
V	Studying bird populations and communities, sampling methods; Macro ecology; Molecular Techniques in Ornithology; Avian Disease; Citizen Science and Ornithology; Threats faced by birds; Bird Conservation with case studies
Course Outcome	**Course Outcome**
	On successful completion of the course, students will be able to
CO1	Recall the taxonomic position of birds, their external morphology and internal parts, types of bird behaviour, sampling methods and types of avian diseases.
CO2	Identify the external parts of the bird, internal structures of the bird and different types of bird behaviour

CO3	Differentiate birds based on their morphology, foraging strategies and other behavior
CO4	Explain and discuss how birds evolved, bird adaptations to flight, different aspects of bird behaviour, threats to birds and the role of citizen science in ornithology
CO5	Discuss and analyse case studies relating to bird conservation
Books For Reference	
1	Lovette, I.J and Fitzpatrick, J.W. (2016). *Handbook of Bird Biology*, 3rd ed. Wiley.
2	Birkhead, T. (2013). *Bird Sense: What it's like to be a bird?* Bloomsbury, NY.
3	Birkhead, T., Wim penny, J., and Montgomerie, B. (2014). *Ten Thousand Birds:*
4	Ornithology since Darwin. Princeton University Press, Princeton, NJ.
5	Gill, F.B, and Prum, R.O. (2019). *Ornithology*, 4th ed. Macmillan.

Course Code ECC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K3ZECC1:1	**ECONOMIC ENTOMOLOGY**	**ECC**	**Y**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**100**

Learning Objectives	
CO1	To develop understanding of various class of insects
CO2	To group the important pests of Agriculture
CO3	To understand the mode of action of Pesticides
CO4	To explain about insects associated with public health
CO5	To understand the economics of beneficial insects and their products
UNIT	Details
I	Scope of Entomology - Class Insecta-Diagnostic characters. General organization of typical insect. Insect development and metamorphosis (Complete & Incomplete).
II	Importance of Insects in Agriculture - Pests of rice, sugarcane and vegetables (Brinjal & Tomato).
III	Methods and principles of pest control – physical, chemical, mechanical, biological And integrated pest management.
IV	Insects in relation to public health: a) Insects associated with human beings (Pediculus sp.,-Vagabonds disease) b) Insects associated with household environment (Housefly and diseases-Cholera, typhoid, tuberculosis and dysentery).
V	Beneficial Insects - lifecycle and by products-Honeybees and Lac insects - soil builders (termite) and scavengers (dung insect).
Course Outcomes	
Course outcomes	On Completion of this course, students will:
CO1	On completion of this course students learn knowledge about the concept of Insects and their metamorphosis, Pest of various crops, methods of pest control insect associated with public health and beneficial insects
Text Books	
1	Mani M.S., 1973.General entomology Oxford & TEM.

2	Nayar K.K., Ananthakrishnan T.N., and David V.D .1990. General and applied entomology. Tata McGrow Hill .New Delhi.
	B.Vasanthararaj David and T.kumaraswami 1982. Elements of Economic entomology popular book dept, Chennai.
References Books	
1	Chapman R.F., 1993.The Insects. Structure and functions.ELBS.London
2	David B.V., Muralirangan N.C., and Meera Muralirangan.1992. Harmful and Beneficial Insects. Popular book depot
3	David B.V., 1992. Pest management and pesticides: Indian Scenario.Namrutha publications
4	Ramakrishnan Ayyar, T.V., 1984. Hand book of economic entomology for south India. International books and periodicals supplies service, New Delhi

SEMESTER -IV

Course Code CCVII	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K4Z07	**DEVELOPMENTAL BIOLOGY**	**Core**	**Y**	**-**	**-**	**-**	**4**	**4**	**25**	**75**	**100**

Learning Objectives	
CO1	To create an awareness to the students about the theories, concepts and basics of Developmental Biology.
CO2	To provide students about the idea of sex cells, fertilization, cleavage, differentiation and development of organs.
CO3	To make an awareness of the induction, organizers and development of extra embryonic structures.
CO4	To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing
CO5	To give an idea about teratogenesis, invitro fertilization, stem cells and amniocentesis to the students

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**Gametogenesis & Fertilization:** Basic concepts of developmental biology. Structure& types of Spermatozoa, Mammalian egg - Egg membranes. types of egg - Spermatogenesis – Oogenesis. Fertilization – mechanism, theories and significance – Parthenogenesis.	12	CO1
II	**Blastulation & Gastrulation:** Cleavage - Planes and Patterns, Factors controlling cleavage - Fate map and its construction. Blastulation –types of blastula. Morphogenetic movements - Gastrulation of frog & chick.	12	CO2
III	**Organogenesis:** Development of Brain, Eye and Heart in frog. Development of Nervous system in chick. Foetal membranes in chick. Development of Pro, Meso Metanephric kidneys. Placentation in Mammals.	12	CO3
IV	**Applied Embryology:** Organizer concept –Structure – mechanism of induction and competence. Nuclear transplantation - teratogenesis – Regeneration: types - events and factors. Embryonic stem cells & significance. Methods to culture embryo	12	CO4

V	**Human embryology:** Reproductive organs, Menstrual cycle and menopause - Pregnancy – trimesters – development. Erythroblastosis fetalis -Twins – types. Infertility – causes - Test tube baby and Assisted Reproductive Technology – Embryo transfer – Amniocentesis.	12	CO5
		60	

Course Outcomes	**Course Outcomes**	
CO1	To describe and illustrate the significance of cellular processes in embryonic development.	PO1
CO2	To relate the factors that contribute to the developmental process, construct fate maps and illustrate the steps in morphogenesis and organogenesis.	PO1, PO2
CO3	To correlate the involvement of specific cell types in the formation of specific organs and explain the importance of morphogens.	PO4, PO6
CO4	To distinguish between the different types of developmental mechanisms in various organisms and appraise the species-based differences in development.	PO4, PO5, PO6
CO5	To justify and validate the role of environment and genetics in influencing embryonic development	PO3, PO8

Text Books (Latest Editions)

1.	Lewis Wolpert 2007. Principles of development, 3rd edition, Oxford University Press, New Delhi, India
2.	Subramoniam, T. 2003. Developmental Biology, Narosa Publishing House, New Delhi, India.
3.	Verma, P.S., Agarwal, V. K.2010.Chordate Embryology: Developmental Biology, S. Chand & Company, New Delhi., India.

References Books (Latest editions, and the style as given below must be strictly adhered to)

1.	Gilbert S.F. 2010. Developmental Biology, Sinauer Associates, Massachusetts, USA.
2.	Balinsky, B.I. 1970. Introduction to Embryology, Philadelphia & London, UK.
3.	Berril, N.J.1971. Developmental Biology, McGraw Hill, New York, USA.
4.	Russ Hodge 2010. Developmental Biology, Facts on File, Inc., New York, USA.
5.	Carlson, Bruce, M. 2009. Human embryology and Developmental Biology, Elsevier, Philadelphia, USA

Web Resources

1.	https://www.ncbi.nlm.nih.gov/books/NBK10052/
2.	https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html
3.	https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468
4.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1) B N

Course Code CCVIII	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K4Z08P	**PRACTICAL - IV DEVELOPMENTAL BIOLOGY**	**Core**	**Y**	**-**	**-**	**-**	**3**	**3**	**25**	**75**	**100**

Learning Objectives	
CO1	To create an awareness to the students about the theories, concepts and basics of Developmental Biology.
CO2	To provide students about the idea of sex cells, fertilization, cleavage, differentiation and development of organs.
CO3	To make an awareness of the induction, organizers and development of extra embryonic structures.
CO4	To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing
CO5	To give an idea about teratogenesis, invitro fertilization, stem cells and amniocentesis to the students
UNIT	**Details**
I	**Spotters:** Structure of Sperm, types of Egg Structure of Ovum. Induced ovulation in Frog.
II	Mounting of blastoderm in chick. Mounting of developmental stage in chick. **Spotters:** Cleavage: 2 cell stage, 4 cell stage and 8 cell stage. Blastula, CS of Blastula, Gastula and Morula Frog/ Chick
III	Mounting of Brain in Frog / Frog. Development stages of chick embryo. Development of Brain and Heart in Frog. Demonstration of extra embryonic in chick. Placentation in Mammal. Observation of chick embryo by vital staining.
IV	Regeneration of tail in tadpoles. Demonstration: Effect of thyroxine/ Iodine on Amphibians metamorphosis.
V	Rh Typing. Child development stage. Spotters: Twins and Test tube baby

