

ದಾವಣಗರೆ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

ಸಂಯೋಜನಾಧಿಕಾರಿಗಳು,
ಪ್ರಾಣಿಶಾಸ್ತ್ರ ಅಧ್ಯಯನ ವಿಭಾಗ,
ದಾವಣಗರೇ ವಿಶ್ವವಿದ್ಯಾಲಯ,
ಶಿವಗಂಗೋತಿ, ದಾವಣಗರೇ-577007

ಸಂಖ್ಯೆ:ದಾವಿದಾಳಿ:ಪ್ರಾಳಿ:2024-25/ 594

ದಿನಾಂಕ:24.10.2024

ಗೆ,
ಮಾನ್ಯ ಕುಲಸಚಿವರು,
ಆಡಳಿತ ವಿಭಾಗ.
ದಾವಣಗರೆ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ,
ಶಿವಗಂಗೋತ್ತಿ, ದಾವಣಗರೆ-577007.

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3d 01/2023

ಮೂಲಕ,
ಡೀನರು
ವಿಜಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ ನಿಕಾಯ
ದಾವಣಗರೆ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ,
ಶಿವಗಂಗೋಡಿ, ದಾವಣಗರೆ-577007.

ಮಾನ್ಯರೇ,
ವಿಷಯ: ಸ್ವಾತಕೋತ್ತರ ಪ್ರಾಣಿಶಾಸ್ತ ಅಧ್ಯಯನ ವಿಭಾಗದಿಂದ ಪದವಿ ಪಿ.ಎ. ಬಿ.ಎ.ಸ್.-
ನಡಾವಳಿಗಳನ್ನು ಮತ್ತು ನೇರೀಕರಿಸಿದ ಪರ್ಕೆಮವನ್ನು ಕಳುಹಿಸುತ್ತಿರುವ ಕುರಿತು.

ಮೇಲ್ಕುಂಡ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ, ದಾವಣಗೆರೆ ವಿಶ್ವವಿದ್ಯಾನ್ಯಾಲಯ, ಸಾತ್ವಕೋತ್ತರ ಪ್ರಾಣಿಶಾಸ್ತ್ರ ಅಧ್ಯಯನ ವಿಭಾಗದಲ್ಲಿ, ದಿನಾಂಕ: 16.10.2024ರಂದು ಅಧ್ಯಯನ ಮಂಡಳಿ ಸಭೆಯನ್ನು (BOS) ನಡೆಸಲಾಯಿತು, ಸದರಿ ಸಭೆಯ ನಡಾವಳಿಗಳನ್ನು ಮತ್ತು ಪಿ.ಜಿ. ನರ್ವಿಕರಿಸಿದ ಪರ್ಯಾಕ್ರಮವನ್ನು ಡಿನರು, ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ ನಿರ್ಕಾಯ ಇವರ ಮುಖಾಂತರ ಮುಂದಿನ ಸೂಕ್ತ ಕ್ರಮಕ್ಕಾಗಿ ಈ ಪತ್ರದೊಂದಿಗೆ ಲಗತ್ತಿಸಿ ತಮ್ಮುದ್ದಿಗೆ ಕಳುಹಿಸಲಾಗಿದೆ.

ವಂದನೆಗಳೊಂದಿಗೆ,

S. S. J.
Department of Zoology
DAVANGERE UNIVERSITY
Savagangotri, Davangere

DEPARTMENT OF STUDIES IN ZOOLOGY

DAVANGERE UNIVERSITY, DAVANGERE



Syllabus

For

MASTER OF SCIENCE IN ZOOLOGY

Under Choice Based Credit System

2024-2025

Dr. U.S. MAHABALESHWAR
M.Sc., M.Phil., Ph.D.
Professor & Dean, Science & Technology
Davangere University, Shivagangotri,
Davangere-574 007, Karnataka, India.

30/10/2024
Registrar
Davangere University
Shivagangotri, Davangere.



DAVAGERE UNIVERSITY

DEPARTMENT OF STUDIES IN ZOOLOGY, SHIVGANGOTRI-07

Prof. K Vijayakumar
BOS (PG), Chairman

No: DU:ZOO:2024-25/

Date: 16.10.2024

Proceedings of the meeting of Board of Studies in Zoology (PG) held on 16th October 2024 at department of Studies in Zoology, Davangere University, Shivagangotri, Davangere.

Members Present:

1. Prof. K Vijayakumar
Professor,
Department of Studies in Zoology
Gulbarga University
Kalaburagi
2. Prof. David
Professor
Department of Studies in Zoology
Karnataka University
Dharwad.
3. Dr. Sreenivasa G
Assistant Professor
Department of Studies in Zoology
Davangere University
Davangere
4. Dr. Ambarisha Chabbi
Assistant Professor
Department of Studies in Zoology
Davangere University
Davangere

Signature

BOS Chairman

PG BOS meeting was held on 16.10.2024, Prof. K Vijayakumar, chairman, BOS in Zoology, welcomed the board members through online and briefed the agenda of the meeting regarding the Program structure and syllabus for Zoology PG, Davangere University, CBCS scheme. Internal BOS members Dr Sreenivasa.G and Dr Ambarisha Chabbi along with External BOS member Prof. David has attended the meeting.

Agenda:

1. The BOS discussed thoroughly and approved the revised/ updated syllabus for M.Sc. Zoology, Course of I to IV semester.
2. The board has given approval for the syllabus of additional open elective course along with preexisting OE for third semester, PG Students Davangere University.
3. The board has updated/ revised the syllabus and resolved to approve the syllabus.



Signature

BOS Chairman
Chairman
PGBOS in Zoology
Davanagere University

M.Sc. Zoology (CBCS) Course Structure (2024-2025)

Semester	Subject/Paper Code	Title of the Paper	Instruction Hrs./week	Marks			Credits	Examination duration (Hrs.)	
				Examination	Internal Assessment	Total Marks			
THEORY PAPERS									
SEMESTER-I	ZOO 1.1	Animal Systematics and Biology of Non-Chordates	4	70	30	100	4	3	
	ZOO 1.2	Advanced Cell Biology	4	70	30	100	4	3	
	ZOO 1.3	Basic and Applied Entomology	4	70	30	100	4	3	
	ZOO 1.4	Biochemistry and Instrumentation	4	70	30	100	4	3	
PRACTICAL PAPERS									
	ZOO 1.5	Animal Systematics and Biology of Non-Chordates	4	40	10	50	2	3	
	ZOO 1.6	Advanced Cell Biology	4	40	10	50	2	3	
	ZOO 1.7	Basic and applied Entomology	4	40	10	50	2	3	
	ZOO 1.8	Biochemistry and Instrumentation	4	40	10	50	2	3	
Mandatory Credits: English Language Communication Skills									
SEMESTER-II	THEORY PAPERS								
	ZOO 2.1	Biology of Chordates	4	70	30	100	4	3	
	ZOO 2.2	Genetics and Molecular Biology	4	70	30	100	4	3	
	ZOO 2.3	Developmental Biology	4	70	30	100	4	3	
	ZOO 2.4	Animal Physiology	4	70	30	100	4	3	
	PRACTICAL PAPERS								
	ZOO 2.5	Biology of Chordates	4	40	10	50	2	3	
	ZOO 2.6	Genetics and Biostatistics	4	40	10	50	2	3	
SEMESTER-III	ZOO 2.7	Developmental Biology	4	40	10	50	2	3	
	ZOO 2.8	Animal Physiology	4	40	10	50	2	3	
	Mandatory Credits: Computer Skills								
	THEORY PAPERS								
	ZOO 3.1	Animal Biotechnology	4	70	30	100	4	3	
	ZOO 3.2	Parasitology and Immunology	4	70	30	100	4	3	
	ZOO 3.3	Evolutionary Biology and Ethology	4	70	30	100	4	3	
	ZOO 3.4	Applied Zoology	4	70	30	100	4	3	
	ZOO 3.5	A: Economic Zoology/ B: Human Genetics / C: Reproductive Biology D: Entomology (OPEN ELECTIVE)	2	40	10	50	2	2	
	PRACTICAL PAPERS								
	ZOO 3.6	Animal Biotechnology	4	40	10	50	2	3	
	ZOO 3.7	Parasitology and Immunology	4	40	10	50	2	3	
SEMESTER-IV	ZOO 3.8	Evolutionary Biology and Ethology	4	40	10	50	2	3	
	ZOO 3.9	Applied Zoology	4	40	10	50	2	3	
	THEORY PAPERS & PROJECT WORK/DISSESSATION								
	ZOO 4.1	Endocrinology and Biology of Reproduction	4	70	30	100	4	3	
	ZOO 4.2	Environmental Biology	4	70	30	100	4	3	
	ZOO 4.3	Biodiversity, conservation and	4	70	30	100	4	3	


