

Part	Course Type	Title of the Course	Hrs/ Week	Credits	Exam Hrs	Marks		
						CIA	ESE	Total
I	LC – II	Tamil	6	3	3	25	75	100
II	ELC -II	English	6	3	3	25	75	100
III	CC – III	Chordata Theory	5	5	3	25	75	100
	CC - IV	Laboratory Techniques in Zoology II – Practical	3	3	3	40	60	100
	GEC - III	General Principles of Zoology	4	3	3	25	75	100
	GEC - IV	Allied Zoology Practical - II	2	2				
IV	SEC	Basic course in ornithology	2	2	3	25	75	100
	EVS	Environmental Studies	2	2	3	25	75	100
		Total	30	23				800

SEMESTER – III

Part	Course Type	Title of the Course	Hrs/ Week	Credits	Exam Hrs	Marks		
						CIA	ESE	Total
I	LC – III	Tamil	6	3	3	25	75	100
II	ELC –III	English	6	3	3	25	75	100
III	CC – V	Cell Biology Theory	6	5	3	25	75	100
	CC – VI	Laboratory Techniques in Zoology III - Practical	3	3	3	40	60	100
	GEC – V	Cryptogamous Botany - I	4	3	3	25	75	100
	GEC – VI	Lab Course Principles of Botany Practical	2	2				
IV	SEC	Apiculture	1	1	3	25	75	100
	SEC	Food, Nutrition and Health	2	2	3	25	75	100
		Total	30	22				800

Type		Week	Credits	Hrs	Marks		
					CIA	ESE	Total
CC - IX	Evolutionary Biology	6	5	3	25	75	100
CC - X	Animal Physiology	5	5	3	25	75	100
CC - XI	Project with Viva Voce	6	5	3	25	75	100
CC - XII	Laboratory techniques in Zoology- V - Practical	3	2	3	40	60	100
DSE - I	1. Animal Behaviour	4	3	3	25	75	100
	2. Biochemistry						
	3. Wild life conservation and Management						
DSE - II	1. Biophysics and Biostatistics	4	3				
	2. Bioinstrumentation						
SEC	Vermiculture	2	2	3	25	75	100
AEC - I	Internship/Industrial training	-	1				
	Total	30	26				800

SEMESTER - VI

Course Type	Title of the Course	Hrs/Week	Credits	Exam Hrs	Marks		
					CIA	ESE	Total
CC - XIII	Genetics	5	5	3	25	75	100
CC - XIV	Developmental Biology	5	5	3	25	75	100
CC - XV	Laboratory techniques in Zoology- VI - Practical	6	5	3	25	75	100
DSE - III	1. Bioinformatics and Computer Application	5	3	3	40	60	100
	2. Biotechnology						
	3. Economic Zoology						
DSE - IV	1. Commercial Zoology	4	3	3	25	75	100
	2. Microbiology and Immunology						
	3. Bio composting for entrepreneurship						
SEC	Aquaculture	2	2				
AEC - II	General awareness for competitive examinations	2	1	3	25	75	100
GS	Gender Studies	1	1	3	25	75	100
	Total	30	25				700

INVERTEBRATA

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 I

Phylum Protozoa: General characters and classification of Phylum Protozoa up to classes.

Type study –Paramecium&Plasmodium

General Topics:

1. Nutrition in protozoa
2. Locomotion in protozoa
3. Parasitic protozoans (*Entamoeba*, *Trypanosoma*, & *Leishmania*)

UNIT II

Phylum Porifera and Coelenterata: Cnidaria General characters and classification up to Classes.

Type study - Sycon and Obelia

General Topics:

1. Canal system in sponges
2. Skeleton in sponges.
3. Polymorphism in Hydrozoa.
4. Economic importance of corals and coral reefs.

UNIT III

Phylum Platyhelminthes and Nematelminthes: General characters and classification of up to classes.

Sub Code: U23ZC101

Type study – Fasciola hepatica and Ascaris

General Topics:

1. Parasitic adaptations. Host-parasitic interactions of Helminth parasites.
2. Nematode Parasites and diseases –*Wuchereria bancrofti*, *Enterobius vermicularis*, *Ancylostoma duodenale*.

UNIT IV

Phylum Annelida and Arthropoda: General characters and classification up to Classes.

Type study: Nereis and Penaeus indicus.

General Topics:

1. Metamerism
2. Nephridium and coelomoducts
3. Affinities of *Peripatus*
4. Larval forms in Crustacea.

UNIT V

Mollusca and Echinodermata: General characters and classification up to Classes.

Type study: Pilaglobosa and Asterias.

General Topics:

1. Foot and torsion in Mollusca,
2. Economic importance of Molluscs
3. Water vascular system in Echinodermata
4. Larval forms of Echinoderms.

Course Outcomes

CO1 - Understand the basic concepts of invertebrate animals and recall its structure and functions.

CO2 - Illustrate and examine the systemic and functional morphology of various groups of invertebrata.

CO3 - Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.

CO4 - Explain, and relate the origin, structural organization and evolutionary aspects of invertebrates.

CO5 - Analyze, compare and distinguish the developmental stages and describe the important biological process.

Text Books

(Latest Editions)

1. Ekambaranathalyer, 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. EkambaranathaAyyar, and T. N. Ananthakrishnan, 2000. A Manual of Zoology. Vol 1 (Invertebrata). Part II – Viswanathan Pvt. Ltd, 842pp
4. Kotpal R.L. 2019. Modern Text Book of Zoology, Invertebrates 9th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut, 1004 pp.

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 –

McGraw Hill Book Co.

5. Parker, J. and Haswell, 1978. A text book of Zoology Vol. I - Williams and Williams.

Web Resources

1. <https://www.nationalgeographic.com/animals/invertebrates/>
2. <https://bit.ly/3kABzKa>
3. <https://www.nio.org/>
4. <https://greatbarrierreef.org/>

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



INVERTEBRATA PRACTICALS SUB CODE: U23ZC102P

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 I

Major Dissection : Cockroach: Circulatory system, Nervous system, Reproductive system. Earthworm: Nervous System, Reproductive system. *Pilaglobosa*: Nervous system. Prawn: Nervous system (including Appendages).

UNIT II

Minor Dissection: Cockroach: Digestive system. Earthworm: Viscera, Lateral hearts.

Pilaglobosa: Digestive system (Including radula). Freshwater Mussel: Digestive system.

UNIT III

Mounting: Earthworm: Body setae; Pineal setae. *Pilaglobosa*: Radula. Freshwater muscle: Pedal ganglia.

UNIT IV

Mounting : Cockroach: Salivary apparatus, Mouth parts - Honey Bee, House fly and Mosquito mouth parts.

UNIT V

Spotters :(i). Protozoa: Amoeba, Paramecium, Paramecium Binary fission and Conjugation, Vorticella, Entamoeba 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, Pennatulidae(iv). **Platyhelminthes:** Planaria, Fasciola hepatica, Fasciola larval forms - Miracidium, Redia, Cercaria, Echinococcus granulosus, Taeniasolium. Schistosoma haematobium(v). **Nemathelminthes:** Ascaris(Male & Female), Dracunculus, Ancylostoma, Wuchereria(vi). **Annelida:** Nereis, Aphrodite, Chaetopterus, 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, Pterodo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva (ix). **Echinodermata:** Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva

Insect pollinators: Bees and pollinators

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, Pest of Sugarcane, Pest of coconut, Pest of cotton, Pests of vegetables, Pests of fruits, Pest of stored products.

Course Outcomes

On completion of this course, students will;

CO1 - Identify and label the external features of different groups of invertebrate animals.

CO2 - Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate animals.

CO3 - Differentiate and compare the structure, function and mode of life of various groups of animals.

CO4 - To compare and distinguish the dissected internal organs of lower animals.

CO5 - Prepare and develop the mounting procedure of economically important invertebrates.

Text Books (Latest Editions)

1. Ekambaranathalyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai
2. Ganguly, Sinha and A dhikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.
3. Sinha, Chatterjee and Chattopadhyay, 2014. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1070 pp.
4. Lal, S. S., 2016. Practical Zoology Invertebrate, Rastogi Publications.
5. Verma, P. S. 2010. A Manual of Practical Zoology: Invertebrates, S Chand, 497pp.

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/>
6. <https://iinrg.icar.gov.in/>



VALUE EDUCATION(YOGA)

SUB CODE: U231VE

Objectives: To gain knowledge on Values of life, behaviour, responsibilities, health, disorders and reforms values of life with morality and its impact of globalization, self control regulation, Exercise, meditation, yoga.

Course outcomes:

UNIT-I

Introduction to values: Values of life. Factors affecting values of life, significance of life value education

UNIT-II

Behaviour: Respect to the parents, respect to the teachers, worship, self respects

Social oriented values: Unity, equality, family, Citizen's responsibility, Patriotism

UNIT-IV

Physical and mental health: Quality food, personal hygiene, women's health, Thought power

UNIT-V

Disorders and Reforms: Values of life with morality and its impact of globalization, Impact of media, Reforms, Self control regulation, Exercise, meditation, yoga.

References

1. Jayakrishna(2016). Value education with section on Yoga. Viva Publication.
2. B.K.S. Iyengar(2006). Light on yoga, Thorson Publication.
3. Swami Vishnu Devanandha(1995). Complete Illustration of Yoga, RHUS Publishers.
4. Hansaji J. Yogendra(2018). Yoga for all. Rupa Publications, India.



Unit I

Introduction to Zoology, History of Zoology, Branches of Zoology

Five kingdom classification of animals, Binomial nomenclature--.

Unit II

Life – characteristics of life, Hierarchical level of organization of life, the origin and chemistry of life, cell as the unit of life.

Unit III

Continuity of life –Genetics an overview – Mendel's investigations, the chromosomal basis of inheritance, Gene theory.

Unit IV

Organic evolution-Lamarkism, Darwin's theory, Devries theory of mutation, fossils, micro evolution, and macro evolution

Unit V

Process of Reproduction – Structure of reproductive organs, the role of hormones in reproduction. An outline of the Developmental process -germ cells, gametogenesis, fertilization, cleavage, gastrulation, and organogenesis.

REFERENCE

Text books

1. Integrated Principles of Zoology , Hickman, Keen, Eisenhour, Larson, Ansen – Eighteenth edition – McGraw Hill.

Web source

1. <https://www.newworldencyclopedia.org/entry/Zoology>
2. <https://www.studocu.com/ph/document/cebu-normal-university/bachelor-of-science-in-psychology/zoology-introduction-to-zoology/13593002>
3. <https://www.newworldencyclopedia.org/p/index.php?title=Zoology&oldid=688300>



CHORDATA

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 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 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*).

UNIT II

Prochordates and Agnatha: Characteristics of subphylum vertebrata, Classification of Vertebrata upto Class level, Agnatha (*Petromyzon*), - Pisces (*Scoliodon sorrah*) 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.

UNIT 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.

UNIT IV

SUB CODE:U23ZC203

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

UNIT V

Aves and Mammalia : Aves: General characters and classification - Type study - *Columba livia* - Origin of birds, Flight adaptations, Migration. Mammalia: General characters and classification - Type study - Rabbit - Adaptive radiation in mammals - Egg laying mammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in mammals.

Course Outcomes

- CO1 - Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata.
- CO2 - Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates.
- CO3 - Analyze, compare and distinguish the developmental stages and describe the important biological process.
- CO4 - Correlate the different modes of life and parental care among different vertebrates.
- CO5 - Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.

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.
6. Pough H. Vertebrate life, VIII Edition, Pearson International.
7. Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan & Co., New York, 587 pp.
8. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

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://biologveducare.com/aves/>
6. <https://www.vedantu.com/biology/mammalia>

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)

CHORDATA PRACTICAL

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 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.

UNIT II

Mounting: Fish: Placoid and Ctenoid scales, Frog: Hyoid apparatus and Brain (Demo).

UNIT III

Osteology: Frog: Skull and lower jaw, Vertebral column, Pectoral girdle, Pelvic girdle, Forelimb, Hindlimb. Chelonia- Anapsid skull, Pigeon - skull and lower jaw, synsacrum.

UNIT 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, Exocoetetus, Echieneis, Labeo, Catla, Clarius, Auguilla,

SUB CODE:U23ZC204P

Protopterus, Scales: Placoid, Cycloid, Ctenoid(v). **Amphibia:** Ichthyophis, Amblystoma, Siren, Hyla, Rachophous, Bufo, Rana, Axolotal larva (vi). **Reptilia :** Draco, Chamaeleon, Gecko, Uromastix, Viperarusselli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas. (vii). **Aves:** Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down(viii). **Mammalia:** Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog

UNIT V

Embryology: Stages in the development of Amphioxus, Frog and Chick-Placental shark and mammals.

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.

CO2 - Explain the structural organization of various organs and systems in different classes of vertebrates.

CO3 - Analyse, compare and distinguish the morphological features and developmental stages of chordates

CO4 - Dissect and explain various organs and internal systems in different vertebrates and correlate its function.

CO5 - Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.

Text book

1. Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.
2. Verma P.S, 2000. A Manual of Practical Zoology: Chordates, S.Ch

and Limited, 627pp.

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

1. Robert William Hegner, 2015. Practical Zoology. BiblioLife, 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/3CzTEv8>
3. <http://tolweb.org/Chordata/2499>
4. <https://www.nhm.ac.uk/>
5. <https://bit.ly/3Av1Ejg>

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)



BASIC COURSE IN ORNITHOLOGY

Learning Objectives

- 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
- To enable students to comprehend the biological evolution of birds and their structural adaptations
- To enable students to understand and learn aspects of bird behaviour
- To enable students to learn about the breeding biology of birds
- To equip students with a knowledge of macroecology of birds, bird populations and communities, bird diseases, bird conservation and on the role of citizen science in ornithology.