Course Code SEC6	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K4ZSEC6	**BIOPHYSICS AND BIOSTATISTICS**	**SEC**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**
Learning objectives											
CO1	To understand the concepts of diffusion, osmosis, centrifugal force, surface tension.										
CO2	To understand the techniques for the separation of biomolecules.										
CO3	To understand radiology, sonography, Laser techniques for biological and medical application.										
CO4	To know to calculate standard deviation, correlation coefficient, chi-square analysis and student't' test using the formula.										
UNIT	**Details**										
I	**Biophysical Principles:** Physical laws in living system: diffusion–Factors affecting diffusion- types of diffusion – Fick's law – Biological significance of diffusion– Osmosis–Osmotic pressure (endocytosis, pinocytosis, phagocytosis, exocytosis plasmolysis and haemolysis) Principles of viscosity–Brownian movement–surface tension–turgor pressure–Centrifugation: Principle–types–applications.										
II	**Applications of Biophysics**: Principle and applications of colorimeter – electrophoresis –principle, instrumentation – applications of gel electrophoresis. Radioactivity: Types of radioactive decay – Radioactive isotopes – Autoradiography – biological impacts – Geiger-Muller counter: Principle – working procedure – advantages and disadvantages. Medical and biological uses of X-rays, Ultrasound and Laser										
III	**Collection and Classification of Data**: Introduction to biostatistics: Definition – characteristics, importance and applications of biostatistics. Collection of data: Primary – secondary data. Statistical population and sampling in biological studies. Types of Classification: Qualitative – quantitative. Variables: discrete – continuous. Frequency distributions.										
IV	**Presentation of Data: Tabulation**: Types – Components – advantages. Diagrammatic and graphical representations of data: Bar diagrams (Simple, multiple, subdivided and percentage) – Pie diagram – Frequency diagram: histograms – frequency polygon – frequency curve – line graphs.										
V	**Descriptive & Inferential Statistics:** Measure of central tendency: Arithmetic mean – median– mode. Measures of dispersion: Standard deviation – Standard error– Coefficient of variance. Test of significance: Chi-square test for goodness of fit – Student't' test.										

Course Outcomes	
CO1	Understand and recall the basic biophysical concepts, statistical data and formula.
CO2	Apply suitable physical techniques and statistical methods to solve biological problems.
CO3	Identify and relate the bio analytical techniques and statistical principles for the application of biological experiments.
CO4	Select suitable biophysical techniques to study the biological process and statistical approach to assess the experimental results.
CO5	Integrate the bio analytical techniques and statistical methods to validate research investigations.
Text Books	
1.	Antonisamy, B., Solomon Christopher and P. Prasanna Samuel, 2011. Biostatistics: Principles and practices. Mac Graw Hill Education Pvt. Ltd. New Delhi. 349pp.
2.	Betty Karasek, 2015. Advanced concepts of biophysics, Callistro Reference, 198pp.
3.	Daniel, W.W.,2000. Biostatistics: A foundation for analysis in the health sciences, 7thEd.John Wiley & .New York. 328pp
4.	Gurumani, N., 2006. Research methodology for biological sciences, MJP, Chennai. 753pp.
5.	Harvey Motulsky, 2015. Essentials of Biostatistics. A non-mathematical approach. Oxford University Press. New York. 208pp.
Suggested Readings	
1	Michael C., Whitlock and Dolph Schluter, 2009.Theanalysisofbiologicaldata, 2ndEd. Mac Millan Publishers, New York, USA.818pp.
2	Edward K. Yeargers,2018.BasicBiophysicsforBiology,CRCPress,USA.195pp
Web Resources	
1	https://bit.ly/2XGFuML
2	http://www.life.uiuc.edu/molbio/geldigest/electro.html
3	http://users.stat.ufl.edu/~winner/sta6934/st4170_int.pdf
4	http://www.biostathandbook.com/analysissteps.html
5	https://bit.ly/3nXUIrD

Course Code SEC7	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K4ZSEC7	**MEDICAL LABORATORY TECHNIQUES**	**SEC**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
CO1	To understand the different protocols and procedures to collect clinical samples.
CO2	To explain the characteristics of clinical samples.
CO3	To demonstrate skill in handling clinical equipment.
CO4	To evaluate the safety precautions while handling clinical samples.
CO5	To summarise the control measures to avoid contamination of clinical samples.
UNIT	**Details**
I	**Laboratory Safety and Human Health and Hygiene:** Laboratory safety –toxic chemicals and biohazards waste- bio safety level- good laboratory practice – hygiene and health issue – physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.
II	**Haematology:** Composition of blood and their function- collection of blood & lab procedure-haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time- clotting time- determination of hemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis- bleeding disorder of man - Haemolytic disease of new born, Platelet count, reticulocytes count, Absolute Eosinophil count.
III	**Medical Microbiology and Instrumentation Techniques:** Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome- Computer tomography (CT scan) – Magnetic Resonance imaging – flowcytometry – treadmill test – PET.
IV	**Medical Physiology**: Cardiovascular system- Blood pressure - Pulse – regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – significance – ultra sonography- Electroencephalography (EEG).
V	**Diagnostic Pathology** : Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome- sectioning, staining –staining methods- vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

Course Outcomes	Course Outcomes (COs)
CO1	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.
CO2	Explain the characteristics of clinical samples.
CO3	Demonstrate skill in handling clinical equipment.
CO4	Evaluate the hematological and histological parameters of biological samples.
CO5	Elaborate the role of medical laboratory techniques in health care industry
Text Books	
1	Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.
2	Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi.
3	Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.
4	Sood, R, 2009. Medical Laboratory technology, Methods and interpretation.
Suggested Readings	
	Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi.
	Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia.Published by Tata McGraw-Hill Education Pvt. Ltd.,
	Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.
Web Resources	
1	https://bit.ly/3tUs8In
2	https://bit.ly/2XKu7mT
3	https://bit.ly/3hNS1EP
4	https://bit.ly/2ZgrLga
5	https://bit.ly/3hTBO1b

Course Code EVS	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K4EVS	**ENVIRONMENTAL STUDIES**	**EVS**	**Y**	**-**	**-**	**-**	**1**	**2**	**25**	**75**	**100**

Learning Objectives	
CO1	To learn the concept and Importance of Environment
CO2	To create awareness about the Biodiversity and its conservation
CO3	To understand the various pollution, its causes and its prevention
CO4	To understand the environmental Laws
CO5	To understand the Environmental Agencies
UNIT	**Details**
I	Environment- Definition- Concept, Components and Importance. Ecosystem- Structure and function- Food chain, food web and Ecological pyramids.
II	Biodiversity- Definition- Importance- flora and fauna of India- Endangered and threatened species in India- Conservation strategies (Insitu and Exsitu)
III	Environmental pollution- Definition- Agents/ causes effects and control measures of air, water, land and Noise pollution- Nuclear hazards.
IV	Environmental Laws and Ethics- Wild life Act– Water act– Air act– and Environmental protection Act– Environmental Ethics (Libertarian Extension- Ecological Extension- Conservation Ethics)
V	Environmental Agencies- National (Department of Environment, forest and wildlife) International (UNICED- Earth Summit- Only one Earth)- Man and Biosphere (MAB).

Text Book:	
1	K Kumaraswamy, A Alagappa Moses, M Vasanthy, "Environmental Studies", Bharathidasan University, Trichy- 620 024.
2	P Chandrasekaren, "Sutrusuzhal payilvugal", U.G.C Core Module Course in Environmental Studies, T K Publication, Pudukkottai.
3	V Kumaresan, "Plan Ecology and Phytogeography".
4	N Arumugam, "Environmental Studies".
5	D Dharmaraj, "Environmental Science".
6	B Chandrasekaran, "Environmental Studies".

Reference:	
1	P.D.Sharma, "Ecology and Environment"
2	Purohit, "A Text Book of Environmental Sciences".
3	M P Mishara," Our Environmental Pollution Control and Future Strategies".

Course Code ECC3	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K4ZECC3:1	MEDICAL ZOOLOGY	ECC	Y	-	-	-	3	-	-	-	100

Learning Objectives	
CO1	Acquire knowledge about medically important insects.
CO2	Understand the causes for non infectious
CO3	Differentiate he infectious diseases from non infectives diseases.
CO4	List out the medically important nematodes
CO5	Apply the techniques for clinical diagnosis
UNIT	**Details**
I	Scope of medical zoology - Medical importance and control of pediculus humans Carporis, Anopheles, Culex, Aedes, Xenopsylla cheopis.
II	Causes, types, Symptoms, Complications, diagnosis and prevention. Diabetes (Type-I and II), Hypertension (Primary and Secondary), Testing of Blood glucose using Glucometer/Kit.
III	Causes, types, Symptoms, diagnosis and prevention - Bacteria - Tuberculosis and Typhoid fever. Virus - Hepatidis B, AIDS. Fungi - Dermatophylosis, Candidiasis. Protozoans- Amoebiosis, Malaria.
IV	Nematode infectious - Ascarisis filariasis. Trematode infections - Liver fluke. Zoonotic infections - Zoonosis - Nosocomial infections.
V	Clinical diagnosis: Specimens collections and analysis. Blood - Blood smear examinations and Erythrocytes sedimentation Rate (ESR). Urine - Coolour Appearance, Volume and odour
Text Books	
1	R.C. Sobti., Medical Zoology. Professor and Chairman / Head Department of Biotechnology, Punjab University. Shoban Lal Nagin Chand & Co.,
2	Krishnan N.T., 1993.Economic entomology. J.J. Publications, Madurai.
References	
1	Park and Park 2005. Text book of Preventive and Social Medicine. M/s. Banarsidas Bha Not Publishers, Jabalpur.