Dr. U.S. MAHABALESHWAR

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	Biostatistics						
ZOO 4.4	Project Work/Dissertation	6	70	30	100	6	3
PRACTICAL PAPERS & STUDY TOUR/FIELD VISIT							
ZOO 4.5	Endocrinology and Biology of Reproduction	4	40	10	50	2	3
ZOO 4.6	Environmental Biology	4	40	10	50	2	3
ZOO 4.7	Biodiversity and conservation	4	40	10	50	2	3
Study Tour/Field Visit		-	-	-	-	2	-
Mandatory Credits: Personality Development		2	-	-	-	2400	100
Total Credits for the Course		134	-	-	-	-	-

Co-ordinator
Department of Zoology
DAVANGERE UNIVERSITY
Shivagangotri, Davangere

Dr. U.S. MAHABALESHWAR
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ZOO 1.1 Animal Systematics and Biology of Non-Chordates

64 hours

Unit I: 16 Hours
Principles of Zoological classification: The species category. Polytypic species, population systematics and infra specific categories. Theories of Biological classification and their history. Hierarchy of categories and the Higher Taxa. Methods of zoological classification: Taxonomic collections and the process of identification, preservation and their classification (terrestrial and aquatic specimens).

Unit II: 16 Hours
Principles and application of Zoological Nomenclature: The rules of Zoological nomenclature. Interpretation of the rules of nomenclature. Taxonomic keys and challenges in taxonomy. Curating: types and cataloguing. Curator's diary. Taxonomic tissue and molecular material labelling, barcoding.

Unit III: 16 Hours
Non-Chordates: Evolution, organisation and significance of Coelom. Acoelomates, Pseudocoelomates and Coelomates. Protostomia and Deuterostomia. Locomotion in: Protozoa, Coelenterates, Annelida Nematoda, Arthropoda, Mollusca and Echinodermata. Filter feeding in: Polychaetes, Molluscans, Crustaceans and Echinoderms. Respiratory organs, pigments and their functions among invertebrates: gills, book lungs, trachea, and lungs. Excretory organs and their functions among invertebrates: Flame cells, nephridia, coxal glands, green glands and Malpighian tubules.

Unit IV: 16 Hours
Circulation and body fluids: Patterns of circulation and functions of body fluids. Nervous system: Primitive nervous system in Cnidaria and Echinoderms, advanced nervous system in Annelida, Arthropoda and Mollusca. Reproduction: Patterns of reproduction among non-chordates. Larval forms and their evolutionary significance. Minor phyla- Characteristics of Sipunculid Chaetognath and Ctenophore and their evolutionary significance.

References:

1. Barnes, R.D. *Invertebrates Zoology*. HInd Saunders, Philadelphia, 1968.
2. Barrington, E.J.W. *Invertebrates structure and Function*. Nelson, London, 1967.
3. Barrington, E. J. W. *Structure and Function of Invertebrates*. ELBS, 1971
4. Hyman, L.H. *The Invertebrates*. Vol. I-VI. McGraw-Hill, New York, 1940-67.
5. Mayr, E. *Principles of Systematic Zoology*. Tata-McGraw-Hill, New Delhi, 1997.
6. Mayr, E. and Ashlock, P. D. *Principles of Systematic Zoology*. 2nd Edition, McGraw-Hill, 1991
7. Kapoor, V.C. *Theory of Animal Taxonomy*. Oxford IBH Co. Pvt. Ltd, New Delhi, 1998.
8. Marshall, A.J. and Williums W.D. (Eds). *Text book of Zoology- Invertebrates*. VII Ed. Vol. I ALTBS Publications, 1995.
9. Russel Hunter, W.D. *Biology of Lower Invertebrates*. Macmillan Company, New York, 1968.
10. Simpson, G.G. *Principles of Animal taxonomy*. Columbia University Press, New York, 1961.

ZOO 1.2 Advanced Cell Biology

64 hours

Unit I: 16 Hours

Discovery, Theories and basic properties of cell. Prokaryotic and eukaryotic cells. Visualizing cells: Principles and applications - light microscope, phase-contrast microscope, fluorescent microscope, laser scanning confocal microscope, scanning and transmission electron microscope (SEM and TEM). Cell staining techniques, Cell fractionation and cell differentiation, Cell junctions and Cell adhesion molecules.

Unit II: 16 Hours

Cellular membranes: A brief history of studies on plasma membrane structure, composition and functions of membrane, membrane proteins. Membrane transport mechanisms, Receptor mediated endocytosis and transcytosis,

Endoplasmic reticulum (ER): Origin, composition, structure and types of ER. Mechanism of protein secretion, transportation and Export of proteins in ER.

Golgi complex (GC): Ultrastructure, protein glycosylation, lipid and polysaccharide metabolism, protein sorting and export from the Golgi.

Lysosomes: Structure and functions of lysosome, mechanism of lysosomal enzyme transport.

Unit III: 16 Hours

Mitochondria: Ultrastructure, mechanism of synthesis and transport of proteins into mitochondria, electron transport chain and electron transport complexes, mechanism of ATP synthesis, Mitchell's hypothesis, peroxisomes.

Nucleus: Structure of nuclear envelope, nuclear pore complex (NPC), nuclear export and import of proteins. Structure and function of nucleolus.

Cytoskeleton: Ultrastructure and function of different cytoskeleton, cytoskeleton assembly and regulation of cytoskeleton filament, structure and dynamics of ciliary and flagellar movement.

Unit IV: 16 Hours

Cell Cycle: Molecular mechanism of cell cycle and its regulation in eukaryotes, Regulatory molecules during cell cycle-Cyclins and Cyclin dependent protein kinases (CDKs), Cytostatic factor (CSF). Cell aging and causes of aging, telomeres and aging, Apoptosis.

Cancer Biology: Characteristics, Types, properties and causes of cancer; oncogenes, tumor viruses, tumor suppressor genes. Prevention and treatment of cancer.

References:

1. Alberts, B. A. Jhonson, J. Lewis, M. Raff, M. Roberts, K. and Walter, P. *Molecular Biology of the cell*. V Ed. Garland Science, New York. 2008.
2. Alberts, B. Dennis, B. Julian, L. Martin, R. Roberts K. and Watson J.D. *Molecular biology of Cell*. Garland publishing Inc. New York, 1994.
3. Brachet, J. *Molecular Cytology*, Academic Press, New York, 1985.
4. Cellis, J.E. *Cell Biology. A Laboratory hand book* Vol. I and II. Academic Press, 1998.
5. Cooper, G.M. and Hausman, R.E. *The Cell – A Molecular Approach*. ASM Press, 2004.
6. Furukawa, R., and M. Fechheimer. *The structure, function and assembly of actin filament bundles*. Int. Rev. Cytol. 175: 29-90. 1997.
7. Lodish, H., A. Berk, C.A Kaiser, M.P. Scott, A Bretscher, H. Ploegh, P. Matsudaira. VI Ed. *Molecular Cell Biology*. W. H. Freeman and Co., New York, 2008.
8. Malacinski, G.M. and Freifelder D. *Essentials of Molecular Biology* III Ed. Jones and Bartlett Publishers, 1998.
9. Pollard, T. D. and Earnshaw, W. C. *Cell Biology*. Saunders, 2002
10. Wolfe, A. *Chromatin: Structure and function*. Academic Press, N. Y. 1995

ZOO 1.3 Basic and Applied Entomology

64 Hours

Unit I:

16 Hours

Introduction to Entomology: History, Scope, importance. Evolution of insects, Classification and general characters of Superclass Hexapoda, Systematic position and classification of insects up to orders. Distinguishing characters, general biology, habits and habitats of insect orders and economically important families contained in them. Methods of insect collection and preservation. Organization of insect body: Body wall structure, cuticular outgrowths, coloration and special integumentary structures in insects, body tagmata, sclerites and segmentation.

Unit II:

16 Hours

Insect Head: Structure and modification; antenna, eyes, mouthparts. neck sclerites. Insect Thorax: Structure, areas and sutures of tergum, sternum and pleuron. Areas and sutures of tergum, pterothorax. Wings: Structure and modifications, venation, wing coupling apparatus; Legs: structure and modifications. Insect Abdomen: Segmentation and appendages; Genitalia. Sense organs in insects (mechano-, photo- and chemoreceptors).