Unit I

Introduction to Ornithology; Bird Lore; Birds and Humans; Classification of Birds, Bird Evolution and Speciation; Endemism

Unit II

External Morphology of the Bird; Structure of bird feather, Internal Structure of the Bird; Adaptations to Flight

Unit III

Bird Behaviour: Foraging, Roosting, Vocalization, Imprinting, Feather care, Bird Intelligence, Social Behaviour, Mixed Species Flocks, Migration

Unit IV

SUB CODE: U23Z2SE1

Breeding Biology: Differential investment of sexes; territoriality, courtship and display behaviour, nesting, eggs, incubation and care of young, brood parasitism

Unit 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 LEARNING OUTCOME

On successful completion of the course, students will be able to

- Recall the taxonomic position of birds, their external morphology and internal parts, types of bird behaviour, sampling methods and types of avian diseases.
- Identify the external parts of the bird, internal structures of the bird and different types of bird behaviour
- Differentiate birds based on their morphology, foraging strategies and other behaviour
- 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
- 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.



Press, Princeton, NJ.

5. Gill, F.B. and Prum, R.O. (2019). *Ornithology*, 4th ed. Macmillan.

Ornithology

ENVIRONMENTAL STUDIES

Objectives: To acquire the knowledge on the Environment - principles, definition and importance, its influence on the living organism through ecosystem structure and components, various habitats,

sources of pollution and conservation of wildlife, influence of population growth, health and rights.

UNIT-I

The Multidisciplinary Nature of Environmental Studies

- Definition, Scope and Importance.
- Renewable and Non-Renewable Resources.
- Nature Resources and associated problems.

UNIT-II

Biodiversity and its Conservation

- Introduction-Definition.
- Biodiversity at global, national and local levels.
- India as a mega-diversity nation.
- Hot-spots of biodiversity.
- Conservation of Biodiversity: In-Situ and Ex-situ conservation of Biodiversity.

UNIT-III

Environmental Pollution Definition

- Causes, Effects on layer and Control Measures of:

a. Air Pollution – Climate Change,

global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.

b. Water pollution.

c. Soil pollution.

d. Noise pollution.

SUB CODE: U232ES

- Solid Waste Management: Causes, Effects and Control measures of urban and Industrial Wastes.
- Role of an individual in prevention of pollution
- Disaster Management: Floods, Earthquake, Cyclone and landslides.

UNIT-IV

Social Issues and the Environment

- From non-sustainable to sustainable development.
- Urban Problems related to energy.
- Water Conservation, rainwater harvesting, Watershed Management.

UNIT-V

- Resettlement and rehabilitation of people : its problems and concerns case studies.
- Environment protection Act.
- Air (prevention and control of pollution) Act.
- Wildlife protection Act.
- Forest conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.
- Health.
- Human Rights.
- HIV/AIDS.
- Women and child welfare.

Role of Information Technology

Human Population and the Environment

- Population growth explosion, variation among nations – Family Welfare programme.
- Environment and Human Health.
- Human Rights.
- HIV/AIDS.
- Women and child welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

Reference Books:

- 1 Bernis Anandharaj (2016) Soolnilaiyiyal. Chrisolite publications. Adyar, Chennai.
- 2 Odum E.P (1971). Fundamentals of ecology. W.B Saunders Company, Philadelphia.
- 3 Kendeigh S.C (1961). Animal ecology. Prentice Hall.
- 4 Clarks G.L (1954). Elements of Ecology. John Wiley and sons, New York.
- 5 Purohit S.S., Shami D.H and A.K Agarwal (2004). Environmental sciences - A new approach. Agrobio, Jodhpur.
- 6 Krishnamurthy K.V (2003). Introduction to Biodiversity. Oxford and IBH.

Course Outcomes

CO1: Gain knowledge of surrounding environment.

CO2: Understand the diversities at local and national levels.

CO3: Learn the impact of various pollutants in Air, Water and Noise.

CO4: Understand the various acts to control the pollution and creating awareness.

CO5: Acquire knowledge of the significance of Natural resources and recent advances in information technology



ALLIED ZOOLOGY I - LAB COURSE IN BIOLOGY OF INVERTEBRATES AND CHORDATES

SUB CODE: U23ZGE1

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 I

Diversity of Invertebrates-I

Principles of taxonomy. Criteria for classification-Symmetry and Coelom-Binomial nomenclature. Classification of Protozoa, Coelenterata, Helminthes and Annelida upto classes with two examples.

UNIT II

Diversity of Invertebrates-II

Classification of Arthropoda, Mollusca and Echinodermata upto class level with examples.

UNIT III

Diversity of Chordates-I

Classification of Prochordata, Pisces and Amphibia upto orders giving two examples.

UNIT IV

Diversity of Chordates-II

Classification of Reptilia, Aves and Mammalia upto orders giving two examples.

UNIT V

Animal organization

Structure and organization of

- (i) Earthworm
- (ii) Rabbit/Rat
- (iii) Prawn/Fish

Course Outcomes

CO1 - Recall the characteristic features invertebrates and chordates.

CO2 - Classify invertebrates up to class level and chordates up to order level

CO3 - Explain and discuss the structural and functional organisation of some invertebrates and chordates

CO4 - Relate the adaptations and habits of animals to their habitat

CO5 - Analyse the taxonomic position of animals.

Text Books (Latest Editions)

1. Ekambaranatha Iyer, -
Outlines of Zoology Viswanathan Publication

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

1. Ekambaranatha Iyar and T.N. Ananthakrishnian -
A Manual of Zoology Invertebrata-
Vol I: Viswanathan Publisher
2. Ekambaranatha Iyar and T.N. Ananthakrishnan, - A
Manual of Zoology-Invertebrata-
Vol II: Viswanathan Publishers.
3. Ekambaranatha Iyar and T.N. Ananthakrishnan, A
Manual of Zoology: Chordata Viswanathan
Publishers.
4. Jordan E.L. and P.S. Verma-Invertebrate
Zoology, S. Chand & Co.

Web Resources

www.sanctuaryasia.com

www.iaszoology.com

ALLIED ZOOLOGY I - LAB COURSE IN BIOLOGY OF INVERTEBRATES AND CHORDATES

SUB CODE: U23ZGE1

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 I

Diversity of Invertebrates-I

Principles of taxonomy. Criteria for classification—Symmetry and Coelom—Binomial nomenclature. Classification of Protozoa, Coelenterata, Helminthes and Annelida upto classes with two examples.

UNIT II

Diversity of Invertebrates-II

Classification of Arthropoda, Mollusca and Echinodermata upto class level with examples.

UNIT III

Diversity of Chordates-I

Classification of Prochordata, Pisces and Amphibia upto orders giving two examples.

UNIT IV

Diversity of Chordates-II

Classification of Reptilia, Aves and Mammalia upto orders giving two examples.

UNIT V

Animal organization

Structure and organization of

- (i) Earthworm
- (ii) Rabbit/Rat
- (iii) Prawn/Fish

Course Outcomes

CO1 - Recall the characteristic features invertebrates and chordates.

CO2 - Classify invertebrates up to class level and chordates up to order level

CO3 - Explain and discuss the structural and functional organisation of some invertebrates and chordates

CO4 - Relate the adaptations and habits of animals to their habitat

CO5 - Analyse the taxonomic position of animals.

Text Books (Latest Editions)

1. Ekambaranatha Iyer,-

Outlines of Zoology Viswanathan Publication

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

1. Ekambaranatha Iyar and T.N. Ananthakrishnan - A Manual of Zoology Invertebrata-Vol I: Viswanathan Publisher
2. Ekambaranatha Iyar and T.N. Ananthakrishnan, - A Manual of Zoology-Invertebrata-Vol II: Viswanathan Publishers.
3. Ekambaranatha Iyar and T.N. Ananthakrishnan, A Manual of Zoology: Chordata Viswanathan Publishers.
4. Jordan E.L. and P.S. Verma-Invertebrate Zoology, S. Chand & Co.

Web Resources

www.sanctuaryasia.com

www.iaszoology.com

Abn. huf.

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)

Amulya

LAB COURSE IN BIOLOGY OF INVERTEBRATES AND CHORDATES

SUB CODE:U23ZGE2P

Major Practical

1. Earthworm–Digestive system.
2. Cockroach digestive system
3. Virtual dissection of frog digestive system using video clipping.

Minor Practical

1. Mounting of body setae.
2. Mounting of Pila radula
3. Mounting of fish placoid
4. Mounting of ctenoid scales.
5. Mounting of Honey bee mouth parts.

Spotters

Protozoa: Amoeba, Paramecium;

Sponges, spicules **Cnidaria:**

Annelida: Nereis; Heteronereis **Arthropoda:** Prawn; Peripatus
(connecting link),

Echinodermata: Starfish, Sea urchin

Prochordata: Amphioxus, Petromyzon,
Ascidian, Tornaria larva; **Pisces:** Shark, Clarius, Hippocampus,
Echeneis, Exocoetetus, Echeneis, Eel, *Gambusia*; **Amphibia:**
Axolotl larva, Ichthyophis, Alytes, Hyla; **Reptilia:** Calotes,

Porifera: Sponge;

Physalia, Aurelia,

Mollusca: Pila, Chiton;

Chelonemydas, Chaameleon, Draco, Varanus; **Aves:** Pigeon,
Quill feather, Dinopium; **Mammalia:** Bat, Rabbit

Submissions

- 1) Record

Course outcomes

Upon completion, students should be able to
CO1: Have hands on experience of dissecting invertebrates and chordates

CO2: Obtain the ability to identify the important microscopic animals of different phyla

CO3: Able to understand the structural features of invertebrates and Chordates

CO4: Understand the structural complications of invertebrates and Chordates

CO5: Able to correlate the components of mouthparts of different animals with their functions.

Am. Singh

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 behaviour such as foraging, courtship, nest construction, parental care and learning.

UNIT 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.

UNIT II

Fertilization, Cleavage, Gastrulation and Organogenesis of Frog; Placentation in mammals.

UNIT III

Innate and Acquired - Active and Passive; Antigens and Antibodies; Immunological organs—responses in humans; Vaccination schedule.

UNIT 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.

UNIT V

Animal Behaviour: Foraging, Courtship Behaviour, Shelter and Nest Construction, Parental Care, Learning Behaviour.

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.

CO2 - Analyse the different developmental stages

CO3 - Analyse the working of body and immune systems

CO4 - Analyse the different patterns of inheritance

CO5 - Relate the behaviour of animals to physiology. Analyse the different types of behaviour.

Text Books

(Latest Editions)

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. Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co.

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)

Abn. hup.

LAB COURSE IN GENERAL PRINCIPLES OF ZOOLOGY

SUB CODE:U23ZGE4P

Unit I

Animal Physiology

1. Qualitative tests for Ammonia, Urea and uric acid.
2. Clotting Time
3. Bleeding Time
4. Models of haemoglobin and ATP.

Unit II

Developmental biology

1. Collection of frog egg from ponds and observation of tadpole formation
2. Observation of Frog: Egg, Cleavage, Blastula, Yolk Plug stage.
3. Yolk sac placenta.

Unit III

Immunology

1. Dissect and display the immunological organs in fish/Rat (Virtual)
2. ABO Blood grouping.
3. Spotters: Immunoglobulin classes

Unit IV

Genetics

1. Recording of Mendelian traits in man
2. Human Karyotype – Normal- Male and Female
3. Chromosomal abnormalities – Autosomal (Down's syndrome) and Sex chromosomal (Turner and Klinefelter's syndrome)

Unit V Animal Behaviour

Learning behaviour in practical

Habituation in snail / Phototropism/Geotropism in Earthworm

Spotters: 1. T Maze 2. Pavlovian conditioning in Dog.

Submissions

Record

Course outcomes

CO1: Understand the Physiology of animals

CO2: Gather experience about the embryonic developmental stages

CO3: Obtain skills to dissect out immunological organs and immunological techniques.

CO4: Understand the role of genetics in Human

CO5: Acquiring knowledge on the Animal Behaviour



VALUE ADDED COURSE WEALTH FROM WASTE

Course duration: 30 hours (Theory 18 hours; Practical 12 hours)

Course objectives:

- To facilitate agriculture-based rural students with a cow-based lifestyle to earn more.
- To promote sustainable rural economy.
- To establish animal-human-agriculture synergy for sustainable development.

Unit I (6 hours Theory)

Scope of cow-based income generation; Differences between indigenous and exotic cows; A1 and A2 milk; Demand for Indian cow products at the national and international market; Successful Cow based entrepreneurs in India.

Unit II (6 hours Theory)

Value addition of cow urine: Medicinal values of cow urine; Go Ark _Physical and chemical properties of Go Ark, Applications of Go Ark in Agriculture, Aquaculture, and medicine.

Unit III (6 hours Theory)

Value addition of cow dung: Properties of cow dung; Differences in Indian and exotic cow's dung; Value added products of cow dung - fuel cakes, fuel logs, floor coating material, mud-brick additives, pond fertilizer, pH balancer, tooth polish, and Panchagavya.

Unit IV (6 hours Practical)

Preparation of Go Ark, Value-added Go Ark with medicinal plants, Panchagavya preparation

Unit V (6 hours Practical)

Preparation of cow dung-based mosquito repellent coils, Dhoop sticks, Agal lamps, Dolls, and Bath powder/soap - Field visit for Unit IV and Unit V

Course Outcomes:

- Students acquire knowledge on the value of Indian cows and cow products.
- Students obtain skills to produce value-added products of cow urine and dung
- Students have learned techniques to turn out dry cows that are considered as a burden into income generators.



BIOPHYSICS AND BIOSTATISTICS

SUB CODE -U23ZDE1

Learning objectives

1. To understand the concepts of diffusion, osmosis, centrifugal force, surface tension.
2. To understand the techniques for the separation of biomolecules.
3. To understand radiology, sonography, Laser techniques for biological and medical application.
4. To know to calculate standard deviation, correlation coefficient, chi-square analysis and student 't' test using the formula.

Unit 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.

Unit 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

Unit 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.

Unit 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.

Unit 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.