SEMESTER- V

Course Code CCIX	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K5Z09	**EVOLUTIONARY BIOLOGY**	**Core**	**Y**	**-**	**-**	**-**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
CO1	Evolutionary biology is a branch of the biological sciences concerned with the origin of life and the diversification and adaptation of life forms over time.
CO2	This course helps to understand the important processes, principles, and concepts on evolution.
CO3	To provide adequate information on the Lamarckism - Neo Lamarckism – Darwinism, Neutral Theory of Molecular Evolution, and Human Genome Project.
CO4	To explain the importance of the fossil records in evolutionary studies, and the role of phylogenetic studies in the wider context of biodiversity and conservation.
CO5	In this course, we will apply the knowledge of human evolutionary history to simulate how genetic variation within and among human populations affects risk, diagnosis, and treatment of modern diseases.

UNIT	Details	No. of Hours	Course Objectives
I	Inorganic and organic evolution-History of evolutionary thought, Primordial earth and primeval atmosphere, Chemical origin of life: Synthesis of organic molecules, Urey-Miller experiment, Origin of prokaryotes and eukaryotes.	12	CO1
II	Lamarckism - Neo Lamarckism - Darwinism - Neo Darwinism and modern synthetic theory - DeVrie's Mutation theory – modern concepts of mutation - Mutation and their role in evolution - Animal colouration and Mimicry.	12	CO2
III	Isolating mechanisms - Modes of speciation- Hybridization is an evolutionary catalyst- Law of Adaptive Radiation- Adaptive radiation in reptiles and mammals - Convergence and parallelism - Evolutionary constancy.	12	CO3
IV	Morphological, physiological and biochemical, embryological, Taxonomical and geographical evidences -Palaeontological evidences – evolutionary genomics.	12	CO4

	Types of rocks - Geological time scale – Nature of fossils- Dating of fossils - Fossil records of man and fossil records of horse.		
V	Natural selection in action in man- level of selection- Eugenics, Euphenics and Euthenics- Adaptation- Human Genome Project – Evolution and ethics.	12	CO5
	Total	**60**	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	To understand the Primordial earth and theories on origin of life	PO1	
CO2	To integrate and assess Lamarckism - Neo Lamarckism – Darwinism	PO1, PO2	
CO3	To analyse various fossil records of man and fossil records of horse, various types of rocks - Geological time scale.	PO4, PO6	
CO4	To explain the Nature of fossils- Dating of fossils, evidences of evolution, Adaptive radiation in reptiles and mammals,	PO4, PO5, PO6	
CO5	To construct and compile the role of Human Genome Project, Evolution in the diagnosis, and treatment of diseases.	PO3, PO8	
Text Books (Latest Editions)			
1.	Ridley, M., 2004. Evolution. III Edition. Blackwell Publishing.		
2.	Lull, R.S. 2010. Organic evolution, The Macmillan, New York.		
3.	Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company		
4.	Sober, E. (1994). Conceptual issues in evolutionary biology. Cambridge, MA: MIT Press.		
5.	Dr. Kishore R. Pawar, Dr. Ashok E. Desai, 2019. A text book of Organic Evolution, Nirali Prakashan,		
6.	Rastogi VB. 1991. Organic Evolution. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.		
7.	Stricberger, M.W., 1996. Evolution. Jones& Bartlett, USA		
8.	Colbert, E.H. Morales, M. and Minkoff, E.C. 2011. Colbert's Evolution of The Vertebrates: A History of the Backboned Animals Through Time, Wiley, India.		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	Burns GW. 1972. The Science of Genetics. An Introduction to Heredity. Mac Millan Publ. Co.Inc.		
2.	Gardner EF. 1975. Principles of Genetics. John Wiley & Sons, Inc. New York.		

3.	Harth and Jones EW. 1998. Genetics – Principles and Analysis. Jones and BarHett Publ. Boston.
4.	Levine L. 1969. Biology of the Gene. Toppan.
5.	Pedder IJ. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc.
6.	Rastogi VB. 1991. A Text Book of Genetics. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.
7.	White MJD. 1973. Animal Cytology and Evolution. Cambridge Univ.Press.
Web Resources	
1.	https://bit.ly/3nPD09m
2.	https://bit.ly/3CHOdgL
3.	https://bit.ly/2XvcCXl
4.	https://bit.ly/2XAL1Vh
5.	https://bit.ly/3zoU9Jl

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course Code	**Course Name**	**Credit**	**L**	**T**	**P**	**S**	**C**	**I**	**Marks**

CCX									**CIA**	**External**	**Total**
23K5Z10	**ANIMALPHYSIOLOGY**	**Core**	**Y**	**-**	**-**	**-**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
CO1	TofamiliarisestudentswiththeprinciplesandbasicfactsofAnimalPhysiology
CO2	Togivestudentsaninsightaboutthemolecularandcellularbasisofphysiologicalfuncti onsin animals.
CO3	Togiveanideaabouttheregulationoforgansystemfunctionsinawholeanimalusingac onceptualmodel of feedback to explain homeostasis.
CO4	To make the students aware about how the structure-function relationships and its synchronisation with the molecular signals.

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**Nutrition & Respiration:** Nutrition: Digestion and absorption of carbohydrates proteins and lipids. Minerals &Vitamins–their efficiency. Hormonal control of digestion. Types of Respiration, Respiratory pigments-structure of Hemoglobin, Transportation of gases-Bohr effect-Regulation of respiration - bronchitis, asthma - Physiological effects of smoking	12	CO1
II	**Circulation & Excretion:** Blood- composition and functions, Mechanism of clotting. Types of Hearts – Heartbeat and its regulation -pace maker – Cardiac cycle – ECG - Pulse and blood pressure. Nephron structure & mechanism of urine formation, Regulation of acid base balance, Excretory products, Osmoregulation in fishes.	12	CO2
III	**Muscle & Nerve Physiology:** Types of muscles – Ultra structure of striated muscle, Muscle contraction & properties, Neurons – structure &types-Impulse propagation, synaptic transmission, neurotransmitters - Reflex action, Nerve disorders – epilepsy, Alzheimer's disease, Parkinson's disease.	12	CO3
IV	**Sense Organs:** Structure of eye, physiology of vision, visual elements and pigments, photo chemistry of vision - Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract - Structure of ear and mechanism of hearing - Hearing impairments – deafness, labyrinthine disease -Olfactory, gustatory and tactile sense organs	12	CO4

V	**Reproductive Physiology:** Endocrine glands in man - Hormones, action and disorders - Feed-back mechanism, Outlines of mechanism of hormonal activity. Puberty, adolescence, pregnancy, parturition, lactation and birth control.	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	To be able to explain how the various organ system are coordinated and controlled.	PO1
CO2	To be able to list the functions of various organs in relation to physiological process.	PO1, PO2
CO3	To be able to develop the idea of multi-level controlling and feedback mechanism in relation to various physiological functions.	PO4, PO6
CO4	To be able to understand the basic physiological process related to adaptation, metabolism and major requirements.	PO4, PO5, PO6
CO5	To be able to correlate and understand human physiology.	PO3, PO8

Text Books (Latest Editions)	
1.	Agarwal R A., Anil K Srivastava., Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 pp.
2.	Ambika Shanmugam, 2001. Fundamentals of Biochemistry for Medical students, Karthik Offset Printers, Chennai, 590pp
3.	Berry A.K.1998. A text book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp.
4.	Parameswaran, Ananta krishnan and Ananta Subramanian, 1975. Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 329 p p.
5.	Verma P.S., Tyagi B.S & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co. Ltd., New Delhi Publishing., 417 pp.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 pp.
2	Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340 pp.
3	Hill, W.R., Wyse, G.A and Anderson, M. 2016. Animal Physiology (4thedn). Sinauer Associates is an imprint of Oxford University Press; USA, 828 pp.
4	Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi, 928 pp.

5	Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 pp.
6	Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., 2018. Text Book of Human Physiology, S. Chand & Co, New Delhi.
7	Singh, H.R and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864 pp.
Web Resources	
1.	https://microbenotes.com/category/biochemistry/
2.	https://www.stem.org.uk/resources/collection/3931/animal-physiology
3.	https://animalphys4e.sinauer.com
4.	https://nptel.ac.in/courses/102/104/102104042/
5.	https://biochem.oregonstate.edu

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course Code	**Course Name**	**Credit**	**L**	**T**	**P**	**S**	**Credit**	**Marks**

CCXI									CIA	External	Total
23K5Z11	**ENVIRONMENTAL BIOLOGY**	**Core**	**Y**	**-**	**-**	**-**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
CO1	To understand the structure and functions of the ecosystem.
CO2	To explain the relationship between biotic and abiotic factors in an ecosystem.
CO3	To know the causes and effects of climate change and habitat loss.
CO4	To bring awareness about the impact of socio-economic development on the environment and the solutions put forward by the government to reduce environmental damage.