Insect Physiology: Physiology of integument, moulting, growth (embryonic and post-embryonic development), metamorphosis in insects.

Unit III:

16 Hours

Structure and function of Digestive system, Respiratory system, Excretory system, Nervous system, Circulatory system, Secretory (Endocrine and Exocrine glands) system. Bioluminescence in insects.

Forensic Entomology: Forensically important insects, use/role of insects in medico-criminal investigations

Applied Entomology: Economically important insects and their products. Pests: Definition, categories, causes for insects assuming pest status, origin of pest, causes for outbreak, economic damage.

Unit IV:

16 Hours

Agricultural Entomology: General account (importance, seasonal history, biology, nature of damage, symptoms and management) of the pests of cereals, pulses, oilseeds, fibre and stored grain pests. General account (importance, seasonal history, biology, nature of damage and symptoms) of the pests of vegetables, fruits and plantation crops.

Pest management: Different phases of pest control, (Cultural, Mechanical, Quarantine, Physical, Chemical, Biological control, Genetic and Biotechnological methods) in pest control. Integrated pest management with suitable examples.

References:

1. Chapman RF. 1998. *Insects: Structure and Function*. ELBS Ed., London.
2. Duntson PA. 2004. *The Insects: Structure, Function and Biodiversity*. Kalyani Publ., New Delhi.
3. Evans JW. 2004. *Outlines of Agricultural Entomology*. Asiatic Publ., New Delhi.
4. Gullan, P.J. and Cranston, P.S. 2000. *The Insects: An Outline of Entomology*. 2nd Ed. Blackwell Science, U.K.
5. Kerkut GA & Gilbert LI. 1985. *Comprehensive Insect Physiology, Biochemistry and Pharmacology*. Vols. IXIII. Pergamon Press, New York.
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8. Richards OW & Davies RG. 1977. *Imm's General Text Book of Entomology*. 10th Ed. Chapman & Hall, London.
9. Saxena RC & Srivastava RC. 2007. *Entomology: At a Glance*. Agrotech Publ. Academy, Jodhpur.
10. Snodgrass RE. 1993. *Principles of Insect Morphology*. Cornell Univ. Press, Ithaca.
11. Wigglesworth VB. 1984. *Insect Physiology*. 8th Ed. Chapman & Hall, New York.

ZOO 1.4 Biochemistry and Instrumentation

64 Hours

Unit I:

16 Hours

Scope and principles of biochemistry. Atoms, Molecules, Orbitals. Chemical bonds-Covalent bond, ionic bond, hydrogen bond. Hydrophobic and Van der Waals interaction. Principle of biophysical chemistry: pH, buffer, thermodynamic principles, molarity, normality of solutions.

Structure and composition of biomolecules: Carbohydrates – classification, physical, chemical and biological properties of carbohydrates, sugar derivatives, configuration, stereoisomers, chair and boat shaped configuration.

Unit II:

16 Hours

Proteins - classification, physical, chemical and biological properties of proteins, biological values of proteins. Structural organization of proteins: Ramachandran plot and Christian Anfinsen's experiment. Protein folding and misfolding.

Lipids and enzymes: Classification, structure and properties of fatty acids. Biosynthesis of lipids and steroids. Beta oxidation, bile salts and bile pigments, ketone bodies. Enzymes: Classification, kinetics, inhibition, factors affecting enzyme activity. Coenzymes, isoenzymes and abzymes. Clinical applications of enzymes.

Unit III:

16 Hours

Nucleic acids and Vitamins: Classification, chemical composition and structural organization of RNA and DNA. Types of RNA and DNA. Biosynthesis of Purines and Pyrimidines.

Vitamins and Minerals: Classification of vitamins, Biological importance of Vitamins. Deficiency symptoms of vitamins, Macro and trace elements in nutrition.

Unit IV:

16 Hours

Chromatography: Principles, types and application of chromatography, Spectrophotometry: Principles, types and application. (UV spectrophotometer, Calorimeter), Principles and applications- Flow Cytometry Radiolabelling Immune Assay (RIA), ELISA, FISH, PCR, Electrophoresis. Microtomy and Cryostat microtomy.

References:

1. Berg, J.M. Tymoczko, J.L. Stryer, L. and Gatto, G.J. *Biochemistry*. IX Ed. Kate Ahr Parker Publishers, W.H. Freeman company, 41 Madison Avenue, New York. 2012.
2. Conn, E.E. Stumpf, P.F. Bruening, G. and Dooi, R.H. *Outlines of Biochemistry*. John Wiley and Sons, Singapore, 1995.
3. Garrett, R.H. and Grisham, C.M. *Biochemistry*. Saunders college publishing, Florida, 1995.
4. Satyanaraya, U. and Chakrapany, U. *Biochemistry*. III Ed. Arunabha Sen, Books and Allied, pvt. Ltd. Kolkata, 2007.
5. Voet, D. and Voet, G.J. *Biochemistry*. IV Ed. VP and publisher, United States of America, 20011.
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7. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., *Molecular Cell Biology*, 7th ed., W.H. Freeman & Company (New York). 2013
8. Garret, R. H. and Grisham, C.M., *Biochemistry* (2010) 4th ed., Cengage Learning (Boston)
9. Voet, D.J., Voet, J.G. and Pratt, C.W., *Principles of Biochemistry*, 3rd ed., John Wiley & Sons, Inc. (New York), 2008

ZOO 2.1 Biology of Chordates

64 Hours

Unit I: 16 Hours

Protochordates and Chordates: Introduction, general characters, organization, unique features and classification of chordates. Origin and evolution of Chordates. Different theories of Chordate origin. Phylogeny, Systematic position and General organization of Urochordata and Cephalochordata. Significance of retrogressive metamorphosis. Affinities to Chordate.

Vertebrates: Origin and evolution of Vertebrates. Distinctive character and classification of Agnatha and Gnathostomata. Cyclostomes, Ostracoderms and Placoderms. Adaptive radiations in Chondrichthyes – Elasmobranchs and Holocephalians. Acanthodians, Adaptive radiations in Osteichthyes –Actinopterygians and Sarcopterygians. Aquatic adaptations and migration in fishes, sensory organs in fish.

Unit II: 16 Hours

Herps: Origin, evolution and adaptive radiations in Amphibians. Stegocephalians- Ichthyostega and Acanthostega and Labyrinthodonts, Neoteny: Types and significance. Distinctive characters of Salamanders and Caecilians. Origin, evolution and adaptive radiations in Reptiles. Stem Reptiles, Amphibious adaptation of Reptiles and Extinction of Mesozoic reptiles.

Aves: Origin and evolution and adaptive radiations of Birds. Distinctive characters and classification of birds. Aerial adaptations, Mechanism of flight. Courtship and breeding behavior, Migration in birds. Aquatic/amphibious birds, flightless birds.

Unit III: 16 Hours

Mammals: Origin, evolution and adaptive radiations of Mammals: Prototherians, Eutherians and Placental Mammals. Old World monkeys. Volant and aquatic adaptations in mammals. Migration, dentition in mammals. Phylogenetic relationship and parental care among vertebrates: Pisces, Amphibians, Reptiles, Aves and Mammals.

Unit IV: 16 Hours

Comparative anatomy and osteology: Integument and its derivatives, dermal and epidermal derivatives. Comparative anatomy of heart, aortic arches, brain and kidney in vertebrates.

Osteology: Axial and appendicular skeletal system in humans.

References:

1. Marshall, A.J. and Williams W.D. (Ed). *Text Book of Zoology: Vertebrates-VII* (Ed.) Vol. II AITBS Publishers and Distributors, 1995.
2. McFarland, W.N. Harvey Pough, F. and Heiser, J.B. *Vertebrate Life*. Collier-Macmillan Publishers, London, 1979.
3. Pough, H.F. Heiser, J.B. and McFarland, W.N. *Vertebrate Life*. IV Ed. Prentice-hall of India, Pvt. Ltd, New Delhi, 1999
4. Pough, F.H. Janis, C.M. & Heiser, J.B. *Vertebrate Life*. Pearson Education, Inc., 2002
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6. Romer, A.S. and Parsons, T.S. *The Vertebrates Body*. Saunders, Philadelphia, 1986
7. Young, J.Z. *The Life of Vertebrates*. III Ed. Clarendon Press, Oxford, 1981.
8. Kotpal RL; Modern Textbook of Zoology –Vertebrates; Rastogi Publications - Meerut; 2016 edition.
9. Tiwari SK., *Fundamentals of World Zoogeography*, Sarup & Sons , 2006.