Text Books

1. Das, D., 1996. Biophysics and Biophysical Chemistry for Medical and Biology students, Academic, Calcutta. 302pp.
2. Subramanian, M.A., 2016. Biophysics – Principles and Techniques, MJP, Chennai. 324pp.
3. Gurumani, N., 2005. An introduction to Biostatistics, MJP, Chennai, 250pp.
4. Palanichamy, Sand M. Shanmugavelu, 1991. Principles of Biostatistics. Palani Paramount. India. 350pp
5. Roy, R.N. 1996. A Text Book of Biophysics, New Central Book Agency Ltd, Calcutta. 992pp.

Suggested Readings

1. Antonisamy, B., Solomon Christopher and P. Prasanna Samuel, 2011. Biostatistics: Principles and practices. MacGraw Hill Education Pvt. Ltd. New Delhi. 349pp.
2. Betty Karasek, 2015. Advanced concepts of biophysics, Callisto Reference, 198pp.
3. Daniel, W. W., 2000. Biostatistics: A foundation for analysis in the health sciences, 7th Ed. John Wiley & Sons Ltd. New York. 328pp.
4. Edward K. Yeager, 2018. Basic Biophysics for Biology, CRC Press, USA. 195pp
5. Gurumani, N., 2006. Research methodology for biological sciences, MJP, Chennai. 753pp.
6. Harvey Motulsky, 2015. Essentials of Biostatistics. A non mathematical approach. Oxford University Press. New York. 208pp.
7. Michael C., Whitlock and Dolph Schluter, 2009. The analysis of biological data, 2nd Ed. MacMillan Publishers, New York, USA. 818pp.
8. Narayanan, R., 2010. Essentials of biophysics, II Ed., New age International publishers, Chennai. 546pp.
9. Pranab Kumar Banerjee, 2014. Introduction to biostatistics (A Text Book of Biometry, S. Chand & Company Ltd. New Delhi, India. 208pp.
10. Rodney M. J., Cotterill, 2002. Biophysics: An introduction, John Wiley & Sons Ltd. New York. 400pp.
11. Ronser, B., 2006. Fundamentals of Biostatistics, Thomson Brooks/Cole, 6th Ed. Duxbury press, Singapore. 784pp

12. Sail Bose, 2000, Elementary Biophysics, Vijaya printers, Madurai.
13. Tanford, C., 1961. Physical chemistry of macromolecules, John Wiley & Sons Ltd. England. 710pp.
14. Yadav, B. S., 2020. Textbook of biophysics, Arjun Publishing House, New Delhi.

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>
6. https://onlinecourses.nptel.ac.in/noc19_bt19

Course outcomes (COs)

1. Understand and recall the basic biophysical concepts, statistical data and formula.
2. Apply suitable physical techniques and statistical methods to solve biological problems.
3. Identify and relate the bioanalytical techniques and statistical principles for the application of biological experiments.
4. Select suitable biophysical techniques to study the biological process and statistical approach to assess the experimental results.
5. Integrate the bioanalytical techniques and statistical methods to validate research investigations.



WILDLIFE CONSERVATION AND MANAGEMENT

SUB CODE -U23ZDE2

Learning Objectives

1. To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies.
2. To assess and instil strong foundations on wildlife policies and be familiar with a variety of laws and regulations.
3. To analyse and design appropriate approaches to turn conflict into tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions.
4. 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.
5. To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation.

Unit 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.

Unit 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.

Unit 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.

Unit 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.

Unit 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.

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. Dasmann R F, 1964. Wildlife Biology, John Wiley & Sons, New York, p 231.

4. Justice Kuldip Singh 1998. Handbook of Environment, Forest and Wildlife Protection Laws in India, Natraj Publishers, Dehradun.
5. Hosetti, B.B. 1997 Concepts in Wildlife Management, Daya Publishing House, Delhi.
6. Sutherland, W.J 2000. The conservation handbook: Research, Management and Policy. Blackwell Science.
7. Caughley, G and Sinclair, A.R.E 1994 Wildlife ecology and management. Blackwell Science.
8. Woodroffe R, Thirgood, S. and Rabinowitz A. 2005. People and Wildlife, Conflict or Co existence? Cambridge University.
9. Sinha, P.C. 1998. Wildlife and Forest Conservation, Anmol Publishing Pvt. Ltd., New Delhi.
10. Singh, S.K, 2005. Text Book of Wildlife Management. IBDC, Lucknow.

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. Saharia V B, 1982. Wildlife of India, Natraj Publishers, Dehra Dun.
4. Goutam Kumar Saha and Subhendu Mazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi.
5. Katwal/Banerjee, 2002. Biodiversity conservation in managed and protected areas, Agrobios, India.
6. Gopal, Rajesh, 1992. Fundamentals of Wildlife Management, Justice Home, Allahabad, India.

7. Sharma, B.D, 1999. Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi.
8. Stephen, H.B. and V.B. Saharia, 1995. Wildlife research and management. Asian and American Approaches, Oxford University Press, Delhi.
9. Negi, S.S. 1993. Biodiversity and its conservation in India, Indus Publishing Co., New Delhi.
10. Moulton, M. P. & J. Sanderson, 1997. Wildlife Issues in a Changing World. St. Lucie Press.

Web resources

1. <https://bit.ly/39oPj44>
2. <https://bit.ly/3IHdEYJ>
3. <https://bit.ly/3CwBCfY>
4. <https://bit.ly/3EDYr3a>
5. <https://bit.ly/3tVtG4U>

Course outcomes (COs)

1. To understand and recall the importance of wildlife, extinction and Conservation Approaches of wildlife.
2. To integrate and assess the National, international approaches for biodiversity conservation.
3. To analyse and differentiate threats to wildlife, various action plans, conservation strategies on wildlife of India to turn conflict into tolerance and coexistence.
4. To explain the role PVA models, Wildlife conservation approaches, and limitations.
5. To construct and simulate National and International strategies for Conservation, Wild life laws and ethics.

BIOCHEMISTRY SUB CODE -U23ZDE3

Objectives: To imbibe the knowledge on biochemical substances with scope of biochemistry, classification and metabolism of carbohydrates, classification and metabolism of proteins, classification and metabolism of fat and enzymes - their role in the metabolic events in the living organisms.

UNIT-I

Introduction, Definition and Scope of biochemistry. Water-physical properties, Structure and role of water in life- **pH** and Buffers-Biological buffer systems.

UNIT-II

Carbohydrates-structure and classification (with one example)- Metabolism-Glycolysis, Glycogenolysis-TCA cycle and Oxidative phosphorylation.

UNIT-III

Structure and classification of amino acids and proteins. Protein metabolism-Oxidative deamination, transamination, Decarboxylation and Transmethylation.

UNIT-IV

Structure and Classification-Fatty acids and Lipids. Metabolism- β -oxidation. Structure and functions of Nucleic acids.

UNIT-V

Enzymes- Classification and Characteristics.
Mechanism of Enzyme action – Lock and key hypothesis.
Biochemical Classification and characteristics of Hormones.

Reference Books:

1. Jain J.L., Sunjay Jain and Nithay Jain (2005). Fundamentals

of Biochemistry. Chand Publications.

2. Jain J.L. (2015). Fundamentals of Biochemistry. Chand Publications.

3. Ambika Shanmugam (2016). Fundamentals of Biochemistry for Medical students. Wolters Kluwer India, P. Ltd.

4. Abraham Mazur and Benjamin Harrow (1971). Text Book of Biochemistry. Saunders (W.B) Co. Ltd.

5. Satyanarayana U (1999). Biochemistry, Uppala Author-Publisher Interlinks, Vijayavada.

Course Outcomes:

CO1: Learn unique properties and biological importance of water, acquire clear understanding about pH , acid-base balance and biological importance of body buffer.

CO2: Understand the structure, classification and metabolism of carbohydrates.

CO3: Acquire a clear understanding of structure, classification and metabolism of proteins and amino acids.

CO4: Learn the structure, classification, and metabolism of lipid and nucleic acids.

CO5: Understand mechanism, kinetics, regulation of enzymes and hormones.

Learning Objectives

1. To learn the origin and development of animal behaviour and to understand the influence of genetics, environment on animal behaviours.
2. To understand the biological properties of animal behavior, with an evolutionary and ecological emphasis.
3. To Compare innate and learned behavior and differentiate between various mating system.
4. To impart the knowledge about visual and auditory communication; courtship, mate choice, and mating systems; social behavior and social systems; and animal personality.
5. To discuss how movement and migration behaviors are a result of natural selection.

Unit 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.

Unit 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.

Unit 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.

Unit 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.

Unit 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.

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. Hoshang S. Gundevia and Hare Govind Singh, 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.



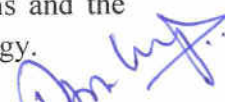
Suggested Readings

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 MillanCompany,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/>

Course Outcomes (COs)

1. Recall and record genetic basis and evolutionary history of behaviour.
 2. Classify movement and migration behaviors and explain environmental influence upon behaviour.
 3. Analyze and identify innate, learned and cognitive behavior and differentiate between various mating systems.
 4. Assess complexity involved in behavioural traits and evaluate hormones and their role in aggression and reproduction.
 5. Discuss the rhythmicity of behavioural expressions and the scientific concepts in behavior and behavioral ecology.
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MICROBIOLOGY AND IMMUNOLOGY

SUB CODE -U23ZDE5

Objectives: To learn the general structure of bacteria, virus and fungi – their culture, food spoilage and recombination in bacteria and also to understand the biotechnological, principles – Scope and importance through gene cloning, tools of genetic engineering vectors – their application in medicine and Intellectual Property Right Values.

UNIT - I

Outline classification of microorganisms - General structure of Bacteria, virus and fungi. Sterilization techniques, bacterial growth, methods of culturing bacteria - pure culture and culture characteristics. Food microbiology - food poisoning, food spoilage, food preservation.

UNIT - II

Recombination in bacteria, transformation, conjugation, sexduction, Recombination in bacteriophage, transduction, lytic and lysogenic cycles of bacteriophage. Medical microbiology - Tuberculosis, leprosy and AIDS.

UNIT-III

Immunology: Immunity- Types of Immunity. Lymphoid organs - Types, Function, Organization. Lymphoid cells, Antigen-Antibody-structure and type. Antigen-antibody reaction.

UNIT IV: Tumour Immunology - Tumour antigens, Immune response to tumours- immune surveillance - Escape mechanism from immune response, Immunotherapy for tumours.

UNIT-V

Immune Response: Humoral and cell Mediated. Transplantation Immunology: Types of Grafts. Mechanism of All organ graft rejection, Autoimmunity- Rheumatoid Arthritis. Hypersensitivity- Types.

Reference Books:

1. Verma P. Sand V. K. Agarwal (1975). Chordate Embryology. Published by S. Chand and Company
2. Chandrasekaran R and Thiagarajan (2012). Developmental Biology. Sri Murugan Publications.
3. Rastogi Balinsky. (2012). Introduction to Embryology. WBSA UNDER CO.
4. Scott F. Gilbert (2013). Developmental Biology. SINAUER Associates, INC. 10th Edn.
5. Lewis Wolpert (2009). A Very Short Introduction for Developmental Biology. Oxford Publications.
6. Arumugam N. (2017). A Text Book of Embryology, Sara Publications.

COURSE OUTCOMES:

CO1: Understand the types and functions of immune system.

CO2: Induct basic concepts of antigenicity and immunogenicity.

CO3: Understand the molecular basis of humoral (Cytokines and complement) and cellular process.

CO4: Understand the principles of hypersensitivity and develop theoretical knowledge On tissue and organ transplantation

CO5: Integrate knowledge of immune prophylaxis (Vaccine), Auto immunity And tumour immunology

HUMAN REPRODUCTIVE BIOLOGY

SUB CODE -U23ZDE6

Learning Objectives:

- To enable students to understand the endocrine structures and hormones associated with the physiology of reproductive system
- To enable students to learn about the male reproductive system and accessory glands and regulation
- To enable students to learn about the female reproductive system and regulation of its function
- To enable students to comprehend about fertilization, pregnancy, parturition and lactation
- To equip students with knowledge on causes of infertility, reproductive health, assisted reproductive technology and associated ethical issues

Unit 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

Unit 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

Unit 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

Unit 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 regulation

Unit 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

- Recall the structure and functioning of the male and female reproductive system, associated endocrinology, causes for infertility and assisted reproductive technology

- Describe the structure and physiology/function of male and female reproductive systems.
- Explain the role of structures, accessory glands and hormones associated with the reproductive tracts and their control
- Explain the mechanism of sex determination.
- Discuss age-associated physiological changes in the reproductive tract
- Describe physiological changes during pregnancy and benefits of breastfeeding.
- Identify causes for infertility, treatments available and ethical issues related to treatments.
- Discuss advantages and disadvantages of available contraceptives.
- Analyze the different techniques and associated ethical issues related to reproductive technology

Jones, R.E. (2013). *Human Reproductive Biology*. Amsterdam: Elsevier.

Neill, Jimmy D. ed (2006). *Knobil and Neill's Physiology of Reproduction*. Volume I. Third edn. Elsevier Academic Press.

Pinon, R. (2003). *Biology of Human Reproduction*. California: University Science Books.



BOOKS FOR REFERENCE

Cassan, A. (2005). *Human reproduction and Development (Inside the Human Body)*. New York: Chelsea Clubhouse.

Field, M.A. (1990). *Surrogate Motherhood*. Massachusetts: Harvard University.

Gardner, D. K. (2001). *Textbook of Assisted Reproductive Techniques: Laboratory and Clinical Perspectives*. London: Martin Dunitz.

Gardner, D. K. (2006). *In vitro Fertilization: A Practical Approach*. CRC Press.

Johnson, M. H. (2018). *Essential Reproduction*. New Jersey: Wiley-Blackwell.

BIOTECHNOLOGY SUB CODE -U23ZDE7

Objectives: To learn the general structure of bacteria, virus and fungi – their culture, food spoilage and recombination in bacteria and also to understand the biotechnological, principles – Scope and importance through gene cloning, tools of genetic engineering vectors – their application in medicine and Intellectual Property Right Values.