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**Ecosystem:** Concept of an ecosystem-Structure and function of an ecosystem- Producers, consumers and decomposers-Energy flow in the ecosystem-Ecological Succession-Food chains, food webs and ecological pyramids-Introduction, types, characteristic features, structure and function of the following ecosystem: Forest Ecosystem-Grassland Ecosystem-Desert Ecosystem-Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	12	CO1
II	**Population and Biological Cycles:** Structure and distribution – Growth curves - Groups, natality, Mortality -Density indices, Life study tables - factors affecting population growth -Carrying capacity. Population regulation and human population control. Complete and incomplete biogeochemical cycles - Sedimentary cycle.	12	CO2
III	**Environmental Stresses and Management**: Global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition. Uptake, biotransformation, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemical in agriculture, industry and hygiene and their disposal. Bio indicator	12	CO3

	and biomarkers of environmental health. Biodegradation and bioremediation of chemicals.		
IV	**Environmental Pollution**: Definition- cause, effects and control measures of: -Air pollution - Water pollution - Soil pollution -Marine pollution - Noise pollution - Thermal pollution -Nuclear hazards.	12	CO4
V	**Biodiversity Conservation**: Biodiversity crisis – habitat degradation, poaching of wild life. - Socio economic and political causes of loss of biodiversity. - In situ and ex situ conservation of biodiversity -Hot spots of Biodiversity. Green peace movement – Chip ko Movement - Role of government agencies: Central and State Pollution Control Boards - Ministry of Environment and Forests- National Biodiversity Authority. Awareness, Programme, NGOs, Natural Disaster Management, Legislations for environmental Protection, Bio villages – sustainable utilization and development, Environmental ethics.	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the fundamental structure and functions of the ecosystem.	PO1
CO2	Assess the inter-relationship between organisms and between biotic and abiotic factors in an ecosystem.	PO1, PO2
CO3	Analyze the factors that cause pollution, climate change, loss of biodiversity and depletion of resources.	PO4, PO6
CO4	Evaluate the impact of human population growth and socio-economic development on the structure and function of the ecosystem.	PO4, PO5, PO6
CO5	Design plans to scientifically solve environmental problems using biological tools, technologies and government policies.	PO3, PO8

Text Books (Latest Editions)	
1.	Matthew R. Fisher, 2018. Environmental Biology. Open Oregon Educational Resources. James Madison University.
2.	Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand, New Delhi.

3.	Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata.
4.	Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Odum E.P.1983. Basic Ecology, Saunders, New York
2.	Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.
3.	Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.
Web Resources	
1.	https://bit.ly/2VYWOM5
2.	https://bit.ly/2VZQFiT
3.	https://bit.ly/3kqdXYA
4.	https://bit.ly/39rvvgt

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course Code CCXII	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K5Z12P	**PRACTICAL -V- EVOLUTIONARY BIOLOGY, ANIMAL PHYSIOLOGY AND ENVIRONMENTAL BIOLOGY**	**Core**	**Y**	**-**	**-**	**-**	**4**	**6**	**25**	**75**	**100**

Learning Objectives	
CO1	To demonstrate an understanding of core ecological principles, and define scientific principles and concepts as related to environmental studies and sustainability.
CO2	To understand the physiological processes that regulate body functions.
CO3	To strive to demonstrate the role of experimentation in developing our understanding of living animals.
CO4	To attain knowledge of important biomolecules such as carbohydrates, lipids, amino acids, proteins and enzymes.
CO5	Measure and interpret experimental data and demonstrate laboratory skills in animal physiology and ecology.

Details

1. Evolutionary Biology:

Spotters: Homologous (Fore limbs and Hind limbs of frog and pigeon) and Analogous organs (wings of bird and insects), Fossils.

Protective Colorations: Leaf insects, Stick insects, Chameleon, Hippocampus, Pepper moth, Mimicry. Monarch and Viceroy butterfly.

Quantum Evolution**:** Evolutionary significance of Archaeopteryx and Peripatus.

2. Animal Physiology:

Ptyalin activity in relation to temperature and pH in human saliva. Qualitative tests for identification of carbohydrates, proteins and lipids. Total erythrocyte count by hemocytometer.

3. Environmental Biology:

Estimation of dissolved Oxygen, Dissolved carbon-di-oxide, Determination of salinity of water samples. Use of pH meter for estimation of pH in water and soil samples. Collection, isolation, identification and mounting of marine and freshwater plankton. Study of sandy shore fauna- Study of rocky shore fauna - Study of animal Association.

4.Field Visit:

Course Outcomes

Course Outcomes	On completion of this course, students will;
CO1	List and recall the basic equipment used in physiology and ecology lab and develops skill about quantitative determination of biomolecules and quantitative analysis of blood.
CO2	Demonstrate the instruments, discuss the clinical importance and its applications, and explain the principle of bio instruments.
CO3	Understand and identify the chemical composition of major and minor nutrients and analyse Physico - chemical parameters that regulate metabolism.
CO4	Evaluate and Examine the various parameters of haematology and biochemistry and Identify the nitrogenous waste products of animals.
CO5	Summarise the effect of various physical and chemical factors on enzyme activity.
Text Books (Latest Editions)	
1.	Widmaier, E.P., Raff, H. and Strang, K.T. 2008. Vander's Human Physiology, XI Edition., McGraw Hill., 770 PP.
2.	Bishop, ML.,Fody, E.P., Schoeff, LE. 2010. Clinical Chemistry: Principles, Procedure, correlations. Wolters Kluwer, Inida, 298 PP.
3.	Burtis, C.A. and Ashwood, E.R. 2008. Tietztext book of Fundamentals of clinical chemistry and molecular diagnostics, Elsevier, Philadelphia.
4.	Tortora G.J.&Derrickson B.., 2016. Principles of Anatomy and Physiology, John Wiley and Sons, Inc. 1232 PP.
5.	Agarwal R A., Anil K Srivastava.,Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 PP.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi., 928 PP.
2.	Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 PP.
3.	Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London.,342 PP.
4.	Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 PP.
5.	Wilson, J.A. 1984, Principles of Animal Physiology, Macmillan Publishing., 426 PP.
Web Resources	
1.	https://bit.ly/3hNyeFN
2.	https://www.medicinenet.com/alp_test/article.htm
3.	https://vlab.amrita.edu/?sub=3&brch=63
4.	https://www.asbmb.org/education/online-teaching/online-lab-work
5.	https://open.umn.edu/opentextbooks/textbooks/687

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course Code	**Course Name**	**C a**	**L**	**T**	**P**	**S**	**C**	**I**	**Marks**

EC VII									CIA	External	Total
23K5ZELZ7:1	**ANIMAL BEHAVIOUR**	**EC**	**Y**	**-**	**-**	**-**	**3**	**4**	**25**	**75**	**100**
Learning Objectives											
CO1	To learn the origin and development of animal behaviour and to understand the influence of genetics, environment on animal behaviours.										
CO2	To understand the biological properties of animal behavior, with an evolutionary and ecological emphasis.										
CO3	To Compare innate and learned behavior and differentiate between various mating system.										
CO4	To impart the knowledge about visual and auditory communication; courtship, mate choice, and mating systems; social behavior and social systems; and animal personality.										
CO5	To discuss how movement and migration behaviors are a result of natural selection.										
UNIT	**Details**										
I	**Genetics and Behaviour** : Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.										
II	**Evolution and Social Behaviour :** Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments										
III	**Animal and the Environment:** Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.										
IV	**Understanding Complex Behaviour :** Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion.										
V	**Chronobiology** : Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo-transduction; The physiological clock and measurement of day length; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock										

	function (dysfunction); Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.
Course Outcomes (COs)	
CO1	Recall and record genetic basis and evolutionary history of behaviour.
CO2	Classify movement and migration behaviors and explain environmental influence upon behaviour.
CO3	Analyze and identify innate, learned and cognitive behavior and differentiate between various mating systems.
CO4	Assess complexity involved in behavioural traits and evaluate hormones and their role in aggression and reproduction.
CO5	Discuss the rhythmicity of behavioural expressions and the scientific concepts in behavior and behavioral ecology.
Text Books	
1	David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.
2	Harjindra Singh,1990. A Text Book of Animal Behaviour, Anomol Publication,293pp.
3	HoshangS.GundeviaandHareGovingSingh,1996. Animal Behaviour, S. Chand &Co, 280pp.
4	Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5	Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.
Suggested Readings	
1	Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2	Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3	Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.
4	Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA
Web Resources	
1	https://www.ncbs.res.in/content/animal-behaviour
2	https://bit.ly/3i6wUxR
3	https://www.behaviour.univie.ac.at/
4	https://www.ru.nl/bsi/