ZOO 2.2 Genetics and Molecular Biology

64 Hours

Unit I: 16 Hours

Overview of Mendel's principles, Incomplete dominance, Codominance, Interaction of genes (Epistasis, Suppressors), Lethal alleles, Penetrance and Expressivity, Pleiotropy, Phenocopy, Multifactorial and Polygenic inheritance, Inheritance of Autosomal and Sex chromosomal traits. Giant Chromosomes- Polytene and Lampbrush chromosomes.

Structural Aberrations in Chromosomes- Deletion, Duplication, Inversion and Translocation. Numerical aberrations in chromosomes - Polyploidy and Aneuploidy. Gene mutations, transposable genetic elements; Linkage maps. Genome imprinting, Multifactorial and Polygenic inheritance.

Unit II: 16 Hours

Fine Structure of the gene: Classical concept. Studies in Bar eye and Lozenge loci in Drosophila. Benzer's work on rII locus in T4 phages. The concept of Cistron, Recon and Muton. Extra chromosomal inheritance: Mitochondrial and Cytoplasmic inheritance, Examples: Chlamydomonas, Neurospora, Paramoecium, Yeast and Drosophila.

Genetic disorders: Chromosomal disorders (Autosomal and Sex chromosomal). Epigenetics.

Unit III: 16 Hours

DNA structure and functions: DNA as the hereditary material-Experiments; Watson - Crick Model and alternative models of DNA; Replication-Models of replication, Enzymology and mechanism of DNA replication in prokaryotes and Eukaryotes, DNA damage and repair mechanisms, Recombination: Types of recombination. Transcription- Mechanism of transcription in prokaryotes and eukaryotes, Post-transcriptional modifications; Translation- Mechanism of protein synthesis and post-translational modifications; Regulation on gene expression in eukaryotes- cis and trans regulation, genetic code and codon.

Unit IV: 16 Hours

Human karyotyping, International System for Human Cytogenomic Nomenclature (ISCN), Karyotype and Idiogram- Pedigree analysis. Genetic Counselling and Genetic Screening- Amniocentesis, Chorionic Villus Sampling and Cardocentesis. Chromosome banding techniques. Bioinformatics: Introduction to Database its types, Biological Database and its types, significance- Nucleic acid databases, Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: Structure databases.

References:

1. Gardner, E. J. Simmons, M. J. and Snustad, D.P. *Principles of Genetics*. John Wiley & Sons. INC. New York. 1991.
2. Griffiths, A. J. F., Muller, H. J., Suzuki, D. T., Lewontin, R. C. and Gelbart, W. M. *An introduction to genetic analysis*. W. H. Freeman. New York, 2000.
3. Lewin, B. *Genes VIII*. OxfordUniversity Press. Oxford, 2003
4. Lodish, H., A. Berk, C.A Kaiser, M.P. Scott, A Bretscher, H. Ploegh, P. Matsudaira. VI Ed. *Molecular Cell Biology*. W. H. Freeman and Co., New York, 2008.
5. Miglani, G. S. *Advanced Genetics*. Narosa Publishing House, New Delhi, 2002
6. Simmons, S. *Principles of genetics*, IV Ed. John Wiley and Sons (Asia) Pvt. Ltd. New Jersey. 2006.
7. Strickberger, M. W. *Genetics*. Mac Millan Publishing Co. New York, 2000
8. Tamarin, R H. *Principles of Genetics*. McGraw-Hill, 2009.
9. Klug, W.S., Cummings, M.R., Spencer, C.A. *Concepts of Genetics*. X Edition. 2021.
10. Fletcher H. and Hickey I. *Genetics*. IV Edition. GS, Taylor and Francis Group, New York and London., 2015.

ZOO 2.3 Developmental Biology

64 Hours

Unit I: 16 Hours

Issues in developmental biology, mechanisms regulating developmental process, multicellularity: The evolution of differentiation. Developmental patterns among metazoans, developmental mechanism of cell specification, morphogenesis and cell adhesion, morphogenetic movements and selective affinities of cells in frog. Nucleo-cytoplasmic interactions during development in amoeba and frog.

Fertilization- Structure of gametes, egg and sperm recognition, sperm capacitation, fusion, strategies for monospermy and conservation of species, Egg activation, Biochemical changes during fertilization. prevention of Polyspermy, rearrangement of cytoplasm in frogs egg, sex determination in slipper snail (Crepidula fornicate), Drosophila, Reptiles and Mammals.

Unit II: 16 Hours

The embryological origins of the gene theory, genomic equivalence, methylation pattern and control of gene expression, determination of primary body axis in Drosophila - anterior/posterior, terminal group genes, dorso/ventral axis, segmentation genes (gap genes, pair-rule genes, segment polarity genes in Drosophila. Homeotic selector genes in flies, mammals (Hox code), left-right axis in mammals.

Induction and competence, paracrine factors, cell surface receptors and their signal transduction pathways (RTK, Smad and JAK-STAT pathways), cell death pathways, neural tube, neuronal types, the neural crest, axonal specificity and pathfinding (attractants and repulsive signals), somite's and their derivatives.

Unit III: 16 Hours

Molecular mechanism of ecdysone action, Molecular responses to thyroid hormone during metamorphosis in Amphibians, blastema formation and differentiation during regeneration, genetic mechanisms-heterotopy, heterochrony, heterometry, heterotypy, homologous genetic pathways of development. Regeneration in Hydra, Planaria and Salamander. Cellular choice between apoptosis and differentiation.

Unit IV: 16 Hours

Environmental disruption of normal development- Dosage compensation, the environmental basis of human anomalies - Teratogenic agents and their assault on human development (alcohol, retinoic acid, thalidomide, endocrine disruptors), developmental symbiosis, embryonic diapause, phenotypic plasticity (Polyphenism - nutritional, seasonal, predator induced polyphenism).

References:

1. Alberts, B, Johnson, A. Lewis, J. Roff, M. Roberts, K. and Walter. P. *Molecular Biology of the Cell*. IV Ed. Garland Science, New York, 2002.
2. Gilbert, S. F. *Developmental Biology*. John Wiley Publishing, 2003.
3. Graur, D. and W.H. *Fundamentals of molecular evolution*. Sinauer Associate, 2000.
4. Lodish, H., A. Berk, C.A Kaiser, M.P. Scott, A Bretscher, H. Ploegh, P. Matsudaira. VI Ed. *Molecular Cell Biology*. W. H. Freeman and Co., New York, 2008.
5. Subramoniam, T. *Developmental Biology*. Narosa Publishing House, 2002.
6. Twyman, R. M. Instant Notes: *Developmental Biology*. Bios Scientific Publishers Ltd, 2001.
7. Lewis Wolpert. *Principles of Development*. II Edition, Oxford University Press, 2010.
8. Kalthoff. *Analysis of Biological Development*, II Edition, McGraw-Hill Publishers 2008.

ZOO 2.4 Animal Physiology

64 Hours

Unit I: 16 Hours
Central themes in animal physiology. Acclimatization. Feedback mechanisms in homeostasis: negative and positive. Osmotic regulation: Osmoregulators and osmoconformers; osmoregulation in fresh water, marine water and terrestrial environments; challenges to change in salinity. Excretion: Structure and basic mechanisms of kidney function. Thermoregulation in ectotherms, heterotherms and endotherms. Specialized metabolic states: Dormancy- sleep, torpor, hibernation and estivation.

Unit II: 16 Hours
Physiology of digestion and absorption of carbohydrate, protein and fat in gastrointestinal tract. Gastrointestinal secretions and hormones. Energy metabolism: Metabolic rate and its measurement; standard metabolic rate and basal metabolic rate.
Respiration: Gaseous exchange in water: Gills; gaseous exchange in air: Lungs (mammals and birds) and tracheal systems; air breathing fishes; Respiration in eggs; neural regulation of breathing; oxygen and carbon dioxide transfer in blood: Oxygen dissociation curves; facilitated diffusion; acid-base physiology.