UNIT - I

Biotechnology: Scope and importance. Genetic Engineering : Gene cloning: Isolation of desired DNA - insertion of DNA into vector – introducing rDNA into host - identification, selection and expression of cloned DNA. Tools - Tools of genetic engineering: Restriction endonucleases (Eco R1, Hind III, B and H1) and DNA ligases. Vectors - Plasmids - pBR322, Cosmids.

UNIT – II

Molecular probes: Blotting techniques - Southern, Northern and Western blotting PCR, DNA finger printing. Gene bank and libraries. Monoclonal Antibodies: production and uses. Stem cell technology.

UNIT-III

Basic Tools for Gene Manipulation Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics). Restriction enzymes: Nomenclature, Types. Transformation techniques: Calcium chloride method, electroporation and biolistic method. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

UNIT-IV

Advance Tools and Techniques Southern, Northern and Western blotting DNA sequencing: Sanger method, Polymerase Chain Reaction, DNA Finger Printing and DNA micro array. Genetically Modified Organisms Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection;

Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.

UNIT - V

Application of biotechnology in Medicine: Gene Therapy, Vaccine production, knowledge based drug designing. Transgenic animals. Biotechnology and future: IPR and ethical concerns.

Reference Books:

1. Old and Prim Rose. Principles of Gene Manipulation. Latest Edition.
2. Balasubramania D (1996). Concepts in Biotechnology. University Press (India) Ltd., Hyde
3. Dharmarajan M (1989). Genetic Engineering. S. Viswanathan and Co.,
4. Dubey R, C (1995). Text book of Biotechnology. S. Viswanathan and Co.,
5. Gupta. Principles of Biotechnology.
6. Ananthanarayanan. Text book of microbiology. Orient Longmen.
7. David Freifelder. Microbial genetics. Narosa Publishing house.



Objectives:

1. Students gain skills in basics of computers
2. To impart knowledge on usage of computers as a biologist
3. Applications of internet and statistical bioinformatics in research

UNIT I

Fundamentals of Computers: Block diagram of computer (input and output devices), Generations, Advantages and limitations of Computers; Basics of operating system: DOS, Windows NT & XP, UNIX and Application Software.

UNIT II

Communication Technology: Networking- LAN, WAN & MAN - Internet & Intranet - Data transfer, storage & retrieval via network- Email, DNS, WEB servers and browsers.

UNIT III

Fundamentals of database: Database models (Hierarchical, Network, Relational, Object- Oriented Models), RDBMS, Database System applications and Security.

UNIT IV

Introduction to M.S. office package: word- creating a new document - templates and wizards- scientific data representation and basic calculations with EXCEL- Creating

Tables and databases using Access - interactive presentations using Power Point.

UNIT V

Basics of Biological databases: Types of data using in biologicaldatabases - Literature Databases and searches – Pub med Central – Medline – OMIM – SCOPUS – Science direct – Elsevier

. TEXT BOOKS:

1. Fundamentals of Computers- Pradeep K. Sinha, PritiSinha
2. Principles of database systems- Jeffery O. Ullma

COURSE OUTCOMES:

Upon completion of the course, the students are able to

1. Handle different operating systems in computer
2. Apply bioinformatics tools
3. Use life science data bases.
4. Use MS office tools for routine teaching learning process



UNIT – I

Classification of Insects up to orders and their diagnostic characters with familiar and important examples. Insect Reproduction, Development and Metamorphosis.

UNIT - II

Harmful Insects: Classification of Insects pests; Injuries and Damages caused by Insect pests. Assessment of Insect pest population, Assessment of pest damage. Pest surveillance and forecasting pest outbreak. Methods and principles of pest control - Chemical, Mechanical Biology - IPM.

UNIT – III

Insect pests: Destructive insects; Their bionomics and life cycle. Pest of Cultivated crops –Predominantly occurring pests in Rice (eg.), Sugarcane(eg.), Coconuts(eg.), Cotton(eg.). Pest of vegetables (brinjal). Pest of stored products (groundnut).

UNIT-IV

Apiculture:Species of Honey Bees-Types of Bee hives-Care and Management honeyextractionnutritive and medicinal values od honey.

UNIT-V

Vermiculture and vermicomposting-types of earthworm-vermicomposting methods-pit,heap,tank-economic importance-Vermiwash.

Reference Books:

1. Chapman RF (1993). The Insects. Structure and Functions. ELBS. London.
2. Chandler AC and CP Read (1961). Introduction to Parasitology. John Wiley and Sons, NewYork.
3. David BV, Muralirangan NC and Meera

Muralirangan (1992). Harmful and beneficial Insects. Popular book Depot.

4. David BV and Kumaraswami (1998). Elements of Economics Entomology. Popular BookDepot. Madras.
5. David BV (1992). Pest management and pesticides: Indian Scenario. Namrutha publications.
6. Krishnan NT (1993). Economics Entomology. JJ Publications, Madurai.
7. Mani MS (1973). General Entomology. Oxford and TEM.
8. Nayar KK, Ananthakrishnan TN and VD David (1990). General and applied Entomology.Tata Mc Grow Hill New Delhi.
9. Balinsky, B.I. 1981. An introduction to embryology. .B.Saunders company Philadelphia.
10. Gupta P.K(2005)-Elements of Biotechnology

Course outcomes

CO1: Understand the insect classification and their diagnostic characters, reproduction, development and metamorphosis.

CO2: Gain the knowledge of classification of harmful insects, pests damages, pest population assessment, assessment of damage, surveillance and forecasting its outbreak. Pest control techniques.

CO3: Learn the destructive insects and their bionomics, life cycle, pest of cultivated Crops and stored products.

CO4: Gain knowledge of apiary management.

CO5: Gain knowledge of earthworm rearing and vermicomposting.

Learning Objective

1. To understand the culturing techniques and production methods of different farm animals.
2. To know the life history of animals and disease control methods used in farming.
3. To understand the concept of breeding, cross breeding and the importance of high yield varieties.
4. To know about the marketing strategies.

Unit 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.

Unit 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.

Unit 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.

Unit 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.

Unit 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.

Text Books

1. Sastry, N.S.R., C.K.Thomas and R.A.Singh, 2015. Livestock Production Management, 4th Ed. Kalyani Publishers, New Delhi.
Mary violet Christy, A. 2014. Vermitechnology, MJP Publishers, Chennai.



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. Shukla&Upadhyay, 2014. Economic Zoology, 5th edn. Rastogi Publication, Meerut New Delhi.
6. Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
7. Shailendra Ghosh, 2009. Fisheries and aquaculture management, Adhyayan, New Delhi.
8. David, B and Ananthakrishnan, T. N., 2006. General and Applied Entomology, Second edition, Tata McGraw hill publishing company Ltd., New Delhi, India.
9. Jagadish Prasad, 2002. Principles and practices of Dairy Farm Management, 3rd Ed. Kalyani Publishers, Ludhiana.
10. Sukumar, D.E., 2002. Outline of Dairy Technology, Oxford University, New Delhi.
11. Rath, R.K., 2000. Freshwater Aquaculture. Scientific Publishers (India), Jodhpur.
12. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
13. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.
14. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea & Fabiger Publisher.

Suggested Readings

1. Glenn Munroe, 2017. Manual of on-Farm vermicomposting and vermiculture, Holdanca Farms Ltd, Wallace, Nova Scotia.

2. Hanifa, M.A., 2011. Aquatic resources and aquaculture, Dominant, New Delhi.
3. Gupta, P.K., 2008. Vermicomposting for sustainable agriculture, 2nd Edition, Agrobios, India.
4. Talashikar, S.C., 2008. Earthworms in Agriculture, Agrobios, India.
5. Abishek Shukla, D., 2009. A Hand Book of Economic Entomology, Vedamse Books, New Delhi.
6. Banerjee, G.C., 2006. Text book of Animal Husbandry 8th Ed. Oxford and IBH Publishing Company Ltd., New Delhi.
7. Walstra, P. Wouters, J.T.M. and Geurts, T.J. 2006. Dairy Science and Technology. CRC Press, New York.
8. Dunham, R.A., 2004. Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
9. Donald D Bell and William D. Weaver, 2002. Commercial chicken meat and egg production, Springer, New York.
10. Eckles C.H. and Anthony, E.L., 2001. Dairy Cattle and milk production, Biotech. Tata McGraw Hill Publishing Co. Pvt. Ltd., New Delhi.
11. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.
12. ICAR, 1997. Handbook of Animal Husbandary— The Indian Council of Agricultural Research, New Delhi.
13. Banerjee G.C., 1992. Poultry, Oxford and IBH, New Delhi.
14. Jhingran, AVG, 1991. Fish and Fisheries of India. Hindustan Publishing Co. New Delhi.
15. James N. Marner, 1975. Principles of dairy processing, Wiley Eastern Limited, New Delhi.
16. Baradach, JE. Ryther JH. and MC larney WO., 1972. Aquaculture. The farming and Husbandry

Web Resources

1. <https://bit.ly/3tXHjk8>
2. <https://bit.ly/3tUTHBu>
3. <https://bit.ly/3hVv96q>
4. <https://bit.ly/39nztH1>
5. <https://bit.ly/3CzasVO>
6. https://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html
7. <https://bit.ly/3nYvgSF>
8. <http://caa.gov.in/farms.html>
9. <http://www.csrtimys.res.in/>
10. <http://www.agshoney.com/training.htm>

Course Outcomes (COs)

1. To identify the breeds and varieties of poultry, fish, bees, and cattle and understand the basic aspects of farming.
2. To assess and integrate the available tools and techniques to increase the productivity in farms.
3. To analyse the pros and cons of different methods of farming and marketing strategies of products.
4. To evaluate the use of available resources in improving the breeds, vermicomposting, farm products etc..
5. To design new methods to improve farm animals with increased productivity and disease resistance and to construct new methods in vermicomposting.



Course outcomes

1. To induce interest in the use of various biological instrumentation and employ them for the study of cells, tissues and genetic material.
2. To help students to map the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
3. To study the working principle of different bioinstrumentation and their applications.
4. To enable students to design experiments and justify them with the underlying principles of bioinstrumentation.

Unit I: Good Laboratory Practices : Guide lines, Laboratory symbols; Cleaning and sterilization of labware 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

Unit II: Microscopy - Light microscope, SEM, TEM, Atomic force microscope; Cryopreservation - principle and procedure; Fluorescence activated cell sorting; X-ray crystallography.



Unit III: Centrifugation - working principle and types of centrifugation; Spectrophotometry; Mass spectrometry; Chromatography - principle and types of chromatography

Unit 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.

Unit 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, Academic Press, New York, USA.
2. Aysha Divan, Janice Royds, 2013. Tools and Techniques in Biomolecular Science, Oxford University Press, UK.
3. Gordon M.H., Macrae R., 2012. Instrumental Analysis in the Biological Sciences, Blackie & Son Ltd., UK
4. Leonard Davis, Mark Dabner 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

To describe and explain the steps in the use of various biological instrumentation that are used in the study of different animal specimens.

1. To relate the applications of biological techniques and employ them for the study of cells, tissues and genetic material.
2. To correlate and appraise the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
3. To compare the working principle of different bioinstrumentation and to summarize their applications.
4. To devise experiments and justify them with the understanding of the underlying principles of bioinstrumentation that are ecofriendly, ethical and have national and global relevance.



COMMERCIAL ZOOLOGY

SUB CODE -U23ZDE9

UNIT - I

Classification of Insects up to orders and their diagnostic characters with familiar and important examples. Insect Reproduction, Development and Metamorphosis.

UNIT - II

Harmful Insects: Classification of Insects pests; Injuries and Damages caused by Insect pests. Assessment of Insect pest population, Assessment of pest damage. Pest surveillance and forecasting pest outbreak. Methods and principles of pest control - Chemical, Mechanical Biology - IPM.

UNIT - III

Insect pests: Destructive insects; Their bionomics and life cycle. Pest of Cultivated crops –Predominantly occurring pests in Rice (eg.), Sugarcane(eg.), Coconuts(eg.), Cotton(eg.). Pest of vegetables (brinjal). Pest of stored products (groundnut).

UNIT-IV

Apiculture:Species of Honey Bees-Types of Bee hives-Care and Management honeyextractionnutritive and medicinal values od honey.

UNIT-V

Vermiculture and vermicomposting-types of earthworm-vermicomposting methods-pit,heap,tank-economic importance-Vermiwash.

Reference Books:

9. Chapman RF (1993). The Insects. Structure and Functions. ELBS. London.
10. Chandler AC and CP Read (1961). Introduction to Parasitology. John Wiley and Sons, NewYork.

11. David BV, Muralirangan NC and Meera Muralirangan (1992). Harmful and beneficial Insects. Popular book Depot.
12. David BV and Kumaraswami (1998). Elements of Economics Entomology. Popular BookDepot. Madras.
13. David BV (1992). Pest management and pesticides: Indian Scenario. Namrutha publications.
14. Krishnan NT (1993). Economics Entomology. JJ Publications, Madurai.
15. Mani MS (1973). General Entomology. Oxford and TEM.
16. Nayar KK, Ananthakrishnan TN and VD David (1990). General and applied Entomology. Tata Mc Grow Hill New Delhi.
9. Balinsky, B.I. 1981. An introduction to embryology. .B. Saunders company Philadelphia.
10. Gupta P.K (2005)-Elements of Biotechnology

Course outcomes

CO1: Understand the insect classification and their diagnostic characters, reproduction, development and metamorphosis.

CO2: Gain the knowledge of classification of harmful insects, pests damages, pest population assessment, assessment of damage, surveillance and forecasting its outbreak. Pest control techniques.

CO3: Learn the destructive insects and their bionomics, life cycle, pest of cultivated Crops and stored products.

CO4: Gain knowledge of apiary management.

CO5: Gain knowledge of earthworm rearing and vermicomposting.