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Course Code	Course Name	Cat	L	T	P	S	C	I	Marks

EC VII									**CIA**	**External**	**Total**
23K5ZECZ7:2	**NANOBIOLOGY**	**EC**	**Y**	**-**	**-**	**-**	**3**	**4**	**25**	**75**	**100**
LearningObjectives											
CO1	This course provides knowledge about the basic concepts of nanobiology.										
CO2	The learners will be able to acquire skills in the assembly, design and types of nonmaterial's and nanoparticles,										
CO3	They will be able to appreciate the applications of nanobiology in diverse fields.										
UNIT	**Details**										
I	Nanobiology- Definition-concepts and scope. History of nanotechnology and nanoscience in Nature; Structure and Properties of nanomaterials: size, surface charge, conductivity, optical properties and biocompatibility.										
II	Synthesis and characterization of nanomaterials, Fabrication of nanostructures, Metallic nanoparticles, semiconductor, bio polymeric Nano-structures and nanoparticles.										
III	Composition and functional properties of nanostructures: Protein and peptide-based nanostructures, carbohydrate and nucleic acid based nanomaterials; Use of gold, silver and other metallic nanoparticles.										
IV	Strategies to design biologically active nanostructure-based biomaterials. Interaction of nanoparticles with biomolecules to study their conformational and functional properties.										
V	Biological Applications of Nanomaterials and nanoparticles – therapeutics – biomaterials - Immobilized enzymes - drug delivery systems – Biosensors - Cellular imaging tools and diagnostics.										
Course out comes (Cos)											
	Students will be able to:										
CO1	Understand basics of Nano-science and Nano-biology.										
CO2	Gain knowledge on nanomaterials and nanoparticles.										
CO3	Know the biological applications of nanomaterials and nanoparticles.										
CO4	Apply their knowledge in their career development in higher education, research and development.										
References											
1	Pradeep, T. (2017) The Essentials: Understanding Nanoscience and Nanotechnology: McGraw-Hill Education.										

Course Code CCXIII	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K6Z13	ANIMAL BIOTECHNOLOGY AND MICROBIOLOGY	Core	Y	-	-	-	6	7	25	75	100

Learning Objectives	
CO1	To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals.
CO2	To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies.
CO3	To become familiar with the foundation concepts of history of Microbiology
CO4	To gain the knowledge of microscopy and staining concepts
CO5	To understand and implement disposal and safety measures

UNIT	Details	No. of Hours	Course Objectives
I	**Fundamentals of Biotechnology** : Animal cell culture: Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines; Stem cells: types, culture and applications; r-DNA technology: Enzymes; Vectors – pBR322, Phage lambda, Cosmid, HAC, BAC, YAC; Host cells; Gene cloning: steps in cloning, selection of clones – chromogenic substrate, antibiotics.	12	CO1
II	**Techniques in Animal Biotechnology** : Isolation and purification: DNA and mRNA; Blotting techniques: Methods of different types of blotting; DNA sequencing: Sanger method, DNA chips, microarray; PCR: principle, types and application; Gene library: screening with probes; Site directed mutagenesis: principle and application; Gene transfer in animal cells: transfection, liposomal, viral mediated, electroporation, biolistic, direct DNA injection.	12	CO2
III	**Transgenic Animal Technology** : Transgenesis: Concept, transgenes, transgenic animal models - knock out mice, sheep; Applications of transgenesis : Molecular farming, Transgenic fishes, transgenic live stocks, and animals as bioreactors.	12	CO3

IV	**Introduction to microbiology:** History, scope, branches of microbiology. Contributions. Systematic position: 5 kingdom classification of Whittaker and 3 kingdom classification of Carl Woese. Classification, structure and staining process of bacteria. Structure of Yeast.	12	CO4
V	**Introductory Virology:** Structure of Virus-medically important viruses Picornaviruses, Coronaviruses. : Paramyxoviruses, Rhabdoviruses, Orthomyxo viruses and Herpes viruses .	12	CO5
	Total	**60**	
Learning Objectives			
Course Outcomes	On completion of this course, students will;		
CO1	To describe the methodologies for handling animal cells based on their diverse characteristics and identify the correct biotechnological tools to obtain the desired products from the cells.	PO1	
CO2	To develop and explain the protocols for genetically manipulating cells and produce transgenic animals	PO1, PO2	
CO3	To select the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and devise methods for easy taxonomical identification and classification for biodiversity and environmental studies.	PO4, PO6	
CO4	To understand history, relevance of microbiology and structure of bacteria	PO4, PO5, PO6	
CO5	To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes	PO3	
Text Books (Latest Editions)			
1.	Singh B. D., 2015. Biotechnology: Expanding horizon, Kalyani publishers.		
2.	Sasidhara, R., 2015. Animal biotechnology, MJP publishers.		
3.	Dubey R. C., 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.		
4.	Atlas R.M., Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.		
5.	Ravindra Nath, Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalayani Publishers.		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	Veer Bala Rastogi, 2016.Principles of Molecular biology, Medtech, Maine, USA.		
2.	Michael Crichton, 2014. Essentials of Biotechnology, Medtech, Maine, USA.		
3.	Godbey W.T.,2014.An Introduction to Biotechnology,Academic press,New York, USA.		
4.	Pelczar .J. Chan E.C.S. and Krieg N.R., Microbiology, McGraw Hill Book Company, New York.		
5.	Benson Harold J, Microbiological Applications, WCB McGraw – Hill, New York.		
Web Resources			
1.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/		

2.	https://www.isaaa.org/resources/publications/pocketk/40/default.asp	
3.	https://www.ncbi.nlm.nih.gov/books/NBK207574/	
4.	https://vlab.amrita.edu/?sub=3&brch=73	
5.	https://learn.chm.msu.edu/vibl/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course Code	**Course Name**	**Category**	**L**	**T**	**P**	**S**	**Credit**	**Marks**

CCXIV									CIA	External	Total
23K6Z14	**IMMUNOLOGY**	**Core**	**Y**	**-**	**-**	**-**	**6**	**7**	**25**	**75**	**100**

Learning Objectives	
CO1	To understand the fundamentals of immunology in protection against disease and also the key principles of antigen- antibody reaction in the immune system.
CO2	To list basic mechanisms that regulate immune responses, describe the main steps in the generation of cells and organs of the immune system.
CO3	To describe the basic mechanisms that provides innate immunity and antigen processing and presentation.
CO4	To differentiate B and T cell receptors, organs, and microenvironments of the Immune System.
CO5	To promote critical thinking and provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics and cell biology.

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**Immune Cells and Organs**: Overview of Immune System - General concepts and Haematopoeisis. Cells of the immune system - T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils -Mast cells and dendritic cells. Organs of the Immune system: Primary lymphoid organs - Thymus and bone marrow; Secondary Lymphoid organs - Lymph nodes and spleen; Lymphatic tissues - Peyer's patches and Kupffer cells, MALT, GALT and CALT.	12	CO1
II	**Innate and Adaptive Immunity:** Innate and Adaptive Immunity; Anatomical barriers, Inflammatory response, Cells and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral). Receptors and Signaling: Cytokines and Chemokines - General Properties of Cytokines and Chemokines. Major Histocompatibility Complex (MHC): Organization and inheritance of the MHC. Structure and cellular distribution of HLA antigens.	12	CO2
III	**Antigen and Antibodies**: Antigens- Antigenicity and immunogenicity: Properties -foreignness, molecular size,	12	CO3

	heterogeneity. B & T epitopes, T-dependent and T-independent B cell responses. Antibodies: Structure, function and properties of the Immunoglobulins, Different classes of Immunoglobulins; antigenic determinants on antibodies (isotype, allotype and idiotype). Hybridoma technology - production of monoclonal antibodies and catalytic antibodies (abzymes).		
IV	**Hypersensitivity and Autoimmune Diseases**: Hypersensitivity: classification and brief description of various types of hypersensitivities. Autoimmunity: cause of autoimmune diseases - classification of autoimmune diseases. Transplantation immunology: Types of grafts, immunologic basis of graft rejection, immunosuppressive therapy and clinical transplantation.	12	CO4
V	**Clinical Immunology:** Immunity and tumors- tumor antigens (TSTA and TAA), immune response to tumors. Tumor evasion of the immune system, Immunotherapy for tumors. Immunity against - viral, bacterial and parasitic infections. Vaccines: Types and uses - Immunization schedule for children.	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand and recall the basic structural and functional components of the immune system, compare and contrast cells with respect to origin and maturation.	PO1
CO2	Classify and explain types of immunity, state the significance of antigen and examine their relevance to immunizations.	PO1, PO2
CO3	Describe and differentiate the biological characteristics of the antibodies, analyze and formulate the procedure for antibody production	PO4, PO6
CO4	Compare and rate the mechanism of various types of hypersensitivity reactions, assess and identify the different types of autoimmune diseases.	PO4, PO5, PO6
CO5	Summarize immune responses against pathogens	PO3, PO8

Text Books (Latest Editions)	
1.	Kuby, J, Punt, J, Stranford, S, Jones,Pand Owen, J, 2018. Immunology, 8th Edition, W.H.Freeman Publishing, New York, 944 pp.