Unit III: 16 Hours
Circulation: General plan of circulatory system; the heart; hemodynamics; the peripheral circulation; regulation of circulation; cardiovascular response to extreme conditions.
Muscles and movement: Physiologic anatomy of the striated muscle, structure and role of contractile proteins – actin, myosin, troponin, tropomyosin. Molecular mechanism of muscle contraction. Transmission at the neuromuscular junction.
General properties of sensory reception; chemical senses; mechanoreceptor; electoreception; thermoreception; vision; limitations of sensory reception.

Unit IV: 16 Hours
Nervous system and sensing of environment: Overview of neuronal structure, function and organization; Initiation and propagation of action potential; transmission of information within a single neuron and between neurons; electric and chemical synapses; presynaptic and postsynaptic mechanisms; neurotransmitters.
Overview on physiological disorders: Diabetes (type I and II), Asthma, Cystic fibrosis, mesothelioma, hypertension, aneurysm, thrombosis, ADHD, dementia and geriatric mental health, epilepsy, Alzheimer, Parkinson's disorder. 16 Hours

References:

1. Eckert, R. and Randall, D. *Animal Physiology*: Surjeet publications New Delhi, 1982
2. Guyton A.C, Hall J.E. *Text book Of Medical Physiology*. Philadelphia, PA : Elsevier, 13th Ed, 2016.
3. Hoar, W.S. *General and Comparative Animal Physiology*. Prentice Hall Inc., New Delhi, 1983
4. Neilson, K.S. *Animal Physiology: Adaptation and Environment*. IV Ed. Cambridge University Press, 1995.
5. Pestonjee, D.M. *Stress and Coping*, Sage Publications, London, 1999.
6. Poole, M.C., Pilkey, Grant and Johnson E.C. *Biology in Action*, Harcourt Brace, Canada, 1995.
7. Prakash, M. and Arora, C.K. *Encyclopedia of Animal Physiology*, Anmol Publications New Delhi, 1998.
8. Randall, D., Burggren, W and French, K. *Animal Physiology*. W.H. Freeman and Co., New York, 1997.

Zoo 3.1 Animal Biotechnology

64 Hours

Unit I:	16 Hours
Concept, scope and application of biotechnology. Animal cell culture: History and developments of tissue culture, laboratory facilities required for animal cell culture, aseptic handling, Growth media and its composition, growth regulators and growth factors, Types of cell culture techniques. Maintenance and preservation of cell cultures.	
Unit II:	16 Hours
Genetic engineering: Definition and scope, Tools of genetic engineering- Restriction endonucleases, DNA ligase. Cloning vectors: prokaryotic and eukaryotic vectors, Gene transfer methods- Microinjection, Electroporation, Polycations, Lipofection and Retroviral infection. Recombinant clone selection and screening methods. DNA libraries- gDNA and cDNA libraries, chromosome walking and jumping, genetic engineering approaches and applications of r-DNA technology in medicine, environment and industries.	
Unit III:	16 Hours
Stem Cell Technology: Definition, Source and isolation of stem cells, culture and maintenance of stem cells. Adult and embryonic stem cells, properties of stem cells, Differentiation of stem cells, Advantages and limitations of stem cell technology, Novel sources of multipotent stem cells. Science policies and Ethics in Stem Cell Research. Transgenic animals and gene therapy: Production of transgenic animals, gene targeting, Knock-out and Knock-in Technology. Transgenic animals- Ethical concerns and Patenting. Gene therapy: somatic versus- germ line therapy, procedure of IVF and ICSI.	
Unit IV:	16 Hours
Nanotechnology: Overview of nanotechnology, properties of materials: Bulk materials vs nanomaterials, synthesis of nano materials, biomaterials and synthetic materials; Types of nanocarriers/nanoparticles: quantum dots, iron nanoparticles, carbon nanotubes, Applications of nano biotechnology. Gene editing techniques- Clustered regularly interspaced short palindromic repeats (CRISPR/Cas9) system.	

References:

1. Brown T.A. (1995) *Gene cloning*, III edition, Stanley-Thornes Publishers, Ellenberg.
2. Chirikjian, J.C. (1995) *Biotechnology: Theory and Techniques* Vol. I-II. Jones and Bartlett.
3. Freshney R. I. (1992) *Animal cell culture – a practical approach*, II edition, OU publishers, Oxford.
4. Freshney R. I. (2000 & 2005) *Culture of animal cells: A manual of basic technique*, IV&V Edition, Alan R. Liss, Inc. New York.
5. Higgins, D. and Taylor, W. (Eds). *Bioinformatics Sequence, Structure and Databanks*. Oxford Univ Press, 2000
6. Grosreld, G. F. Kollians (1992) *Transgenic animals*, Academic Press Ltd., Sandiego
7. Kruse P. F (1973) *Tissue culture methods and application*, Academic Press, London.
8. Primrose, S.B. (2001) *Molecular Biotechnology*- II (Ed). Panima Publishing Corporation, New Delhi
9. Watson J. D, Gilman M, Witkowski J, Zoller M (1992) *Recombinant DNA*, II edition, Scientific American Books, New York.
10. Kesharwani, P., Singh, K. K. (Eds) (2021) *Nanoparticle Therapeutics: Production Technologies, Types of Nanoparticles, and Regulatory Aspects*; Academic Press Inc.
11. Pieter Stroeve and Morteza Mahmoudi (2018) *Drug Delivery Systems*, World Scientific Series: From Biomaterials towards Medical Devices, Vol I.

ZOO 3.2 Parasitology and Immunology

64 Hours

Unit I: 16 Hours
Pathogenic micro-organisms: Brief outline and classification of micro-organisms.
Pathogenic Protozoa: Amoebiasis and differentiation of different amoebae. Giardiasis, Trypanosomiasis of man and domestic animals. Haemosporidians – man and domestic animals.
Pathogenic Nematodes and Trematodes: Etiology, epidemiology, pathogenesis, diagnosis, prevention and control of diseases caused by *Trichinella spiralis*, *Nectar americanus*, *Ancylostoma duodenale*, *Fasciola hepatica* and *Schistosoma* species.

Unit II: 16 Hours
Pathogenic Cestodes: Life cycle, treatment of diseases caused by *Echinococcus*, *Hymenolepis* and *Diphyllobothrium*. Life cycle and pathogenicity of fleas, mites, ticks, lices and mosquitoes.

Unit III: 16 Hours
Immune system: Organs, tissues and cells of the immune system. Types of Immunity - innate and acquired immunity. Generation of B and T-cells responses: Maturation, activation and differentiation of B and T cells. Immunogens and immunogenicity, structure and functions of immunoglobulins, antigen-antibody interactions, major histocompatibility complex and the complement system. Immune effector mechanisms: cytokines and leukocyte activation and migration.

Unit IV: 16 Hours
Immune response and diseases: Tolerance and autoimmunity. Transplantation immunology, hypersensitivity, host response to *Plasmodium*, *Trypanosoma*, *Leshmaniasis* infection and design of malarial vaccines. Innate immunity controls against infection of *Candida albicans*, *Bacillus anthracis*. Acquired immunodeficiency and vaccines. Cancer immunotherapy.

References:

1. Abbas, A.K. and Lichtman, A.H. (2003) *Cellular and Molecular Immunology*, Fifth Edition, Saunders Publication, Philadelphia.
2. Chandler, A.C (1944) *Introduction to Parasitology*, With Special Reference to the Parasites of Man, (7th ed.), New York: Wiley. 716 pp.
3. Despommier, Gwadz, Hotez, Knirsch: *Parasitic Diseases* (2005). Apple Trees Productions, (5th Ed). LLC. 375 pp.
4. Elgert K D (2009) *Immunology* Second Edn. Wiley Blackwell, John Wiley and sons, New Jersey.
5. Kindt, T J. Goldsby, R A, Osborne, B.A. (2007) *Kuby immunology*, New York : W.H. Freeman and Company
6. Levine, N. D. (1978) *Protozoan parasites of Domestic Animals and Man*. II Ed. Minneapolis: Burgess.
7. Male, D., Brostof, F. J., Roth, D.B., and Roitt, I.M. (2013) *Immunology*, 8th Edition, Elsevier Saunders, United States.
8. Molyneux, D *Advances in Parasitology- Control of Human Parasitic Diseases*, (1st Ed). Academic Press. 690 pp.
9. Noble, E.R. and Noble, G.A. (1961) *Parasitology: The Biology of Animal Parasites*. London Kimpton,
10. Owen J A, Punt J., Stanford S A (2013) *Kuby Immunology* Seventh Edn. Macmillan Higher Education International edition, England
11. Ramesh, S. R. (2017). *Immunology*. Mc Graw Hill Education
12. Smith, K.G.V. (1973) *Insects and other Arthropods of Medical Importance*, London: British Museum of National History.
13. Smyth, J.D. (1976) *Introduction to Animal Parasitology*. London: Hodder and Stoughton.