CODE: U23ZC305

CELL BIOLOGY

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	6	-	-	5	25	75	100

Course Content

UNIT I:

History of Cell Biology. Tools and Techniques of Cell Biology - Cell Fractionation, Homogenization, Centrifugation, Isolation of sub cellular Components. Histological techniques - Staining - Vital Stains. - Cytoplasmic and Nuclear Stains. Micro Technique Methods, Microscopes - Types - Light, Phase contrast, SEM, TEM - Units of measurement.

UNIT II:

The Cell - Cell theory - Viruses -Types and Structure - Bacteria - Bacterial membrane - Ultra structure of Animal cell - Cytoplasm - Structure and Composition, Function - Extra Cytoplasmic Structure - Cilia Flagella - Cytoplasmic Inclusions.

UNIT III:

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.

UNIT IV:

Nucleus - Ultrastructure, Composition and Functions - Nuclear Membrane - Nucleoplasm - Chromosomes - Heterochromatin and Euchromatin - Nucleolus - Nucleolus Cycle - DNA and RNAs - Protein Synthesis & regulation.

UNIT V: Cell Divisions and Cell Cycle - Cell division, Amitosis, Mitosis and Meiosis and their Significance - Cancer, Biology - Characteristics and types of cancer cells, theories on Carcinogenesis, Ageing of Cells - Apoptosis - Stem cells -Definition, types and application.

Person & 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) VeerBalaRastogi, Introductory cytology. KedarNath 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.

Books for reference: (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. 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. (3) Cohn, N. S., 1979, Elements of Cytology, Freeman Book Co., New Delhi - 110007, 495 pp

Web references:

(1) <http://www.microscopemaster.com/organelles.html>

(2) <https://bit.ly/3tXwDSB>

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	To recall the basic structure, origin and development of cell organelles.	K1
CO2	To integrate and assess the biochemical, cytological and histological tools to infer the cellular basis of organization.	K2
CO3	To illustrate the role of cells and cell organelles in various biological processes.	K3
CO4	To analyze and differentiate organisms based on structure, composition and inter and intra cellular interactions.	K4
CO5	To construct and simulate the role of different cytological tools to explain the structure and complexity of cells and cell organelles.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted% of Course contribution to POs							

Very strong - 4

Strong-3

Medium-2

Low-1

Question pattern

Section A	Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)
		1 question from each unit (3X10=30)

Zoology

DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY (PRACTICAL)
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-III **CORE COURSE - VI**
CODE: LABORATORY TECHNIQUES IN
ZOOLOGY – III PRACTICAL

Uzc306P

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
PRACTICAL	3	-	-	3	40	60	100

Course Content

Practical

1. Handling of dissection and compound microscopes
2. Onion root tip- Squash preparation and study of mitotic stages
3. Mounting of polytene chromosome in Chironomus larva.
4. Measurement of cells using stage and ocular micrometers.
5. Preparation and observation of squamous epithelial cells.
6. Separation of cells from chicken liver tissue or blood using centrifugation.

Spotters:

1. Epithelial tissues(Columnar epithelium, Ciliated epithelium, Squamous epithelium)
2. Muscular tissues (Striated muscle, Non-striated muscle, Cardiac muscle)
3. Vascular tissues (Blood cell-Human)
4. nervous tissues (Nerve cell)
5. Centrifuge
6. Electrophoresis
7. Cell cycle
8. Camera Lucida.

1. N.Arumugam, L.M.Narayanan, K.Nallasingam, V.Kumaresan, A.M.Selvaraj. 2017. Practical Zoology-Vol-3. Saras publication, Nagercoil, Tamilnadu.
2. Ajoy Paul, Practical Zoology. Books & Allied Pvt. Ltd. Kolkata.
3. P.S.Verma and P.C.Srivastava, 2020. Advanced Practical Zoology, S Chand and Company Ltd. New Delhi.

Books for reference:

- 1.SudhaGarg, Cell biology and Cytogenetics lab, Practical Zoology I, PragatiPrakashan, 2023.
2. Yadav&Varshney, 2021. Modern Practical Zoology-1. KedarNath Ram Nath, Meerut.

Course Outcomes: On completion of the course, students will be able to:		Level
CO1	Acquire knowledge of handle microscopes.	K1
CO2	Familiarize with cellular structure and functions.	K2
CO3	Understand the events in cell division.	K3
CO4	Understand the different structure and functions of various tissues.	K4
CO5	Update the knowledge of principle and application of different equipments used in cell biology labs.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	4	3	4	4	4	4
CO3	4	4	4	3	4	4	4
CO4	4	4	4	4	4	4	4
CO5	4	4	3	4	3	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong – 4 Strong-3 Medium-2 Low- 1

Question pattern

SectionA	SectionC	SectionC
1 X 20 =20	2X 10 = 20	Record = 5 Spotters = 10 Viva = 05

Anshu

GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS), KUMBakonam
DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-III
SKILL ENHANCEMENT COURSE

CODE: U23Z9AC

APICULTURE

U23AC

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	1	-	-	1	25	75	100

Course Contents

UNIT – I:

Honey Bee: Systematic position – species of honey Bees. Bee Colony, Castes. Natural colonies.

UNIT – II:

Types of Bee hives – Structure of natural beehive. Artificial beehive – different types.

UNIT – III:

Apiary care and Management – selection of sites – Catching and transforming a colony – Handling and maintenance of the colony – Natural enemies and diseases of honey bees and control methods.

UNIT – IV:

Instruments employed in Apiary. Newton's hive. honey extractors and smokers. Honey: Extraction and apiculture used – Chemical composition – nutritive and medicinal values.

UNIT – V:

Present studies of apiculture in India. Prospect of apiculture as self employment venture. Preparing proposal (Layout and budget) for financial assistance of funding agencies.

Text Books:

Sharma.P and L.Singh (1987). Hand book of bee keeping. Controller printing and stationary, Chandigarh.

Books for reference:

1. Cherian R and K. Ramanathan (1992). Bee Keeping in India.
2. Mishra R.C (1985). Honey bees and their management in India. ICAR.
3. Morse R.A (1990). The ABC and XYZ of Bee culture. 40th edn. A. I. Root and Co., Ohio.

Course Outcomes: On completion of the course, students will be able to:		Level
CO1	Understand and acquire the knowledge of taxonomy of honey bees to identify the species level.	K1
CO2	Learn to identification of the types of bee hives.	K2
CO3	Gain the knowledge of handling and maintenance of the colony.	K3
CO4	Understand the extraction of honey and it medicinal values	K4
CO5	Understand role of apiculture for self employment and get finance assistance from funding agencies.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Weightage							
Weighted % of Course contribution to POs							

Very strong – 4 Strong-3 Medium-2 Low-1

Question pattern:

Section A		Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)	1 question from each unit (3X10=30)

OUTCOME BASED EDUCATION CHOICE BASED CREDITS SYSTEM
SEMESTER-III SKILL ENHANCEMENT COURSE
CODE: FOOD, NUTRITION AND HEALTH

UZ 3FN

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	2	-	-	2	25	75	100

Course Contents**UNIT I: Nutrition and dietary nutrients:**

Introduction to Nutrition, Definition, Role of Nutrition in growth, development, and maintenance of health, and Prevention of diseases.

UNIT II: Macro nutrients and micronutrients:

Importance of Basic Nutrients - Macronutrients: Carbohydrates, Proteins, Fats - Micronutrients: Vitamins, Minerals, Importance of Water and Electrolytes - Sodium, potassium, and chloride

UNIT III: Malnutrition and nutrient deficiency diseases:

Creating a Balanced Diet, Dietary Guidelines, and Planning

UNIT IV:

Nutrition Throughout the Life Cycle - Pregnancy and Lactation, Infancy and Childhood, Adolescence, Adulthood and Aging.

UNIT V: Diseases caused by microorganisms:

Nutrition and Disease Prevention - Chronic Diseases - heart disease, diabetes, obesity, cancer, Current Issues in Nutrition.

1. Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed.; New Age International Publishers.
2. Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.
3. Swaminathan, M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO.
4. Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd.

Course Outcomes: On completion of the course, students will be able to:		Level
CO1	Gain knowledge to have a healthy life	K1
CO2	Acquire knowledge on healthy foods	K2
CO3	Adopt personal hygiene	K3
CO4	Obtain the concepts of nutritional requirements for healthy life.	K4
CO5	Enrich the knowledge of faulty food habits and proper health management	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	4	4	3	1		2
CO2	4	3	4	3		1	2
CO3	3	4	4	3	1	1	2
CO4	3	3	4	3	2	2	3
CO5	3	4	3	2	1	2	3
Weightage							
Weighted % of Course contribution to POs							

Very strong – 4 Strong-3 Medium-2 Low-1

Question pattern:

Section A		Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)	1 question from each unit (3X10=30)

B.SC. ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-IV
CORE COURSE - VII

CODE: ENVIRONMENTAL BIOLOGY

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	5	-	-	5	25	75	100

Course Contents

UNIT I:

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche: resource partitioning; character displacement.

UNIT II:

Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation-demes and dispersal, interdemec extinctions, age structured populations - action taken to control population explosion.

UNIT III:

Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types; mechanisms; changes involved in succession; concept of climax.

UNIT IV:

Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

UNIT V:

Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches - Waste management. Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation and management strategy (Project Tiger, Biosphere reserves).

- 1.Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
- 2.Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.
- 3.Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.

Booksforreference:

- 1.Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
- 2.Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.3.United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.

CourseOutcomes: On completionofthecourse, students willbeableto:		Level
CO1	Learn about the ecosystem, biotic communities and utilizing the energy processing	K1
CO2	Understand various community and population and population control	K2
CO3	Apply the fundamental knowledge of climatic conditions and its impact on the environment for conservation	K3
CO4	Realizing the nature of pollution and the ways for its control/reduction	K4
CO5	Assess the Impact of environmental studies on solid waste management and develop remedial measures.	K5 &K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	4	4	4	3	4	4
CO3	4	4	4	4	4	4	4
CO4	4	3	4	4	4	4	4
CO5	4	4	4	4	4	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong - 4 Strong-3 Medium-2 Low-1

Question pattern:

SectionA		SectionB	SectionC
2Multiple choice question from Each unit (10X1=10)	1question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)	1question from each unit (3X10=30)

Amulya

**LABORATORY TECHNIQUES IN
ZOOLOGY IV – PRACTICAL**

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
PRACTICAL	3	-	-	3	40	60	100

Course Contents

Practical

1. Estimation of Dissolved oxygen in water
2. Estimation of Dissolved carbon dioxide in water
3. Estimation of salinity in water
4. Estimation of soil pH
5. Estimation of soil moisture
6. Collection and observation of freshwater planktons.
7. Observation of marine plankton.
8. Construction of a food web diagram based on a local visit and collected samples.

Spotters:

1. pH meter
2. Hygrometer
3. Sacchi disc
4. Sandy shore fauna
5. Muddy shore fauna
6. Rocky shore fauna

1. Jayasuriya, D.Fatima, R.P.Meyyan, S.Prasannakumar, A.Mani, A.Mariakuttikan, N.Arumugam, L.M.Narayanan, K.Nallasingam, V.Kumaresan, A.M.Selvaraj. 2017. Practical Zoology-Vol-3. Saras publication, Nagercoil, Tamilnadu.
2. P.S.Verma and P.C.Srivastava, 2020. Advanced Practical Zoology, S Chand and Company Ltd. New Delhi.

Books for reference:

- 1.SudhaGarg, Cell biology and Cytogenetics lab, Practical Zoology I, PragatiPrakashan, 2023.
2. Yadav&Varshney, 2021. Modern Practical Zoology-1. KedarNath Ram Nath, Meerut.

CourseOutcomes: On completionofthecourse, students willbeableto:		Level
CO1	Student obtains the ability to analyze different water quality parameters so they get real practical knowledge about it.	K1
CO2	Students get experience, knowledge and awareness related to ecosystem through field visits.	K2
CO3	Practical knowledge on observation and identification of fresh water planktons.	K3
CO4	Obtain practical knowledge on the eat and to be eaten concept.	K4
CO5	Able to apply the techniques and practices soil moisture	K5 &K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	4	4	4	4	4	4
CO3	4	3	4	4	3	4	4
CO4	4	4	4	4	4	4	4
CO5	4	4	4	4	4	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong – 4 Strong-3 Medium-2 Low-1

Question pattern:

Section A		Section B	Section C
2Multiple choice question from Each unit (10X1=10)	1question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)	1question from each unit (3X10=30)

Am. R. S.

B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER- IV SKILL ENHANCEMENT COURSE

CODE: ORINAMENTAL FISH FARMING

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	2	-	-	2	25	75	100

Course Contents

UNIT 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.

UNITII:

External morphology of a typical fish. Exotic and endemic varieties of ornamental fishes.

UNITIII:

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

UNITIV:

Live fish transport- handling, feeding and forwarding techniques of fish. Fish Diseases and their control.

UNITV:

Breeding - Common characters and sexual dimorphism of Fresh water and Marine aquarium ornamental fish varieties such as Guppies, Mollys, Sword tails, Platy, Siamese fighters and Gold fish, Butterfly fish, Blue morph and Anemone fish.

1. Rath R.K (2000). Fresh water aquaculture. Scientific Publishers (India). P) O Box 91, Jodhpur.
2. Jhingaran AVG (1991). Fish and fisheries of India. Hindustan Publication Company.

Books for reference:

1. Jameson, JD and R Santhanam (1996). Manual of ornamental fishes and farming technology. Fisheries College and Research Institute, Thoothukudi
2. Michael Beazley (1998). Complete guide to tropical aquarium fish care. Read and consume book Ltd. London.