2.	Roitt, M, Peter J. Delves, Seamus J. Martin and Dennis R. Burton, 2017. Essential Immunology, 13th Edition, Wiley-Blackwell Publishing,USA, 576 pp.
3.	Coleman,R.M., 2014. Fundamental Immunology, 2nd Edition, Published by Mc Graw Hill Education India, 357 pp.
4.	Raj Khanna, 2011. Immunology, Oxford University press, New Delhi. 428 pp.
5.	Rao.C.V. 2011. Immunology, Narosa Publishing House, New Dehli, 426 pp.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Abul A. Andrew, Lichtman. H, Shiv. P, 2014. Cellular and Molecular Immunology, 8th Edition, Published by W.B. Saunders, 544 PP.
2.	Chapel. H, Haeney. M, Misbah. S, and Snowden. N, 2006. Essentials of Clinical Immunology, 5th Edition. Blackwell Publishing, 368 PP.
3.	William R. Clark, 1985. The Experimental Foundations of Modern Immunology, Published by Johns Hopkins University Press, New York. 326 PP.
4.	Kenneth Murphy & Casey Weaver, 2016. Janeway's Immunology, Garland Science publishers, 924 pp.
Web Resources	
1.	https://www.aaaai.org/
2.	https://www.bsaci.org/
3.	https://www.immunology.org/
4.	https://nptel.ac.in/courses/102/103/102103038/
5.	https://microbenotes.com/category/immunology/
Methods of Evaluation	
Internal Evaluation	Continuous Internal Assessment Test / Assignments / Seminars / Attendance and Class Participation — 25 Marks
External Evaluation	End Semester Examination — 75 Marks
	Total — 100 Marks
Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course code CCXV	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K6Z15P	PRACTICAL-VI- ANIMAL BIOTECHNOLOGY AND MICROBIOLOGY, IMMUNOLOGY	Core	Y	-	-	-	6	7	25	75	100

Learning Objectives	
CO1	To encourage students to interpret the organization of genomic material and to research theories of genetic inheritance.
CO2	To impart the skills required to prepare samples of genetic molecules and to determine their purity, structure and characteristics and to analyze genomic preparations.
CO3	To study the changes in genetic material and to predict and consider the consequences of those changes.
CO4	To encourage students to report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.

Details

Animal Biotechnology:

Isolation of DNA.

Total RNA isolation from plant/animal cells.

Spotters: Electrophoresis, DNA, RNA, t RNA, PCR, RFLP, PAPD, Plasmids, UV Spectrophotometer And Cloning Vectors.

Microbiology:

Fixing and staining of bacteria - Simple and Gram staining.

Motility of bacterial cell.

Spotters: Autoclave, Petriplate, Innoculation loop and Laminar air flow.

Immunology:

Blood Grouping and Rh Typing.

Total WBC and RBC.

Estimation of Haemoglobin.

Preparation of Serum components.

Radial Immunodiffusion test.

Double Immunodiffusion test.

Spotters: Centrifuge,

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	To describe, examine and interpret the organization of genomic material and to research theories of genetic inheritance.	PO1
CO2	To prepare samples of genetic molecules and to determine their purity, structure and characteristics.	PO1, PO2
CO3	To experiment with genomic preparations and devise techniques to distinguish genetic material in different organisms to survey biodiversity.	PO4, PO6
CO4	To assess the changes in genetic material and to predict and consider the consequences of those changes.	PO4, PO5, PO6
CO5	To report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.	PO3, PO8
Text Books (Latest Editions)		
1.	Surya Nandan Meena, Milind Naik, 2019. Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA.	
2.	Michael Perlin, William Beckerson, Adarsh Gopinath, 2017. Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA.	
3.	Saxena J., Baunthiyal M., Ravi I., 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.	
4.	Bansal M.P., 2013. Molecular Biology and Biotechnology: basic experimental protocols, The Energy and Resources Institute (TERI), New Delhi, India.	
5.	Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.	
References Books(Latest editions, and the style as given below must be strictly adhered to)		
1.	Andreas Hofmann, Samuel Clokie, 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.	
2.	Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, 2018. Labster Virtual Lab Experiments: Basic Genetics, Springer Publishers, NY, USA.	
3.	Leonard Davis, Mark Dibner, James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Pubilshing Co., NY, USA.	
4.	Robert F. Schleif, Pieter C. Wensink, 2012. Practical Methods in Molecular Biology, Springer-Verlag, NY, USA.	
5.	Ian Freshney R., 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, USA.	

Web Resources		
1.	https://www.jove.com/	
2.	https://vlab.amrita.edu/?sub=3&brch=77	
3.	http://cbii-au.vlabs.ac.in/	
4.	https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html	
5.	https://www.ibiology.org/biology-techniques/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course Code EC VIII	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K6ZECZ8:1	WILD LIFE CONSERVATION AND MANAGEMENT	EC	Y	-	-	-	3	7	25	75	100

Learning Objectives	
CO1	To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies.
CO2	To assess and instil strong foundations on wildlife policies and be familiar with a variety of laws and regulations.
CO3	To analyse and design appropriate approaches to turn conflict into tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions.
CO4	To evaluate and integrate all the related areas like Fundamentals in Ecology, Forestry, Natural Resource Conservation approaches and develop the role PVA models for protection of Endangered species.
CO5	To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation.
Details	
I	**Biodiversity Extinction and Conservation Approaches** : Perspectives and Expressions. Identification and prioritization of Ecologically sensitive area (ESA). Coarse filter and fine filter approaches. Regional and National approaches for biodiversity conservation.
II	**Theory and Analysis of Conservation of Populations**:Stochastic perturbations - Environmental, Demographic, spatial and genetic stochasticity. Population viability analysis-conceptual foundation, uses of PVA models. Management Decisions for small populations using PVA models. Minimum viable populations & recovery strategies for threatened species.
III	**National and International Efforts for Conservation**:International agreements for conserving marine life, Convention on wetlands of International Importance (Ramsar convention), Conservation of Natural Resources. Overview of conservation of Forest &Grassland resources. CITES, IUCN, CBD National Forest Policy, 1988, National Wildlife Action Plan 2017-2031, Wildlife Protection Act 1972, National and State Biodiversity Action Plans and other Forests and Environmental Acts.
IV	**Wildlife in India**: Wildlife wealth of India & threatened wildlife, Reasons for wildlife depletion in India, Wildlife conservation approaches and limitations. Wild life Habitat: Characteristic, Fauna and Adaptation with special reference to Tropical

	forest. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers, Nodes and corridors. Community Reserve and conservation Reserves.
V	**Management of Wildlife**: Distribution, status. Habitat utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. Wild life Trade & legislation, Assessment, documentation, Prevention of trade, Wild life laws and ethics
Course outcomes (COs)	
CO1	To understand and recall the importance of wildlife, extinction and Conservation Approaches of wildlife.
CO2	To integrate and assess the National, international approaches for biodiversity conservation.
CO3	To analyze and differentiate threats to wildlife, various action plans, conservation strategies on wildlife of India to turn conflict into tolerance and coexistence.
CO4	To explain the role PVA models, Wildlife conservation approaches, and limitations.
CO5	To construct and simulate National and International strategies for Conservation, Wild life laws and ethics.
Text Books	
1	Robinson W L and Eric G Bolen, 1984. Wildlife Ecology and Management, Maxmillan Publishing Company, New York, p 478.
2	Aaron, N.M.1973 Wildlife ecology, W.H. Freeman Co. San Francisco, U.S.A.
3	Justice Kuldip Singh 1998. Handbook of Environment, Forest and Wildlife Protection Laws in India, Natraj Publishers, Dehradun
4	Sutherland, W.J 2000. The conservation handbook: Research, Management and Policy. Blackwell Science.
5	Caughley.G and Sinclaire, A.R.E 1994 Wildlife ecology and management. Blackwell Science.
Suggested Readings	
1	Gilas R H Jr.(ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun, p 547.
2	Rodgers W A, 1991. Techniques for Wildlife Census in India - A Field Manual: Technical Manual - T M - 2. WII.
3	Goutam Kumar Saha and SubhenduMazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi.
4	Sharma, B.D, 1999. Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi.
5	Stephen, H.B. and V.B. Saharia,1995. Wildlife research and management. Asian and American Approaches, Oxford University Press, Delhi.
Web resources	
1	https://bit.ly/39oPj44
2	https://bit.ly/3lHdEYJ
3	https://bit.ly/3CwBCfY
4	https://bit.ly/3EDYr3a