ZOO 3.3 Evolutionary Biology and Ethology

64 Hours

Unit I:

16 Hours

Theories of evolution: Lamarckism, Darwinism and Neo-Darwinism. Tree of life. Evolution from the fossil record: Rock formation, plate tectonics, Geological time scale, living fossils, connecting links, Hominid fossil records, Evolution of horse. Phylogeny and the fossil record. Evolutionary trends. Types of evolution.

Unit II:

16 Hours

Geography of evolution: Biogeographic evidence for evolution. Major patterns of distribution. Ecological approaches to biogeography. Overview of speciation. Natural selection and adaptation.

Variations and genetic drift: Hardy-Weinberg Law, theory of genetic drift, gene flow. Neutral theory of molecular evolution.

Adaptation and natural selection: Darwinian examples of natural selection, their mechanism and adaptations. Speciation: Modes of speciation, Allopatric, alternative to allopatric. Consequences of speciation.

Unit III:

16 Hours

Ethology: Introduction, history, scope and importance of study of animal behaviour. proximate and ultimate causation. Reflexes and complex behaviour (Latency, after-discharge, summation, warm-up. Fatigue, inhibition, feedback control). Patterns of behaviour: Orientation, kinesis, taxes and reflex. Learning (Habituation, imprinting, associative learning-conditioned reflex types and trial and error, latent and insight learning).

Unit IV:

16 Hours

Animal communication: types of communication (auditory, visual, tactile, chemical), Territoriality and aggression, antipredator behaviour, courtship and mating behaviour, parental care. Social behaviour: social organization in insects and primates, altruism. Biological Rhythms- circadian and circannual.

References:

1. Manning and Marian, S. Dawkins. *An Introduction to Animal Behavior*. Cambridge University, Press, 1995.
2. Futuyama, D.J. *Evolutionary Biology*- III Ed. Sinauer Associates Inc. Massachusetts, 1998.
3. Gerhart, J and Kirchner, M. Cell, *Embryos & Evolution*. Blackwell Science Publishers, 1997.
4. Keynes, R. *Charles Darwin's Zoology Notes & Specimen List from H.M.S Beagle*. Cambridge University Press, 2000.
5. Krebs, J.R. and Davies, N.B. *An Introduction to Behavioural Ecology*-III (ed). Blackwell Science Ltd., 1993.
6. McFarland, D. *Animal Behavior Psychology, Ethology and Evolution*. Pitman Publications. 1985,
7. McFarland, D. *The Oxford Companion to Animal Behavior*
8. Price, P.W. *Biological Evolution*. Saunders College Publishing. 1995.
9. Slater, P. J.B. *Essentials of Animal Behavior*, Cambridge University press, 1999,
10. Strickberger, M. W. *Evolution*. Jone and Barlett Publishers, Boston, London, 2000
11. *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* by Darwin C. Sahni Publications, New Delhi, India 2009.
12. Alcock J 2013 *Animal Behaviour: An Evolutionary Approach*, 10th edition (Sinauer Associates, Inc.).

ZOO 3.4 Applied Zoology

64 Hours

Unit I:

16 Hours

Aquaculture: Overview, history, definition of aquaculture, different types of aquacultures- monoculture, polyculture, cage culture, pen culture, raceway culture, raft culture, sewage-fed fish culture with suitable examples. Important sea weeds and their uses.

Commercially important fin fishes, shell fishes, ornamental fishes, Major carps, cat fishes, breeding of fresh water fish, Fish harvesting, processing and preservation.

Fish diseases and their control measures, by-products and economic importance of aquaculture. Pearl culture, formation and chemical composition of pearl and prawn culture.

Unit II:

16 Hours

Vermiculture: Overview, definition scope and importance of vermiculture, ecological importance of earthworms, indigenous and exotic species of earthworms, culture methods- indoor and outdoor, vermicomposting, chemical composition of vermicompost and vermiwash.

Sericulture: History, mulberry and non-mulberry silk worms, life cycle and rearing of *Bombyx mori*. Protozoan, bacterial, fungal and viral diseases of silkworm – diagnosis, control and management. Pests of silkworm.

Unit III:

16 Hours

Apiculture: History, classification, Indigenous and exotic species of honey bees, social organization in bee colony, bee keeping- traditional and modern methods, product and by-products of apiculture and their uses. Diseases and pests of honey bees- control and preventive measures. Lac culture: cultivation, harvesting, processing of lac, byproducts of lac.

Unit IV:

16 Hours

Dairy and Poultry: Indigenous and exotic breeds of ruminants (cows and buffaloes), Dairy maintenance and management- rearing, housing, feed and rationing, dairy products, diseases of dairy animals.

Indigenous and exotic breeds of poultry, rearing of poultry breeds, diseases of poultry, products of poultry, Nutritive importance of egg and meat.

References:

1. Avatar Singh, Joshi and Singh, B K. *Dairy farming*. ICAR publishers, 2010
2. Bell, F.W. and Canterbury, E.R. *Aquaculture for Developing Countries- A Feasibility Study*. Cambridge: Ballinger Publishing Co. 1976.
3. Dokuhon,Z.S. *Illustrated text book of Sericulture*. Oxford and IBH publishing Co. New Delhi, 1998.
4. Jadhav and Sidiqi. *Handbook of poultry production and management*. Jaypee publishers, 2010
5. Jawaid Ahsan and Sinha, S. P. *A hand book on Economic Zoology*, S. Chand and Co. Ltd. New Delhi. 2000.
6. M. Seetha Lekshmy, R. Santhi, (2012) *Vermitechnology*, Sara Publications, Delhi, India,
7. Mishra, R.C. *Perspectives in Indian Apiculture*. Allied Scientific Publishers, Bikaner, India, 1999.
8. Snathanam, R. Sukumaran, N. and Natarajan, P.: *A Manual of Freshwater Aquaculture*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
9. Srivastava, K.P. *Text Book of Applied Entomology*, Vol. I and II Kalyani Publishers, 1996.

ZOO 3.5A Economic Zoology (Open elective)

25 Hours

Unit I:	5 hours
Overview, scope and importance of economic Zoology.	
Vermiculture: Importance of vermiculture. types of earthworms, life cycle of earthworm, techniques of vermiculture, harvesting of vermicompost and vermiwash,	
Unit II:	5 hours
Poultry Science: Breeds of fowls, poultry rearing (broiler and layer farming), nutritive value of egg and meat, poultry diseases.	
Dairy technology: Breeds of cattle: Cow and Buffalo, disease of dairy, nutritive value of milk and milk byproducts.	
Unit III:	5 hours
Aquaculture: Freshwater, brackish water and marine fish culture in India, preservation and processing of fish; fish by-products, fish diseases.	
Unit IV:	10 hours
Sericulture: Brief history and development of sericulture. Types of silk moths, rearing methods of silkworms, silk production and uses. silkworm diseases.	
Apiculture: Importance, history and development of bee keeping. bee flora, Types of honey bees, management of beekeeping, product and by product of apiculture and their uses.	

Reference:

1. Avatar Singh, Joshi and Singh, B K. *Dairy farming*. ICAR publishers, 2010
2. Bell, F.W. and Canterbury, E.R. *Aquaculture for Developing Countries- A Feasibility Study*. Cambridge: Ballinger Publishing Co. 1976.
3. David, D. V. and Kumarwami, T. *Elements of Economic Entomology*. Popular Book Depot. Madras. 1988
4. Dokuhon,Z.S. *Illustrated text book of Sericulture*. Oxford and IBH publishing Co. New Delhi, 1998.
5. Jadhav and Sidiqui. *Handbook of poultry production and management*. Jaypee publishers, 2010
6. Jawaid Ahsan and Sinha, S. P. A hand book on Economic Zoology, S. Chand and Co. Ltd. New Delhi. 2000.
7. Lee, K.E. *Earthworms: Their Ecology and Relationship with Soils and Land use* Academic Press. London, 1985.
8. M. Seetha Lekshmy, R. Santhi,(2012) *Vermitechnology*, Sara Publications, Delhi, India,
9. Mishra, R.C. *Perspectives in Indian Apiculture*. Allied Scientific Publishers, Bikaner, India, 1999.
10. Snathanam, R. Sukumaran, N. and Natarajan, P.: *A Manual of Freshwater Aquaculture*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
11. Srivastava, K.P. *Text Book of Applied Entomology*, Vol. I and II Kalyani Publishers, 1996.