Course Outcomes: On completion of the course, students will be able to:

		Level
CO1	Understand the scope and commercial values of ornamental fishes, morphological characteristics of some important ornamental fish species.	K1
CO2	Learn the feeding regime, breeding, mass production, live feed culture techniques and synthetic feed preparation.	K2
CO3	knowledge of tank designing, maintenance of water quality parameters and disease management.	K3
CO4	Have practical knowledge about the male and female identifications, breeding techniques, live and synthetic feed productions.	K4
CO5	Understand the hands on trainings in tank designing, water quality parameters, identify the pathogenic forms and its control measures.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	3	4	3	2	2	3
CO2	3	4	3	2	2	2	3
CO3	4	3	4	2	2	2	3
CO4	4	3	4	3	2	2	3
CO5	3	3	3	3	2	2	3
Weightage							
Weighted % of Course contribution to POs							
Very strong - 4 Strong-3 Medium-2 Low-1							

Section A	Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)
		2 Multiple choice question from Each unit (10X1=10)

Abhinav

CODE:

PUBLIC HEALTH AND HYGIENE

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	2	-	-	1	25	75	100

Course Contents

UNIT- I

Introduction to health and hygiene – Mental and Physical Health. Hygiene and disease - TB, Typhoid, Cholera, Jaundice and HIV.

UNIT- II

Epidemiology of communicable diseases – air borne (small pox, tuberculosis) food and water borne diseases (food poisoning, amoebiasis) zoonoses (leptospirosis) arthropod borne (filariasis)

UNIT- III

Epidemiology of non - communicable diseases – Cancer, Diabetes.

UNIT- IV

Individual health – nutritional requirements (balanced diet, malnutrition) Mental health, personal hygiene, hazards of drugs, tobacco and alcohol.

UNIT- V

Community health – environment, housing plan, occupational health hazards, family planning, maternity and child care, health education.

TextBooks:

I.K. Park – Text book of Social and Prevention medicines.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Understand the health and hygiene for disease.	K1
CO2	Learn the communicable diseases	K2
CO3	Gain the knowledge on Non-spreadable diseases.	K3
CO4	Acquire knowledge on nutritional requirements for individuals and hazard drugs.	K4
CO5	Understand role of community health.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	2	2	2
CO4	3	3	3	3	2	2	1
CO5	3	3	3	3	2	3	1
Weightage							
Weighted % of Course contribution to POs							

Very strong – 4

Strong-3

Medium-2

Low-1

Question pattern:

Section A		Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)	2 Multiple choice question from Each unit (10X1=10)

Am. h. p.

GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS), KUMBAKONAM
DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-V **CORE COURSE -IX**

023 ZC 509

CODE: EVOLUTIONARY BIOLOGY

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	5	-	-	5	25	75	100

Course Content

UNIT I:

Theories of Origin of life - abiogenesis, biogenesis, cosmozoic theory, special creation theory, Theory of biochemical origin of life. Urey-Miller experiment, Origin of prokaryotes and eukaryotes.

UNIT II:

Morphological, physiological and biochemical, embryological, Taxonomical and geographical evidences -Paleontological evidences - evolutionary genomics. Geological time scale - Nature of fossils- Dating of fossils

UNIT III:

Lamarckism - Neo Lamarckism - Darwinism - Neo Darwinism and modern synthetic theory - DeVrie's Mutation theory - modern concepts of mutation - Mutation and their role in evolution.

UNIT IV:

Isolating mechanisms - Modes of speciation - Hybridization is an evolutionary catalyst- Laws of Adaptive Radiation- Adaptive radiation in reptiles and mammals- Convergent and divergent, parallelism- Evolutionary constancy

UNIT V:

Fossil records of man and cultural evolution of man - Natural selection in action in man- level of selection. Animal colouration and Mimicry, Evolution and ethics.

Text Books:

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

Books for reference:

(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.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Understand the Origin of Life through several Theories proposed by Biologists	K1
CO2	Analyse the significance fossils through Geological Times	K2
CO3	Apply thr knowledge on the theories of evolution, Concepts of mutation	K3
CO4	Evaluate the impact of radiation and othe environmental factors on survival, adaptation and evolution	K4
CO5	Construct a phylogenetic tree	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong - 4 Strong-3 Medium-2 Low-1
Question pattern

Section A	Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10) 1 (a & b) question from each unit (5X5=25)	1 question from each unit (3X10=30)

Amulya

DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-V
CORE COURSE - X

CODE:

023ZC51D

ANIMAL PHYSIOLOGY

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	5	-	-	5	25	75	100

Course Content

UNIT I:

Nutrition & Respiration: Nutrition: Digestion and absorption of carbohydrates proteins and lipids. Minerals & Vitamins – their deficiency. Hormonal control of digestion. Types of Respiration, Respiratory pigments - structure of Haemoglobin, Transportation of gases – Bohr effect - Regulation of respiration - bronchitis, asthma – Physiological effects of smoking.

UNIT II:

Circulation & Excretion: Blood- composition and functions, Mechanism of blood clotting. Types of Hearts – Heart beat and its regulation - pace maker – Cardiac cycle – ECG - Pulse and blood pressure. Excretion: Nephron structure & mechanism of urine formation, Regulation of acid base balance, Excretory products, Osmoregulation in fishes.

UNIT 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.

UNIT IV:

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

UNIT V:

Endocrinology & Reproduction: Endocrine gland- structure and functions of pituitary, thyroid, parathyroid, Islets of Langerhans, adrenal, sex glands, thymus, pineal gland. Reproduction in human: Reproductive cycle- Hormonal control.

Text Books:

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

Books for reference:

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 (4th edn). Sinauer Associates is an imprint of Oxford University Press; USA, 828 pp.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Explain how the various organ systems are coordinated and controlled.	K1
CO2	List the functions of various organs in relation to physiological process.	K2
CO3	Develop the idea of multi level controlling and feedback mechanism in relation to various physiological functions.	K3
CO4	Understand the basic physiological process related to adaptation, metabolism and major requirements.	K4
CO5	Correlate and understand human physiology.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted% of Course contribution to POs							

Very strong – 4

Strong-3

Medium-2

Low-1

Question pattern

Section A		Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)	1 question from each unit (3X10=30)

Only

GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS), KUMBHARONAM
DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-V **CORE COURSE - XI**

CODE: MICROBIOLOGY

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	5	-	-	5	25	75	100

Course Content

UNIT I:

History, scope, branches of microbiology. Contribution of Leeuwenhoek, Jenner, Pasteur, Koch, Fleming, Iwanowsky, Waksman, Luria, M. J. Thirumalachar, Subba Rao, Sambhu Nath De. Evolution of Microbial diversity. Systematic position: 5 kingdom classification of Whittaker Comparison of Bacteria, Archaea, Eukarya (tabular and diagrammatic). Microscopy: Light, Electron and fluorescence microscopes, staining techniques (simple, differential & special strains).

UNIT II:

Classification of bacteria. Bacterial cell wall: Gram positive Vs Gram negative; Flagella, Pili, Spores, capsules, Nutritional hypere microorganisms, Growth curve & Factors affecting growth.

UNIT III:

Microbial metabolism: Fermentation, respiration, Photosynthesis; Microbial genetics: DNA replication, transcription and translation in Prokaryotes and eukaryotes; Genetic recombination: Transformation, conjugation and transduction

UNIT IV:

Applied Microbiology

Aseptic methods: Sterilization & Disinfection methods, Host pathogen interaction and microbial pathogenesis-Communicable diseases; Mode of transmission, Major bacterial diseases: Tuberculosis, cholera and typhoid, Viral diseases: Influenza, Hepatitis, Fungal & Parasite diseases: Cardidiasis, Malaria, control and precaution strategies (Vaccination, hygiene, surveillance)

UNIT V:

Industrial Microbiology

Production of enzymes, antibiotics, alcohol, dairy products by fermentation. Environmental microbiology:
a) Waste water and sewage treatment, b) Bio degradation and Bioremediation
c) Bio fertilizers and biopesticides.

Microbiology – fundamentals and applications, Macmillan Publishing Company, New York, 3. Ravindra Nath, Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalayani Publishers. 4. Greenwood D, Richard CD, John S and Peuther F (1992). Medical Microbiology, 16th edition. ELBS, Churchill living stone.

Books for reference: Alexopoulos C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi. 2. Thomas M. Bell, 1965. An Introduction to General Virology, William Heinemann Medical books, London, 3. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.

Web references:

1. <https://vlab.amrita.edu/?sub=3&brch=73>
2. <https://learn.chm.msu.edu/vibl/>
3. <https://mvi-au.vlabs.ac.in/>

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Apply knowledge to understand classification of microbes and its basic characteristics	K1
CO2	Acquire information on methods of sterilization of microbial cultures and requirements for the media preparation.	K2
CO3	Attain knowledge about the interactions of microbes with their ecosystem.	K3
CO4	Perceive the role / action mechanism microbes on food spoilage and the principles of food preservation.	K4
CO5	Comprehend various diseases caused by the microbes and its treatments.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong – 4 Strong-3 Medium-2 Low-1

Question pattern

Section A	Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)
		1 question from each unit (3X10=30)

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U23ZC512P

CODE: LABORATORY TECHNIQUES IN ZOOLOGY - V

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Practical	-	-	5	2	25	75	100

Course Content

EVOLUTION

1. Animals of evolutionary significance - Peripatus, Archaeopteryx, Natiloids, Ammonoids.

2. Homologous organ - Fore Limb modification.

3. Analogous organ - Wings of insect and bird.

4. Colouration - Chameleon, Lycodon and Krait.

5. Mimicry - Leaf insect, Stick insect, Monarch and Viceroy Butterfly

6. Clues to for identification adaptation and evolutionary theories

ANIMAL PHYSIOLOGY

1. Salivary amylase activity of human saliva in relation to Temperature & pH.

2. Qualitative tests for Ammonia, Urea and uric acid.

3. Enumeration of RBC.

4. Enumeration of WBC.

5. Haemoglobinometer, Kymograph, Sphygmomanometer (Spotters).

6. Models of haemoglobin and ATP

BIOCHEMISTRY

1. Measuring of haemoglobin using haemoglobinometer in human blood

2. Preparation of Buffer system

3. pH meter (Spotters).

4. Lock and Key Hypothesis-Enzyme Model (Spotters).

5. Qualitative analysis for Carbohydrate, Protein and Lipid

BIOPHYSICS & BIOSTATISTICS

1. Biophysics 1. Determination of Viscosity by Ostwald's viscometer

2. Surface tension by Drop weight method

UNIT V: 2. Biostatistics

1. Calculation of mean, median, mode, standard deviation, Standard error for any one animal data.

2. Diagrammatic representation (Pie and Bar) using biological data.

Books for reference:

1. A practical manual on innovative animal physiology, R.P. MALI, S.K. AFSAR

2. Animal physiology and Biochemistry, Dr. R.A. Agarwal, Dr. Anil, K. Srivastava, Dr. Kaushal Kumar.

3. Simplified Practical Manual of Biochemistry, Javin Bishnu Gogoi

4. Vijayaraman and Palanivelu, Seimurai vilangiyal.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Apply knowledge to understand the relationship between phylum, evolutionary significance	K1
CO2	To demonstrate an understanding the principles, of qualitative analysis	K2
CO3	Acquire knowledge of physiological processes that regulate body functions.	K3
CO4	To understand the physiological processes that regulate body functions.	K4
CO5	Evaluate and Examine the various parameters of haematology and biochemistry and Identify the nitrogenous waste products of animals.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted% of Course contribution to POs							

Very strong - 4

Strong-3

Medium-2

Low-1

Question pattern

Section A	Section B	Section - C	Section D
Major Practical (25x1=25)	Minor Practical (15x1=15)	Spotters (20) (5x4=20)	Record - 10 Viva - 5

DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER- U232G5:1 ELECTIVE CODE:

BIOPHYSICS AND BIOSTATISTICS

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	4	-	-	3	25	75	100

Course Contents

UNIT 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.

UNIT 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

UNIT 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.

UNIT 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.

UNIT 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.

Academic, Calcutta. 302pp. (2)Subramanian,M.A.,2016.Biophysics– PrinciplesandTechniques,MJP,Chennai. 324pp.(3) Gurumani,N.,2005.AnintroductiontoBiostatistics,MJP,Chennai, 250pp. (4)Palanichamy,S and M.Shanmugavelu, 1991. Principles of Biostatistics.PalaniParamount.India. 350pp

Books for reference:

(1)Antonisamy, B., Solomon Christopher and P. Prasanna Samuel, 2011. Biostatistics: Principles and practices. MacGraw 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 & Sons Ltd. New York. 328pp.

Web references:

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

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Recall and describe fundamental biophysical principles and physical laws in living systems as well as basic statistical terms and methods.	K1
CO2	Explain the applications of various biophysical techniques. Also, describe methods for collecting and classifying data in biostatistics.	K2
CO3	Select suitable biophysical techniques to study the biological process and statistical approach to assess the experimental results. Apply suitable physical techniques and statistical methods to solve biological problems.	K3
CO4	Identify and relate the bioanalytical techniques and statistical principles for the application of biological experiments. to organize and analyze biological data.	K4
CO5	Integrate the bioanalytical techniques and statistical methods to validate research investigations.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	1	2	2	3
CO2	2	2	2	1	2	2	3
CO3	2	2	2	1	2	2	3
CO4	2	2	2	1	2	2	3
CO5	2	2	2	1	2	2	3
Weightage							
Weighted % of Course Contribution to POs							

Strong-3 Medium-2 Low- 1

Question pattern:

SectionA		SectionB	SectionC
2Multiple choice question from Each unit (10X1=10)	1question from each unit (5X2=10)	1 (a & b) question from each unit	1question from each unit

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OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-0237GE5:2 **ELECTIVE CODE:**

ANIMAL BEHAVIOUR

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	4	-	-	3	25	75	100

Course Contents

UNIT I: Genetics and Behavior : Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behavior, Heritability of behavior, Natural selection and behavior, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.

UNIT II:
 Evolution and Social Behavior: Sexual selection, Altruism, Sexual strategy and social organization, Animal perception, Neural control of behavior, Sensory processes and perception, Visual adaptations to unfavorable environments.