Course Code	Course Name	C a	L	T	P	S	C	I	Marks

EC VIII									CIA	External	Total
23K6ZECZ8:2	**HUMAN REPRODUCTIVE BIOLOGY**	**EC**	**Y**	**-**	**-**	**-**	**3**	**7**	**25**	**75**	**100**
Learning Objectives											
CO1	To enable students to understand the endocrine structures and hormones associated with the physiology of reproductive system										
CO2	To enable students to learn about the male reproductive system and accessory glands and regulation										
CO3	To enable students to learn about the female reproductive system and regulation of its function										
CO4	To enable students to comprehend about fertilization, pregnancy, parturition and lactation										
CO5	To equip students with knowledge on causes of infertility, reproductive health, assisted reproductive technology and associated ethical issues										
UNIT	**Details**										
I	Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation; Puberty										
II	Outline and histoarchitecture of male reproductive system; Testis: Cellular functions; Spermatogenesis and its hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract; Andropause										
III	Outline and histoarchitecture of female reproductive system; Ovary: oogenesis and its hormonal regulation; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles and their regulation, changes in the female tract; Menopause .										
IV	Ovum transport in the fallopian tubes; Sperm transport in the female tract, Fertilization; Hormonal control of implantation; Hormonal regulation of										

	gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regula.
V	Infertility in male and female: causes, diagnosis and management; Sexually transmitted Infections; Modern contraceptive technologies; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, Stem Cell banks, *in vitro* fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; ethical issues related to ART; Surrogate motherhood; ethical issues; Consanguinity; Fetal Loss and Birth Defects; Adoption.
COURSE OUTCOMES	
	On successful completion of the course, students will be able to
CO1	Recall the structure and functioning of the male and female reproductive system, associated endocrinology, causes for infertility and assisted reproductive technology
CO2	Describe the structure and physiology functions of male and female reproductive systems.
CO3	Explain the role of structures, accessory glands and hormones associated with the reproductive tracts and their control
CO4	Explain the mechanism of sex determination.
CO5	Discuss age-associated physiological changes in the reproductive tract
BOOKS FOR REFERENCE	
1	Cassan, A. (2005). *Human reproduction and Development (Inside the Human Body)*.NewYork: ChelseaClubhouse.
2	Gardner, D. K.(2001). *Textbook of Assisted Reproductive Techniques: Laboratory and Clinical Perspectives* .London: Martin Dunitz.
3	Neill, Jimmy D. ed (2006). Knobil and Neill's Physiology of Reproduction. Volume I. Third edn. Elsevier Academic Press.
4	Field, M.A.(1990).*Surrogate Mother hood*. Massachusetts: Harvard University.
5	Johnson, M. H. (2018). *Essential Reproduction*. New Jersey: Wiley-Blackwell.

Course Code SEC8	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K6ZSEC8	**FOOD, NUTRITION AND HEALTH**	**SEC**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
CO1	The course covers the basic concepts of balanced diet for people of different ages besides focusing on the consequences of malnutrition and the deficiency diseases and the diseases caused due to poor hygiene.
UNIT	**Details**
I	Nutrition and dietary nutrients: Basic concepts of Food: Components and nutrients. Concept of balanced diet, nutrient requirements and dietary pattern for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents and elderly people.
II	Macro nutrients and micronutrients: Macronutrients. Carbohydrates, Lipids, Proteins - Definition, Classification, their dietary source and role. Micronutrients. Vitamins- Water- soluble and Fat-soluble vitamins- their sources and importance. Important minerals viz., Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc: their biological functions.
III	Malnutrition and nutrient deficiency diseases: Definition and concept of health: Common nutritional deficiency diseases- Protein Malnutrition (e.g., Kwashiorkor and Marasmus), Vitamin A deficiency, Iron deficiency and Iodine deficiency disorders- their symptoms, treatment, prevention and government initiatives.
IV	Life style dependent diseases- hypertension, diabetes mellitus, and obesity their causes and prevention. Social health problems - smoking, alcoholism, narcotics. Acquired Immuno Deficiency Syndrome (AIDS) : causes, treatment and prevention.
V	Diseases caused by microorganisms: Food hygiene: Potable water- sources and methods of purification at domestic level. Food and Water-borne infections: Bacterial diseases: cholera, typhoid fever - viral diseases: Hepatitis, Poliomyelitis - Protozoan diseases: amoebiasis, giardiasis - Parasitic diseases: taenia is and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention. Causes of food spoilage and its prevention.
Course outcomes	

	Students will be able to
CO1	Understand the role of food and nutrients in health and disease.
CO2	Gain knowledge about hygiene, food safety, disease transmission.
CO3	Perform food system management and leadership functions that consider sustainability in business, healthcare, community and institutional areas.
References	
1	Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed;; New Age International Publishers
2	Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd.
3	Swaminathan, M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO.
4	Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed;Academic Excellence.
5	Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.

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SEMESTER - I

Course Code EC	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K1B/CHECZ1:1	ELECTIVE ZOOLOGY I	EC	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida
CO2	To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata
CO3	To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia
CO4	To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia
CO5	To acquire detailed knowledge of select invertebrate and chordate forms

UNIT	Details	No. of Hours	Course Objectives
I	Diversity of Invertebrates – I Principles of taxonomy. Criteria for classification–Symmetry and Coelom–Binomial nomenclature. Classification of Protozoa, Coelenterata, Helminthes and Annelida up to classes with two examples.	12	CO1
II	Diversity of Invertebrates – II Classification of Arthropoda, Mollusca and Echinodermata upto class level with examples.	12	CO2
III	Diversity of Chordates–I Classification of Prochordata, Pisces and Amphibia up to orders giving two examples.	12	CO3
IV	Diversity of Chordates – II Classification of Reptilia, Aves and Mammalia up to orders giving two examples.	12	CO4
V	Animal organization Structure and organization of (i).Earthworm (ii)Rabbit/Rat (iii)Prawn/Fish	12	CO5
	Total	**60**	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Recall the characteristic features invertebrates and chordates.	PO1
CO2	Classify invertebrates up to class level and chordates up to order level	PO1, PO2
CO3	Explain and discuss the structural and functional organisation of some invertebrates and chordates	PO4, PO6
CO4	Relate the adaptations and habits of animals to their habitat	PO4, PO5, PO6
CO5	Analyse the taxonomic position of animals.	PO3, PO8
Text Books (Latest Editions)		
1.	Ekambaranatha Iyer,-OutlinesofZoologyViswanathanPublication	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Ekambaranatha Iyar and T.N.Ananthakrishnian - A ManualofZoologyInvertebrata– VolI:ViswanathanPublishers.	
2.	EkambaranathaIyarandT.N.Ananthakrishnan,-AManualofZoology-Invertebrata– VolII:ViswanathanPublishors.	
3.	EkambaranathaIyarandT.N.Ananthakrishnan,-AManualofZoology:ChordataViswanathanPublishers.	
4.	JordanE.L.andP.S. Verma-Invertebrate Zoology,S.Chand&Co.	
Web Resources		
1.	www.sanctuaryasia.com	
2.	www.iaszoology.com	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	

Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course Code EC	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K1B/CHECZ1:2	RADIATION BIOLOGY	EC	Y	-	-	-	4	4	25	75	100

Learning Objectives			
CO1	The course covers basic knowledge on different types of radiation, biological effects of radiation and risks on cellular level to humans, a deeper knowledge on radiation protection for ionizing and non-ionizing radiation, both in legislation and practical radiation protection technology		
UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	Scope of Radiation Biology – Sources of Natural Radiation: Terrestrial and cosmic sources - Man made radiations - Medical (occupational and diagnostic). Types of radiation – Ionizing and non-ionizing radiation.		
II	Properties of Radiation – Radiation Units (Becquerel, RAD, Gray& Curie, Sievert).Measurement of Radiation in the Environment - Alpha and Beta counters and Scintillo meter.		
III	Biological effects of Radiation - Cellular level – Organ and system level – Genetic effects (chromosomal aberrations), radiation induced mutations – Radiation sickness – Syndromes – Cancer induction – Dosimetry		
IV	Radiation safety measures - Safety standards disposal of radioactive waste management, administrative & legislative aspect of radiation protection. Nuclear reactors – Nuclear energy programme in India. Regulatory authorities– AERB, BARC, DAE, IAEA & ICRP.		
V	Applications of Radioisotopes in biology- Auto radiography, Radioimmunoassay; Agriculture -insect, pest and disease management- Sterile Insect Technology (SIT); Medicine - (Therapy & diagnosis); Food preservation.		