ZOO 3.5 B Human Genetics (Open Elective)

25hours

Unit I: 5hrs
Historical account, levels of genetics, Mendelism, history of human genetics, pedigree analysis, pattern of inheritance, structural and numerical chromosomal abnormalities, multigenic and polygenic inheritance.

Unit II: 5hrs

Human Karyotyping, International System of Human Nomenclature (ISCN), Chromosomal aberration, chromosomal syndrome and diseases, Dermatoglyphics, variation of dermatoglyphic patterns in human syndrome,

Unit III: 5hrs

Sex determination and dosage compensation, Sex link inheritance in man, chromosome banding technique, human genome project, human genome and its applications

Unit IV: 10 Hours

Prenatal diagnosis: a).Noninvasive methods - radiation, ultrasonography and fetal echocardiography b. invasive methods- maternal serum screening, amniocentesis, chorionic villus sampling and fetoscopy pre-implantation genetic screening, genetic counseling, gene therapy.

References :

1. Rooney and Czepulkowski, *Human cytogenetics*: A practical approach (Vol. I & II) Publisher Year
2. Mueller and Young, *Emery's Elements of medical genetics* IRL Press 1992
3. Pasternak, *An introduction to molecular human genetics* Churchill 1998
4. Fletcher H. and Hickey I. *Genetics*. IV Edition. GS, Taylor and Francis Group, New York and London., 2015.

ZOO 3.5C Reproductive Biology (Open Elective)

25 hours

Unit I: 05 hours

Sex determination and differentiation: Sex determination and differentiation of gonads and gonadal ducts.

Unit II: 05 Hours

Male reproductive system: histoarchitecture of testis; sertoli and leydig cell structure and functions, spermatogenesis; hormonal control of spermatogenesis; actions of androgens, biochemistry of semen and biology of spermatozoa. functions of male accessory organs; epididymis, vasdeferens, prostate gland, seminal vesicle, coagulating and cowper's glands. male sterility.

Unit III: 10 hours

Female reproductive system: histoarchitecture of ovary, folliculogenesis, follicular atresia, ovulation, corpus luteum, luteinization and luteal function, actions of estrogens. hormonal regulation of reproductive cycles - menstrual cycle and estrous cycle. female reproductive disorders- polycystic ovary syndrome.

Unit IV: 05 hours

Reproductive processes and their control: Puberty, implantation and functions of placenta; pregnancy, parturition and lactation. Fertility control: Fertility control in male and female: Natural methods, Barrier methods, IUDs, Hormonal contraceptives, surgical methods.

References:

1. Hadley, Mc. E. *Endocrinology* – Ed. Prentice Hall Inc, 2000
2. Knobil, E. and Neill, J. D. (Eds). *The Physiology of Reproduction*. Vol. I and II. Raven Press Ltd. 1994.
3. Sastry K.V. *Endocrinology and Reproductive Biology*

ZOO 3.5 D. Entomology

25 Hours

UNIT I 05 Hours

Introduction to Entomology, Scope and importance. organization of insect body, distinguishing characters of Insects, diversity and distribution and importance of Insects. Methods of collection and preservation of insects.

UNIT II 05 Hours

Systematic position and classification of insects up to orders. Class Insecta: Sub-Class: Apterygota and Pterygota. Salient features of insect orders with suitable examples. Insects of commercial importance.

UNIT III 10 Hours

Beneficial Insects: Pollinating insects.

Apiculture: Scope, Importance. honey bee species, beekeeping and management practices, products of apiculture.

Sericulture: Scope, importance. mulberry and non-mulberry silkworms, rearing of silkworms and management practices, products of sericulture.

UNIT IV 05 Hours

Beneficial Insects: Lac Culture: Scope, importance, biology of lac insect, lac cultivation and products of lac culture.

Uses and importance of insects in medico-criminal investigations.

Harmful insects: Pests, parasites, vectors, life history of a few common insect vectors and their management,

References:

1. Chapman RF. 1998. *Insects: Structure and Function*. ELBS Ed., London.
2. Dunston PA. 2004. *The Insects: Structure, Function and Biodiversity*. Kalyani Publ., New Delhi.
3. Evans JW. 2004. *Outlines of Agricultural Entomology*. Asiatic Publ., New Delhi.
4. Gullan, P.J. and Cranston, P.S. 2000. *The Insects: An Outline of Entomology*, 2nd Ed. Blackwell Science, U.K.
5. Richards OW & Davies RG. 1977. *Imm's General Text Book of Entomology*. 10th Ed. Chapman & Hall, London.
6. Saxena RC & Srivastava RC. 2007. *Entomology: At a Glance*. Agrotech Publ. Academy, Jodhpur.

ZOO 4.1 Endocrinology and Biology of Reproduction

64 Hours

Unit I: 16 Hours
Principles of endocrinology: Hormones as biological signals; classification of hormones. hormones and their functions: synthesis, secretion and biological roles of pituitary, hypothalamus, pineal, thyroid, parathyroid, adrenal and pancreas hormones. concept of neuroendocrine system.

Unit II: 16 Hours
Hormone action: Hormone receptors- types, and structure, regulation; Mechanism of hormone action-peptide hormone, receptor signal transduction, G proteins, other membrane messengers, Mechanism of action of steroid hormones, eicosanoids and their action.
Growth factors: Growth hormones and the somatomedins, neurotrophic growth factors; Hematopoietic growth factors; Epidermal growth factors; Peptide growth factors; Transforming growth factors; Fibroblast growth factors.

Unit III: 16 Hours
Male reproductive system: Histoarchitecture of testis, spermatogenesis; Hormonal control of spermatogenesis; Functional role of androgens. Structure and functions of epididymis, Vas- deferens, Prostate gland, Seminal vesicle, coagulating and Cowper's glands. Biochemistry of semen and Biology of spermatozoa. Female reproductive system: Histoarchitecture of ovary, folliculogenesis, Follicular atresia, ovulation, corpus luteum, luteinization, and luteal function. Functional roles of estrogens. Hormonal regulation of reproductive cycles in female - menstrual cycle in human and estrous cycle in rat. Sex determination and differentiation of gonads and gonadal ducts. 16 Hours

Unit IV: 16 Hours
Implantation: Types and hormonal regulation of implantation. Endocrine functions of placenta. gestation: Endocrine control of pregnancy in Rat. Hormones involved in parturition. lactation: Morphological and functional development of mammary glands, Hormonal control of lactation and milk ejection. Fertility control: Fertility control in male and female: Natural methods, barrier methods, IUD's, hormonal contraceptives, surgical methods. Female infertility and disorders-Polycystic Ovary Syndrome (PCOs), endometriosis and pelvic inflammatory disease (PID), Assisted reproductive techniques (ART).

References:

1. Bentely, P. J. *Comparative Vertebrate Endocrinology*, III Ed. Cambridge University Press, 1998.
2. Degroot, L. J. and Neill, J. D. (Eds). *Endocrinology*. Vol. I-III. W. B. Saunders Co., 2001.
3. Hadley, Mc. Levine J. E. *Endocrinology*. 2007, Pearson Prentice Hall
4. Hadley, Mc. E. *Endocrinology* – Ed. Prentice Hall Inc, 2000
5. Knobbill, E. and Neill, J. D. (Eds). *The Physiology of Reproduction*. Vol. I and II. Raven Press Ltd. 1994.
6. Mandal, *A Hand Book of Neuroendocrinology*. EMKAY Publications, 1994.
7. Martin, C. R. *Endocrine Physiology*. Oxford University Press.
8. Norris, D. O. *Vertebrates Endocrinology* III Ed. Academic Press, 1996.
9. Turner, C. D. and Bangara, J. T. *General and Comparative Endocrinology*, 1998.

ZOO 4.2 Environmental Biology

64 Hours

Unit I: 16 Hours
Environmental Biology: Principles and scope. Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Ecology: Basic concepts and definitions (ecology, ecozones, biosphere, ecosystem, autecology and synecology). Ecosystem: Ecosystem: Structure and function; abiotic and biotic components of ecosystem; types of ecosystems: forest, grassland, lentic, lotic, estuarine, marine, desert. Microcosms, mesocosms and macrocosms. Concept of productivity: Primary and secondary productivity, Tropic structure and energy flow, ecological pyramids: pyramids of number, biomass, and energy.