UNIT III:
 Animal and the Environment: Coordination and Orientation, Homeostasis and Behavior, Physiology and Behavior in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning and Cognitive aspects of learning.

UNIT IV:
 Understanding Complex Behavior: Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behavior in Animals, Complex behavior 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.

UNIT 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; Therelevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases – Chronopharmacology, chronomedicine, chronotherapy

- 1. Textbooks:**
 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). Hoshang S. Gundevia and Hare Govind Singh, 1996. Animal Behaviour, S. Chand & Co, 280pp.

Books for reference:

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.

Web references:

- <https://www.ncbs.res.in/content/animal-behaviour>
- <https://bit.ly/3i6wUxR>
- <https://www.behaviour.univie.ac.at/>

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Recall the basic concepts, historical development, and key methods used in the study of animal behavior.	K1
CO2	Explain the neurobiological, hormonal, and genetic mechanisms underlying animal behavior and provide examples of innate behaviors and fixed action patterns.	K2
CO3	Apply principles of learning and cognition to analyze different types of learning and communication in animals, and demonstrate understanding through practical observation and recording of behaviors.	K3
CO4	Analyze various ecological and evolutionary contexts of animal behaviors, such as foraging, predator-prey interactions, mating systems, and parental care strategies.	K4
CO5	Integrate knowledge of social structures, cooperation, altruism, and conflict in animals to construct models of social behavior, and synthesize information from case studies on eusocial insects and primate societies.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	1	2	2	3
CO2	2	2	2	1	2	2	3
CO3	2	2	2	1	2	2	3
CO4	2	2	2	1	2	2	3
CO5	2	2	2	1	2	2	3
Weightage							
Weighted % of Course Contribution to POs							

Strong-3 Medium-2 Low-1

Question pattern:

Section A		Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit	1 question from each unit

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OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER- ELECTIVE COURSE CODE:

BIOCHEMISTRY U23ZGE5:3

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	4	-	-	3	25	75	100

Course Contents

UNIT-I Introduction, Definition and Scope of biochemistry. Water-physical properties, Structure and role of water in life- pH and Buffers - Biological buffer systems.
UNIT-II Carbohydrates - structure and classification (with one example) - Metabolism - Glycolysis, Glycogenolysis - TCA cycle and Oxidative phosphorylation.
UNIT-III Structure and classification of aminoacids and proteins. Protein metabolism - Oxidative deamination, transamination, Decarboxylation and Transmethylation.
UNIT-IV Structure and Classification-Fattyacids and Lipids. Metabolism - β -oxidation. Structure and functions of Nucleic acids.
UNIT-V Enzymes- Classification and Characteristics. Mechanism of Enzyme action - Lock and key hypothesis. Biochemical Classification and characteristics of Hormones.

Books for reference:

- 1.JainJ.L., Sunjay Jain and Nithay Jain (2005). Fundamentals of Biochemistry. Chand Publications.
- 2.JainJ.L.(2015). Fundamentals of Biochemistry. Chand Publications.
- 3.AmbikaShanmugam (2016). Fundamental of Biochemistry for Medical students. Wolters Kluwer India, P. Ltd.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Learn and Recall fundamental concepts in biochemistry	K1
CO2	Explain the structure and classification of carbohydrates, amino acids, proteins, fatty acids, lipids, and nucleic acids, as well as the basic mechanisms of their metabolism.	K2
CO3	Apply biochemical principles to describe metabolic pathways.	K3
CO4	Analyze the roles and interactions of water, pH, and buffer systems in biological processes. Examine the structure-function relationships in biomolecules and enzymes, including the lock and key hypothesis for enzyme action.	K4
CO5	Synthesize knowledge of metabolic pathways to understand the integration and regulation of carbohydrate, protein, and lipid metabolism. Evaluate the biochemical characteristics and mechanisms of enzymes and hormones.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	1	2	2	3
CO2	2	2	2	1	2	2	3
CO3	2	2	2	1	2	2	3
CO4	2	2	2	1	2	2	3
CO5	2	2	2	1	2	2	3
Weightage							
Weighted % of Course Contribution to POs							

Strong-3 Medium-2 Low-1

Questionpattern:

SectionA	SectionB	SectionC
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit

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OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER– **ELECTIVE CODE:**

ECONOMIC ZOOLOGY

U23Z4ES:4

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	4	-	-	3	25	75	100

CourseContents

UNIT 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.

UNIT 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 vermin composting– Vermicultureunit. Harvesting of vermicompost – vermicast – advantages of vermicompost – vermishash and its applications.

UNIT 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.

UNIT 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.

Unit 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.

Text Books:

1.Sastry, N.S.R., C.K.Thomas and R.A.Singh, 2015. Livestock Production Management, 4thEd.Kalyani Publishers, New Delhi. (2)Mary violet Christy, A. 2014. Vermitechnology, MJP Publishers, Chennai.(3)ICAR, 2013. Hand book of Animal Husbandry, 4th Ed., ICAR Publication, Pusa, New Delhi. (4)Awasthi, V.B., 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers, India.

Books for reference:

1.Glenn Munroe, 2017. Manual of on-Farm vermicomposting and vermiculture, Holdanca Farms Ltd, Wallace, Nova Scotia. (2)Hanifa, M.A., 2011. Aquatic resources and aquaculture, Dominant, New Delhi. (3)Gupta, P.K., 2008. Vermicomposting for sustainable agriculture, 2nd Edition, Agrobios, India.

Web references:

- <https://bit.ly/3tXHjk8>
- <https://bit.ly/3tUTHBu>
- <https://bit.ly/3hVv96q>

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	To identify the breeds and varieties of poultry, fish, bees, and cattle and understand the basic aspects of farming.	K1
CO2	To assess and integrate the available tools and techniques to increase the productivity in farms.	K2
CO3	To analyze the pros and cons of different methods of farming and marketing strategies of products.	K3
CO4	To evaluate the use of available resources in improving the breeds, vermicomposting, farm products, etc.,	K4
CO5	To design new methods to improve farm animals with increased productivity and disease resistance and to construct new methods in vermicomposting.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	1	2	2	3
CO2	2	2	2	1	2	2	3
CO3	2	2	2	1	2	2	3
CO4	2	2	2	1	2	2	3
CO5	2	2	2	1	2	2	3
Weightage							
Weighted % of Course Contribution to POs							

Strong-3

Medium-2

Low- 1

Question pattern:

SectionA	SectionB	SectionC
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit

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OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-V **CORE COURSE - SEC**

U23ICVC

CODE: VERMICULTURE

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	2	-	-	2	25	75	100

Course Content

UNIT I:

Importance of Vermicomposting- Problems in traditional composting - Sources of organic wastes. Earthworms - General Characters, Ecological Classification - Saprophages, Geophagus, Epigeic, Endogeic and Anecic forms. Biology of Eudriluseugeniae and Eisenia foetida.

UNIT II:

Importance of Earthworm in Agriculture, Fishing, food, therapeutics and pollution control - soil organic matter decomposition - earthworms and humus formation-benefits of humus in soil.

UNIT III:

Vermiculture: Small scale, large scale. Vermicomposting - Requirements-phases - methods (Pit method, Box method, Heap method, windrow method) - collection of vermicompost - Vermiwash - Preparation and applications.

UNIT IV:

Principles of vermicomposting - Precaution - Factors affecting Vermicomposting - Advantages of vermicomposting - Role of vermicompost in organic farming.

UNIT V:

Economics of Vermicomposting - Financial supports for Vermicompost - Khadi and Village Industries Commission (KVIC) - National Bank for Agriculture and Rural Development (NABARD) - eligibility for financial support.

Text Books: 1. Edwards C.A and P.J. Bohlen (1996). Ecology of Earthworms.

3rd Edition. Chapman and Hall.

2. Ismail S.A (1970). Vermicology. The Biology of Earthworms. Orient Longman, London.

3. Lee K.E (1985). Earthworms - Their ecology and Relationship with soil and Landuse.

Academic Press. Sydney.

Books for reference:

1. Ramalingam R (2006). Manpuzhu valarppu. Tamil Nadu Higher Education Board, Chennai.

2. Edwards C.A and P.J. Bohlen (1996). Ecology of Earthworms. 3rd Edition. Chapman and Hall.

3. Ismail S.A (1970). Vermicology. The Biology of Earthworms. Orient Longman, London.

4. Lee K.E (1985). Earthworms - Their ecology and Relationship with soil and Land use. Academic Press. Sydney

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Acquire knowledge of classification and characteristics of earthworms.	K1
CO2	Understand the biology of earthworm and species selection for vermicompost	K2
CO3	Analyse the importance of traditional and modern vermicomposting	K3
CO4	Apply the knowledge of vermiculture and its vermicomposting for eco friendly practices	K4
CO5	Start a vermiculture set up and develop skills for self-employment and to get financial assistance from funding agencies.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted% of Course contribution to POs							

Very strong - 4

Strong-3

Medium-2

Low-1

Question pattern

Section A	Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)
		1 question from each unit (3X10=30)

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OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-VI **CORE COURSE -XIII**

CODE: GENETICS

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	5	-	-	5	25	75	100

Course Content

UNIT I:

Mendelian Genetics: Mendelian Laws of Inheritance –Test cross & Back Cross – Gene interaction – Incomplete dominance–Co-dominance–complementary genes, supplementary genes, Epistasis - Lethal genes , Multiple alleles –ABO blood group– Polygenic inheritance– Skin colour in man –Importance of drosophila in genetics.

UNIT II:

Linkage & Crossing Over: Linkage in Drosophila – Complete and Incomplete linkage, Linkage theories. Crossing over – Mechanism, types and theories. Chromosomal maps & its construction.

UNIT III:

Sex determination in animals – Geneic Balance theory -Sex determination in Human –Barbodies – Environmental sex determination – Bonelia
Sex linked inheritance-X linked & Y linked inheritance, Extra chromosomal inheritance – shell coiling pattern in snail.
Chromosomal disorders (Klinefelter, Turner & Down syndromes).

UNIT IV:

Mutations: Chromosomal Aberrations (Structural and numerical) - Gene Mutations– Mutagens - Physical & Chemical. Inborn errors of Metabolism: Phenyl ketonuria– Alkaptonuria–Albinism, Sickle cell anemia. Pedigree Analysis, Eugenics, Euthenics, Genetic Counselling, Inbreeding and Outbreeding.

UNIT V:

Modern Genetics: Concept of Gene – Fine structure of gene: Cistron, Muton and Recon– split gene–promoter–repetitive DNA–Transposons Operon concept Lac & trp operons(outlines). Bacterial genome- Transformation – Conjugation – F factor - Sexduction –Transduction.

Books for reference:

1. Gardner EJ Principles of genetics. London, UK, John Wiley & Sons, Inc..
2. Meyyan RPF Fundamentals of Genetics, Saras Publication Nagercoil,
3. Primrose SB, Twyman R. Principles of gene manipulation and genomics. John Sons; 2013 May 28.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Understand the mendalian laws and functions of genetic material in the living system.	K1
CO2	Understand the principles of Linkage and crossing over theories and mechanism	K2
CO3	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities	K3
CO4	Able to distinguish inborn errors and pedigree analysis lytic and lysogenic cycle, and explain the mechanisms of inbreeding and outbreeding	K4
CO5	Apply rDNA technology for the welfare of human beings.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong – 4 Strong-3 Medium-2 Low- 1
Question pattern

Section A	Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)
		1 question from each unit (3X10=30)

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DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-VI **CORE COURSE -XIV**

CODE: DEVELOPMENTAL BIOLOGY

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	5	-	-	5	25	75	100

Course Content

UNIT 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.

UNIT 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.

UNIT III:

Differentiation Organogenesis: Cell lineage, differentiation, Development of Brain and Eye in frog. Development of Nervous system in chick. Foetal membranes in chick. Placentation in Mammals.

UNIT 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

UNIT V:

Human embryology: Reproductive organs, Menstrual cycle and menopause - Pregnancy - trimesters - development. Erythroblastosis foetalis - Twins - types. Infertility - causes, Assisted Reproductive Technology (IVF, ICSI, GIFT, ZIFT) - Embryo transfer - Amniocentesis.

Text Books:

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.

Books for reference:

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.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Understand the basic theories of development of embryo and its stages	K1
CO2	Compare the formation of gametogenesis in the various Invertebrate and Vertebrates.	K2
CO3	Relate the process of fertilization with the onset of cleavage and gastrulation process.	K3
CO4	Know the basics of development of organs, functions of extra embryonic membranes and physiology of placenta.	K4
CO5	Logically view the concept infertility, birth control and applications of cryopreservation techniques.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong - 4 Strong-3 Medium-2 Low-1
Question pattern

Section A		Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)	1 question from each unit (3X10=30)

Signature

B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-VIPRACTICAL

CODE: LABORATORY TECHNIQUES IN ZOOLOGY - VI

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Practical	-	-	5	3	25	75	100

Course Content

GENETICS

1. Identification of Mendelian Traits in humans
2. Life cycle of *Drosophila Melanogaster*
3. Observation of Types of Mutations in *Drosophila*
4. Sex determination in *Drosophila Melanogaster*
5. Identification of Human Karyotypes
6. Pedigree analysis
7. Analysis of Blood group in man

Developmental Biology

1. Chick blastoderm mounting (Demonstration)
2. Observation of prepared micro slides to study the following. Frog: Egg, Cleavage, Blastula, Gastrula, Yolk Plug stage.
- Chick: Egg, Developmental stages 24, 48, 72, 96 hrs.
- Yolk sac placenta.

BIOTECHNOLOGY

1. Isolation of DNA.
- Spotters: Vectors, Polymerase Chain Reaction (PCR), Southern blotting method.

MICROBIOLOGY

1. Laboratory safety measures
2. Bacterial staining: simple staining, Gram's staining.
3. Bacterial motility by hanging drop technique.
4. Counting of bacteria by serial dilution method.

Spotters: Autoclave, Micropipette, inoculation loop,

- Dissections – Immunological Organs in fish (demonstration only).
- ABO Blood grouping.