Course Outcomes	
CO1	To describe the various types of ionizing radiation.
CO2	To highlight the applications of radiation in different fields
CO3	To define the radiation units used in measurement/calculations of “dose”.
CO4	To create awareness about safety precautions when using radioactive isotopes
CO5	To describe the biological impact of radiation on living cells and tissues

References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Sood, D.D. Reddy, A.V.R. and Ramamoorthy, N. (2000) Fundamentals of Radiochemistry, Indian Association of Nuclear Chemists and Allied Scientists, Radiochemistry Division, Mumbai.	
2.	Radiation Biology: A Handbook for Teachers and Students International Atomic Agency (IAEA), 2010 - Training Course Series42	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Course Code EC	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K2B/CHECZ2P	**ELECTIVE ZOOLOGY PRACTICAL**	**EC**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
CO1	To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida
CO2	To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata
CO3	To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia
CO4	To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia
CO5	To acquire detailed knowledge of select invertebrate and chordate forms
UNIT	**Details**
I	**Dissections:** Earthworm - Digestive system and Nervous system . Prawn - Digestive system and Nervous system. Frog/Rat - Video clipping.
II	**Mounting**: Earthworm - Body and penial setae Shark - Placoid scales. Prawn - Appendages
III	**Spotters**: **Invertebrates and Chordates** Amoeba, Paramecium (entire and conjugation), Sea anemone, Hydra, Physaliya, Liver fluke, Redia, Cercaria, Tapeworm, Nereis, Leech, Limulus, Chiton Freshwater mussel, Star fish, Pila, Seaurchin, Balanoglossus, Rohu, Catla, Mirgal, Salamander, Shark, Frog, Lizard, Snakes, Calotes and Pigeon, Bat.
IV	**Developmental biology and Immunology:** 2 cell stage,4 Cell stage, 8 Cell stage, Yolk plug stage, Blastula, Gastrula of frog, Hot air oven, Incubator, Autoclave, Bunsen burner, Centrifuge, Colorimeter, Micropipette, Organs of immune system, Vaccination schedule
V	Haemoglobin, Blood cells - RBC, WBC, Platelets, Blood coagulation pathway.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Recall the characteristic features invertebrates and chordates.	PO1
CO2	Classify invertebrates up to class level and chordates up to order level	PO1, PO2
CO3	Explain and discuss the structural and functional organisation of some invertebrates and chordates	PO4, PO6
CO4	Relate the adaptations and habits of animals to their habitat	PO4, PO5, PO6
CO5	Analyse the taxonomic position of animals.	PO3, PO8
Text Books (Latest Editions)		
1.	Ekambaranatha Iyer,-OutlinesofZoologyViswanathanPublication	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Ekambaranatha Iyar and T.N.Ananthakrishnian - A ManualofZoologyInvertebrata– VolI:ViswanathanPublishers.	
2.	EkambaranathaIyarandT.N.Ananthakrishnan,-AManualofZoology-Invertebrata– VolII:ViswanathanPublishors.	
3.	EkambaranathaIyarandT.N.Ananthakrishnan,-AManualofZoology:ChordataViswanathanPublishers.	
4.	JordanE.L.andP.S. Verma-Invertebrate Zoology,S.Chand&Co.	
Web Resources		
1.	www.sanctuaryasia.com	
2.	www.iaszoology.com	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1)

SEMESTER - II

Course Code EC	Course Name	Category	L	T	P	S	Credits	Inst.	Marks		
									CIA	External	Total
23K2B/CHECZ3: 1	ELECTIVE ZOOLOGY- II	EC	Y	-	-	-	3	4	25	75	100

Learning Objectives	
CO1	To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology.
CO2	To enable students to comprehend the processes involved during development
CO3	To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule
CO4	To enable students to comprehend the basic concepts of human genetics and patterns of inheritance
CO5	To enable students to learn about aspects of animal behavior such as foraging, courtship, nest construction, parental care and learning

UNIT	Details	No. of Hours	Course Objectives
I	Respiration- Respiratory pigments and transport of gases. Mechanism of blood clotting. Types of excretory products– Ornithine cycle. Structure of neuron – Conduction of nerve impulse, Mechanism of vision and hearing.	12	CO1
II	Fertilization, Cleavage, Gastrulation and Organogenesis of Frog; Placentation in mammals	12	CO2
III	Immunity: Innate and Acquired - Active and Passive; Antigens and Antibodies; Immunological organs – responses in humans; Vaccination schedule	12	CO3
IV	Human Genetics: Human Chromosomes – Sex Determination in Humans; Patterns of Inheritance: Autosomal Dominant, Autosomal Recessive, X-linked , Y-linked, Mitochondrial, Multiple Allelic and Polygenic; Genetic Counselling	12	CO4
V	Animal Behaviour: Foraging, Courtship Behaviour, Shelter and Nest Construction, Parental Care, Learning Behaviour	12	CO5
	Total	**60**	

Course Outcomes	
Course Outcomes	On completion of this course, students will;

CO1	Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behaviour	PO1
CO2	Analyse the different developmental stages	PO1, PO2
CO3	Analyse the working of body and immune systems	PO4, PO6
CO4	Analyse the different patterns of inheritance	PO4, PO5, PO6
CO5	Relate the behaviour of animals to physiology. Analyse the different types of behaviour	PO3, PO8

Text Books(Latest Editions)	
1.	Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Owen, J. A., Punt, J. & Stranford, S. A. - Kuby Immunology. New York: W.H. Freeman & Company
2.	Klug, W. S., Cummings, M. R. & Spencer, C - Concepts of Genetics. (12th ed.). New Jersey: Pearson Education
3.	Mathur, R.- Animal Behaviour. Meerut: Rastogi.
4.	VermaP.S.&Agarwal-DevelopmentalBiology,ChordataembryologyS.Chand&Co.
Web Resources	
1.	Continuous Internal Assessment Test
2.	Assignments
3.	Seminars
4.	Attendance and Class Participation
5.	End Semester Examination

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Simple definitions, MCQ, Recall steps, Concept definitions	
	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
External Evaluation	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	75 Marks
	Longer essay/ Evaluation essay, Critique or justify with pros and cons	100 Marks

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

Course Code EC	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23K2B/CHECZ3:2	AGRICULTURAL ENTOMOLOGY	EC	Y	-	-	-	3	4	25	75	100

Learning Objectives	
CO1	Explain the basic concepts of entomology and observe the pest status of agriculture.
CO2	Illustrate and examine the systemic and functional morphology of various group of agricultural insect pests.
CO3	Differentiate and classify the various groups of insect animals and estimate biodiversity.
CO4	To compare and distinguish the general and specific characteristics integrated pest management.
CO5	Infer and integrate the economic importance of insect species.

UNIT	Details	No. of Hours	Course Objectives
I	Outline classification of insects - Causes for insect assuming pest status - Methods of collection, mounting and preservation of insect pests.		
II	Insect vectors of plant diseases, Insect pests of stored grains their preventive and curative methods, Most common insect pests of the following plants and their control measures: Paddy, Sugarcane, Groundnut, Coconut and Cotton. Locust and its control.Insect pollinators and scavenger.		
III	Apiculture: Introduction, types of honey bees, hive, apiary, selection of bees for apiary, Newton's bee hive, enemies and diseases of honey bees. Sericulture: Introduction, types of silk worms, silk worm races, life history of mulberry silk worm, features of sericulture industry, pests and diseases of silk worm. Lac Culture.		
IV	IPM, physical, mechanical, chemical and biological control methods, Pesticide application equipment.		
V	Introduction and steps towards IPM, Pheromones, antifeedents, repellents and biopesticide.		

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	Examine and identify the systemic and functional morphology of various group of agricultural insect pests.
CO2	Differentiate and classify the various groups of insects and estimate the biodiversity.
CO3	Explain the pest status in agriculture and control measures.

CO4	To compare the methods and outcomes of integrated pest management.	
CO5	List the economic importance of agricultural insect species.	
Text Books (Latest Editions)		
1.	David,BandAnanthakrishnan,T.N.2006.Generaland AppliedEntomology, Second edition, Tata McGraw hill publishing company Ltd.,New Delhi, India.	
2	Vasanthraj David, B. and Ramamurthy, VV. 2012. Elements ofEconomic Entomology, Seventh edition, Namruthapublications, Chennai	
3	Pruthi,H.S.1969.TextbookonAgriculturalEntomology,I.C.A.R.Publication, New Delhi	
4	Awasthi, V.B. 2012. Introduction toGeneral and Applied Entomology, third edition, Scientific publishers.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	AbishekShukla, D. 2009.A Hand Bookof EconomicEntomology, VedamseBooks,NewDelhi.	
2.	John WilliamS. 1995. Management ofNatural Wealth, Loyola College Publications, Chennai.	
3.	MinistryofAgriculture,GovernmentofIndia,1995.ManualonIntegratedPest Management in Rice andCotton.	
Web Resources		
1.	http://www.fao.org	
2.	http://flybase.bio.indiana.edu/	
3	http://www.ipm.ucdavis.edu	
4	http://www.ent.iastate.edu/list/	
5	www.entsoc.org	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
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Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	