Unit II: 16 Hours
Community Ecology: Characteristics of a Community, Structure and dynamics, Types of interaction, group selection, interspecific competition. Concept of habitat, ecological niche and guild. Ecological succession-primary and secondary succession, ecotone and edge effect; Concept of diversity and stability; predator-prey-population oscillation.

Unit III: 16 Hours
Biogeochemical cycles: Cycling of nitrogen, phosphorus, sulphur, carbon and hydrologic cycle.
Pollution: Definition and types of pollutant: primary and secondary pollutant. Definition, source, type, effects and control measures of air, water, soil, noise, radioactive and thermal pollution, biotransformation, bio-concentration, bioaccumulation, bio-magnification and eutrophication. Plastic pollution and its impact on human health and ecosystem.

Unit IV: 16 Hours
Natural resources: Concept of renewable, non-renewable, alternative energy resources (solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, geothermal energy, nuclear energy, bio-energy). over exploitation of resources (deforestation, water table depletion, land degradation.). Photochemical smog, acid rain, greenhouse effect, global warming, global dimming, ozone layer depletion, climate change, sea level rise, soil erosion, desertification and its control. concept of sustainable development. Environmental Laws: environmental laws and legislations.

References:

1. Eugene P Odum and Gary W. Barrett. *Fundamentals of Ecology* fifth edition, Cengage Learning India Private Limited, Delhi, India. 2015.
2. Arorra, R. K. *Air Pollution, causes and effects, control*. Mangaldeep Publications, Jaipur, 1999.
3. Chakraborti, N. K. *Environmental Protection and Law*. 1994
4. Chapman, J. L. and Reiss, M. J. *Ecology: Principles and Applications*. Cambridge University Press, 1999.
5. Chikara, M. G. *Encyclopedia of Ecology*. Environment and Pollution. Vol. I – XIII, 1997.
6. Eldon, D. Enger and Bradley, F. Smith. *Environmental Sciences*, 1995.
7. Kormondy, E. J. *Concept of Ecology*. III Ed, Prentice Hall of India Publishers, 1994
8. Willmer, P., Stone, G. Johnson, I. *Environmental Physiology of Animals*. Blackwell Science Ltd. 9.

ZOO 4.3 Biodiversity, Conservation and Biostatistics

64 Hours

Unit I:

16 Hours

Biodiversity: Concept, definition and scope of biodiversity. Types of biodiversity: Genetic diversity, species diversity and ecological diversity. Biodiversity assessment: Inventorying and monitoring. Capturing and marking techniques. Mega biodiversity centers of India. Biodiversity hotspots with special reference to India.

Unit II:

16 Hours

IUCN: Red list criterions and categories. IUCN listed animals and their status in India, Keystone species and flagship species. Conservation of animals: Status of conservation in India. Methods of conservation: In-situ - National parks, wildlife sanctuaries, Biosphere reserve. World Heritage sites of biological importance, Wetlands. Ex-situ conservation methods. Social movements for biodiversity conservation in India: Chipko, Thairdam, Narmada project. Projects for conservation of Tiger, Lion, Elephant, Dolphin and Crocodile.

Unit III:

16 Hours

Loss of biodiversity and conservation: Threats to biodiversity, HIPPO. Biodiversity conventions and biodiversity legislations: CITES, TRAFFIC, IKS, biodiversity act 2002 and amendments, global biodiversity laws. biodiversity laws in India, IPR, biopiracy and biosafety. Agencies involved in biodiversity conservation.

Unit IV:

16 Hours

Biostatistics: Definition; importance of statistics in biology. Data reduction, frequency distribution. Graphical representation, measures of central tendency and depression probability and its types. Regression and correlation, random sampling, tests of significance: one-tailed test or two-tailed test for significance. Variance, proportions, chi-square tests, analysis of variance: One way and two-way ANOVA.

References:

1. Krishnamurthy K.V. *An Advanced Textbook on Biodiversity Principles and Practice*, Oxford & IBH Publishing Company, New Delhi, India 2012.
2. Edward O. Wilson. *The Diversity of Life*. W. W. Norton Company, 1999.
3. Forhofer, R. N., and Lee, E. S. *Introduction to Biostatistics*. Academic Press, New York, 1995.
4. Hawksworth, D. L. (Ed). *Biodiversity: Measurement and Estimation*. Chapman and Hall, 1995
5. Heywood, V.H. (Eds) 1995. *Golbal Biodiversity*, Published for UN Environmental Programme, Cambridge
6. Khan, T.I and Y.S. Shishodia. *Biodiversity Conservation and Sustainable Development*. Pointer Publications, Jaipur, 1998.
7. Kotwal. P. C., and Banerjee, S. *Biodiversity Conservation: In Managed Forests and Protected Area*. Agro Botanica, 1998
8. Kumar, and Asija. *Biodiversity: Principles and Conservation*. Agrobios (India), 2000
9. Sunder Rao, P. S. S., and Richard, J. *An Introduction to Biostatistics*. III Ed. Prentice Hall, India, New Delhi, 1997

ZOO 4.4 Project Work/Dissertation

Value added course ZOO: Aquaculture and by-products

32 hours

Unit I:

08 Hours

Inland fisheries - culture of inland fishes: Carps, catfish, sheatfish, feather backs, mullet, herring, anchovies and eel. Collection of eggs from rivers. Hatching of eggs. Collection of fries from rivers and other breeding grounds. Breeding of carps in tanks. Induced breeding. Transportation of fries from collecting spot to nursery ponds. Rearing pond.

Unit II:

04 Hours

Riverine fisheries: Ganga, Brahmaputra and Indus river system, East coast system, Western coast river system. Riverine fishing crafts and gears.

Unit III:

04 Hours

Marine fisheries: Overview of marine fishery resources, deep sea and off-shore fisheries, sea fishing crafts and gears.

Unit IV:

08 Hours

Estuarine fisheries: Composition of fish flesh, preservation and processing of fish. Freezing and refrigeration, drying, salting, smoking and canning.

Fish by-products: Fish oil, fish meal, fish guano, fish flour, fish silage, fish solubles, shark's fins, fish roes, fish glue, Isinglass, fish skin.

Unit V:

08 Hours

Cage culture of fish: Advantages and disadvantages of cage culture. Importance of larvicultural fishes in India. Exotic and indigenous larvicultural fishes. Classification of larvicultural fishes based on mosquitocidal activity. Exotic fishes of India. Cold water fisheries. Indigenous and exotic sewage fed fisheries.

References:

1. Bell, F.W. and Canterbury, E.R. *Aquaculture for Developing Countries- A Feasibility Study*. Cambridge: Ballinger Publishing Co. 1976.
2. Jayakumar, S. *Basic of fish farming for the beginners*. Notion press.com
3. Lucas, J S and Southgate, P C. *Aquaculture farming aquatic animals and plants*, III ED, John wiley and sons ltd. 2007
4. Lucas, J S, Southgate, P C and Tucker, C S. *Aquaculture farming aquatic animals and plants*, III ED, John wiley and sons ltd. 2019
5. Pillay T V S. *Aquaculture – Principles and practices* (Fishing News Books Oxford), 1990
6. Snathanam, R. Sukumaran, N. and Natarajan, P.: *A Manual of Freshwater Aquaculture*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
7. Stickney R R. *Aquaculture an inductor text*. III ED, Texas A and M University, USA, 2016


Chairman
PGBOS in Zoology
Davanagere University

QUESTION PAPER PATTERN

Paper Name:

Paper Code:

Time: 3 Hours

Max. Marks: 70

PART – A

1. Answer **any five** of the following: **(2×5 = 10)**

- a)
- b)
- c)
- d)
- e)
- f)
- g)
- h)

PART – B

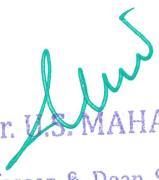
Answer **any Four** of the following: **(5×4=20)**

- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

PART – C

Answer **any Four** of the following: **(10×4=40)**

- 8.
- 9.
- 10.
- 11.
- 12.
- 13.


Dr. V.S. MAHABALESHWAR
M.Sc., M.Phil., Ph.D.
Professor & Dean, Science & Technology
Davangere University, Shivagangotri
Davangere-577 007, Karnataka, India.


Registrar
Davangere University
Shivagangotri, Davangere-577 007, Karnataka, India.