Spotters: Immunoglobulin IgG, IgA, IgM, Lymphoid organs.

Research centres or industrial visit related Biotechnology/ Microbiology/ Genetics/ Immunology

Books for reference:

1. Vijayaraman and Palanivelu, Seimurai vilangiyal.
2. Fundamental of practical gegetics and biotechnology, Dr. Brototi Roy/Dr. Meena Yadav.
3. A manual of practical zoology, M.M. Trigunayat.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Observation of prepared slides and Understanding Mendelian traits in human and life cycle of <i>Drosophila</i> .	K1
CO2	Acquire knowledge of embryological development of chick embryos.	K2
CO3	Apply knowledge to understand the human karyotype, pedigree analysis.	K3
CO4	Reporting and justify the results of biotechnology experiments in an accurate and meaningful manner.	K4
CO5	Prepare samples and to determine Gram positive and negative bacteria and its structure.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong – 4 Strong-3 Medium-2 Low-1

Question pattern

Section - A	Section - B	Section - C	Section - D
Major Practical (25x1=25)	Minor Practical (15x1=15)	Spotters (20) (5x4=20)	Record – 10 Viva - 5

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GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS), KUMBAKONAM
DEPARTMENT OF ZOOLOGY

B.SC., ZOOLOGY

OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER- ELECTIVE CODE:

BIOTECHNOLOGY

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	5	-	-	4	25	75	100

Course Contents

UNIT-I

Biotechnology: Scope and importance. Genetic Engineering: Gene cloning: Isolation of desired DNA- insertion of DNA into vector-introducing rDNA into host - identification, selection and expression of cloned DNA. Tools - Tools of genetic engineering: Restriction endonucleases (Eco RI, Hind III, B and H1) and DNA ligases. Vectors - Plasmids - pBR322, Cosmids.

UNIT- II

Molecular probes: Blotting techniques - Southern, Northern and Western blotting PCR, DNA finger printing. Gene bank and libraries. Monoclonal Antibodies: production and uses. Stem cell technology.

UNIT-III

Basic Tools for Gene Manipulation Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics). Restriction enzymes: Nomenclature, Types. Transformation techniques: Calcium chloride method, electroporation and biolistic method. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

UNIT-IV

Advance Tools and Techniques Southern, Northern and Western blotting DNA sequencing: Sanger method, Polymerase Chain Reaction, DNA Finger Printing and DNA micro array. Genetically Modified Organisms Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection; Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.

UNIT- V

Application of biotechnology in Medicine: Gene Therapy, Vaccine production, knowledge based drug designing. Transgenic animals. Biotechnology and future: IPR and ethical concerns.

Books for reference:

1. Old and Prim Rose. Principles of Gene Manipulation. Latest Edition.
2. Balasubramania D (1996). Concepts in Biotechnology. University Press (India) Ltd., Hyde
3. Dharmarajan M (1989). Genetic Engineering. S. Viswanathan and Co.,

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Recall biotechnological methodologies for genetic engineering	K1
CO2	Develop and explain the protocols for genetically manipulating cells and produce transgenic animals	K2
CO3	Identify the correct biotechnological tools to obtain the desired products from the cells.	K3
CO4	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.	K4
CO5	To speculate on the environmental implications of animal biotechnological methods and design responsible, ethical solutions to livestock production and health issues	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	2	2	3
CO2	2	2	2	1	2	2	3
CO3	2	2	2	1	2	2	3
CO4	2	2	2	1	2	2	3
CO5	2	2	2	1	2	2	3
Weightage							
Weighted % of Course contribution to POs							

Strong-3 Medium-2 Low- 1

Question pattern:

Section A	Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit 1 question from each unit

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GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS), KUMBAKONAM
DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER- ELECTIVE CODE:

WILDLIFE CONSERVATION AND MANAGEMENT

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	5	-	-	4	25	75	100

Course Contents

Unit 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.

Unit 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.

Unit 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.

Unit 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.

Unit 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.

References

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. Dasmann R F, 1964. Wildlife Biology, John Wiley & Sons, New York, p 231.
4. Justice Kuldip Singh 1998. Handbook of Environment, Forest and Wildlife Protection Laws in India, Natraj Publishers, Dehradun.
5. Hosetti, B.B. 1997 Concepts in Wildlife Management, Daya Publishing House, Delhi.
6. Sutherland, W.J 2000. The conservation handbook: Research, Management and Policy. 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. Saharia V B, 1982. Wildlife of India, Natraj Publishers, Dehra Dun.
4. Goutam Kumar Saha and SubhenduMazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Recall the importance of wildlife	K1
CO2	Understand integrate and assess the National	K2
CO3	Analyse and differentiate threats to wildlife	K3
CO4	Explain the role PVA models	K4
CO5	Construct and simulate National and International strategies for Conservation	K5 & K6

Mapping of Course Outcomes with Pos

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	1	2	2	3
CO2	2	2	2	1	2	2	3
CO3	2	2	2	1	2	2	3
CO4	2	2	2	1	2	2	3
CO5	2	2	2	1	2	2	3
Weightage							
Weighted % of Course Contribution to POs							

Strong-3 Medium-2 Low- 1

Question pattern:

SectionA	SectionB	SectionC
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit 1 question from each unit

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DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER- ELECTIVE COURSE CODE:

IMMUNOLOGY

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	5	-	-	4	25	75	100

Course Content

UNIT I:

Immune Cells and Organs: Overview of Immune System - General concepts and Haematopoiesis. 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.

UNIT II:

Innate and Adaptive Immunity: Innate Immunity: Characteristic features, Physical, Cellular, biochemical and physiological barriers. Adaptive Immunity: Characteristic features, types: Humoral Immunity, Antigen recognition, Antigen processing & presentation, T cell B cell stimulating, Plasma cell differentiating and Antibody projection. Primary and secondary immune responses memory and class switching. Cell mediated immune response Receptors and Signaling: Cytokines and Chemokines - General Properties of Cytokines and Chemokines. Major Histocompatibility Complex (MHC) Types and structure, Human leucocyte system-Types, HLA typing and HLA matching.

UNIT III:

Antigen and Antibodies: Antigens- Antigenicity and immunogenicity: Properties - foreignness, molecular size, heterogeneity. B & T epitopes, T-dependent and T-independent B cell responses. Antibodies: Structure, function and properties of different classes Immunoglobulins, antigenic determinants on antibodies (isotype, allotype and idiotype).

UNIT 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.

UNIT 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.

Text Books: 1. Kuby, J., Punt, J., Stranford, S., Jones, P. and 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.

Books for reference: 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.

Web references:

1. <https://www.aaaai.org/>
2. <https://www.bsaci.org/>
3. <https://www.immunology.org/>

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Understand and recall the basic structural and functional components of the immune system, compare and contrast cells with respect to origin and maturation.	K1
CO2	Classify and explain types of immunity, state the significance of antigen and examine their relevance to immunizations.	K2
CO3	Describe and differentiate the biological characteristics of the antibodies, analyze and formulate the procedure for antibody production	K3
CO4	Compare and rate the mechanism of various types of hypersensitivity reactions, assess and identify the different types of autoimmune diseases.	K4
CO5	Summarize immune responses against pathogens	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong – 4 Strong-3 Medium-2 Low-1

Question pattern

Section A	Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit

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GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS), KUMBAKONAM
DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-VI **CORE COURSE-SEC**

CODE:

AQUACULTURE

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	2	-	-	2	25	75	100

Course Content

UNIT I:

Aquaculture-Importance and scope - Status of aquaculture in India, Indian Fishery resources, Fishery research institute and organizations (CMFRI, CIBA, CIFRI, CIFT) Types of farming: extensive, intensive and semi intensive culture,

UNIT II:

Types of fish culture Mono culture, Mono sex culture, Polyculture, integrated fish farming (Paddy cum fish culture, Poultry cum fish culture), induced breeding. Construction and Management of fish farm.

UNIT III:

Culture of Carpspecies -Catla, Rohu, Mirgal, grass carp, silver carp, botla and common carp, Freshwater prawn culture.

UNIT IV:

Types of feed: Live feed culture (Artemia, Azolla culture), Feeding schedule. Fish disease management: Common bacterial, Viral, Fungal, Protozoan diseases - their symptoms and treatment.

UNIT V:

Fish processing - Drying, Smoking, Canning and Freezing.

Text Books:

1. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd.
2. Santhanam, R. (1990). Fisheries Science. Daya Publishing House.
3. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi

Books for reference:

1. Bardasch J E., RYTHER and McLarrey W O (1972). Aquaculture: The farming and husbandry of Freshwater and marine organisms. Wiley inter science.
2. Jhinngan VG (1982). Fish and fisheries of Indian. Hindustan Publishing.
3. Pillai T.V.R (1995). Aquaculture principles and practices. Fishing new Books, Blackwell Science Ltd., Oxford.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Develop knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques.	K1
CO2	Apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture	K2
CO3	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations.	K3
CO4	Apply the knowledge to culture different fish species	K4
CO5	Develop skills for starting an aquaculture farm	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted % of Course contribution to POs							

Very strong - 4
Question pattern

Strong-3

Medium-2 Low-1

Section A		Section B	Section C
2 Multiple choice question from Each unit (10X1=10)	1 question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)	1 question from each unit (3X10=30)

CODE: **IMMUNOLOGY**

Course Content

UNIT 1:
Immune Cells and Organs: Overview of Immune System - General concepts and Haematopoiesis. 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.

UNIT II:
Innate and Adaptive Immunity: Innate Immunity; Characteristic features, Physical, Cellular, biochemical and physiological barriers. Adaptive Immunity: Characteristic features, types: Humoral Immunity, Antigen recognition, Antigen processing & presentation, T cell B cell stimulating, Plasma cell differentiating and Antibody projection. Primary and secondary immune responses memory and class switching. Cell mediated immune response Receptors and Signaling: Cytokines and Chemokines - General Properties of Cytokines and Chemokines. Major Histocompatibility Complex (MHC) Types and structure, Human leucocyte system-Types, HLA typing and HLA matching.

Antigen and Antibodies: Antigens- Antigenicity and immunogenicity: Properties - foreignness, molecular size, heterogeneity. B & T epitopes, T-dependent and T-independent B cell responses. Antibodies: Structure, function and properties of different classes Immunoglobulins, antigenic determinants on antibodies (isotype, allotype and idiotypic).

UNIT 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.

UNIT 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 -

Books for reference: 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.

1. <https://www.aaaai.org/>
2. <https://www.bsaci.org/>
3. <https://www.immunology.org/>

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted%ofCourse contribution to POs							

	Very strong – 4	Strong-3	Medium-2	Low-1
Question pattern				

SectionA		SectionB	SectionC
2 Multiple choice question from Each unit (10X1=10)	1question from each unit (5X2=10)	1 (a & b) question from each unit (5X5=25)	1question from each unit (3X10=30)

GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS), KUMBAKONAM
DEPARTMENT OF ZOOLOGY
B.SC., ZOOLOGY
OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM
SEMESTER-.... **...AEC-II**

CODE: ZOOLOGY FOR COMPETITIVE EXAMINATIONS

Category	Hours			Credits	Marks		
	Lecture	Tutorial	Practical		CIA	External	Total
Theory	2	-	-	2	25	75	100

Course Content

Unit I:

Cell Biology and Genetics (6 hours)

- Structure and function of prokaryotic and eukaryotic cells
- Cell organelles, cell cycle, apoptosis
- Mendelian genetics, gene interactions
- Molecular genetics: DNA replication, transcription, translation
- Chromosomal mutations, operon model

Unit II:

Animal Physiology and Biochemistry (6 hours)

- Digestive, respiratory, circulatory, excretory systems
- Muscle and nerve physiology
- Hormones and endocrine system
- Enzymes, metabolism (carbohydrate, protein, lipid)
- Thermoregulation and osmoregulation

Unit III:

Developmental Biology and Animal Diversity (6 hours)

- Gametogenesis, fertilization, cleavage, gastrulation
- Organogenesis in frog/chick
- Invertebrate and vertebrate phyla with examples
- Comparative anatomy and adaptive features
- Larval forms and metamorphosis

Unit IV:

Ecology, Evolution, and Behaviour (6 hours)

- Ecosystem types, food chains, energy flow
- Biogeochemical cycles, population and community ecology
- Theories of evolution, natural selection, Hardy-Weinberg principle
- Animal behavior and social organization
- Biodiversity conservation, IUCN categories

Unit V:

Applied Zoology and Model Question Practice (6 hours)

- Immunology basics: innate & adaptive immunity, vaccines
- Economic Zoology: sericulture, apiculture, aquaculture
- Parasitology: vectors and diseases (malaria, filariasis, etc.)

Books for reference:

- Trueman's Objective Biology – M.P. Tyagi
- Dinesh Objective Zoology
- NCERT Biology (XI & XII)
- CSIR-NET/GATE Previous Year Question Papers
- NTA & ICAR model tests
- Online platforms: NPTEL, Examrace, Unacademy, etc.

Course Outcomes : On completion of the course, students will be able to:		Level
CO1	Recall key facts, terms, and processes in core zoology topics	K1
CO2	Understand interrelationships and functions of biological systems	K2
CO3	Apply learned knowledge to solve MCQs and problem-based questions.	K3
CO4	Analyze and compare patterns across animal diversity and physiology.	K4
CO5	Evaluate and select correct answers under timed conditions.	K5 & K6

Mapping of Course Outcomes with Pos

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	4	4	4	4	4	4
CO2	4	3	3	3	4	3	3
CO3	4	3	3	3	3	3	4
CO4	4	4	4	4	4	3	4
CO5	4	4	4	4	3	4	4
Weightage							
Weighted% of Course contribution to POs							

Very strong – 4 Strong-3 Medium-2 Low-1
Question pattern: MCQs

Component	Weightage
Unit-wise MCQ Assignments	25%
End Semester Exam (Full syllabus)	75%