

“Dissemination of Education for Knowledge, Science and Culture”

-Shikshanmaharshi Dr. Bapuji Salunkhe



DEPARTMENT OF ZOOLOGY

B.Sc. Part - III

Semester-V&VI

SYLLABUS

As per NEP-2020

NEP 2.0

To be implemented from Academic June 2026-27

Departmental Teaching and Evaluation scheme

Third Year Semester-V & VI

Sr. No.	Course Abb.	Course code	Course Name	Teaching Scheme Hours/week	Examination Scheme and Mark	Course Credit
---------	-------------	-------------	-------------	-------------------------------	-----------------------------	---------------

				TH	PR	SEE	CIE	PR	Marks	
Semester-V										
1	DSC-IX	2DSC03ZOO51	Molecular Biology	2	-	40	10	-	50	2
2	DSC-X	2DSC03ZOO52	Animal Biotechnology	2	-	40	10	-	50	2
3	DSC-XI	2DSC03ZOO53	Ecology	2	-	40	10	-	50	2
4	DSE-I	2DSE03ZOO51	Parasitology	2	-	40	10	-	50	2
		2DSE03ZOO52	Biology of Insect							
5	FP	2FPR03ZOO51	Field Project	2	-	-	-	50	50	2
6	DSC-PR-V	2DSC03ZOO59	DSC Zoology Lab-5	-	16	-	-	100	100	8
Semester –V Total				10	16	160	40	150	350	18
Semester-VI										
1	DSC-XII	2DSC03ZOO61	Immunology	2	-	40	10	-	50	2
2	DSC-XIII	2DSC03ZOO62	Developmental Biology	2	-	40	10	-	50	2
3	DSC-XIV	2DSC03ZOO63	Aquatic Biology	2	-	40	10	-	50	2
4	DSE-II	2DSE03ZOO61	Reproductive Biology	2	-	40	10	-	50	2
		2DSE03ZOO62	Comparative Anatomy of Vertebrates							
5	VSC-PR-III	2VSC03ZOO69	Poultry Farming	-	4	-	-	25	25	2
6	OJT	2OJT03ZOO61	On Job Training	2	-	-	-	50	50	2
7	DSC-PR-VI	2DSC03ZOO69	DSC Zoology Lab-6	-	16	-	-	100	100	8
Semester –VI Total				10	20	160	40	175	375	20

Abbreviations: TH-Theory, PR-Practical, PRO- Project, SEE- Semester End Examination, CIE-Continuous Internal Examination

Note: Minimum passing for 10 marks Internal evaluation = 04 marks
 Minimum passing for 40 marks Theory paper = 14 marks
 Minimum passing for 25 marks Practical = 09 marks
 Minimum passing for 50 marks Practical/FP/OJT = 18 marks
 Minimum passing for 100 marks Practical/FP = 35 marks

Passing percentage for Democracy, Election and Good Governance (DEGG) and Environmental Studies papers should be 40%

Separate passing for each Head – SEE theory, SEE practical, CIE theory and CIE Practicals

B.Sc.: Program Outcomes (POs):

PO 1: Disciplinary Knowledge: Graduates will gain in-depth understanding in their specific major or discipline, mastering the foundational principles and theories, as well as advanced concepts.

Execute theoretical and practical knowledge developed from the specific curriculum.

PO 2: Problem-Solving Skills: Graduates will learn to use their knowledge to identify, analyze and solve problems related to their field of study.

PO 3: Analytical Skills: Graduates will gain the ability to collect, analyze, interpret, and apply data in a variety of contexts. They might also learn to use specialized software or equipment.

PO 4: Research Skills and Scientific Temper: Graduates might learn how to design and conduct experiments or studies, analyze results and draw conclusions. They might also learn to review and understand academic literature.

PO 5: Environment and Sustainability: Possess a sympathetic awareness of the environment while conducting research and scientific studies and focus on sustainable social development.

B.Sc. in Zoology: Program Specific Outcomes (PSOs):

PSO 1: Understand the nature and basic concepts of Animal Diversity, Taxonomy, Comparative Anatomy Developmental Biology, Physiology, Biochemistry, Genetics and Evolutionary Biology.

PSO 2: Perform procedures as per laboratory standards in the areas of Animal Diversity, Taxonomy, Comparative Anatomy, Developmental Biology, Physiology, Biochemistry, Genetics and Evolutionary Biology, Entomology, Sericulture, Biochemistry, Animal biotechnology, Immunology and Research Methodology.

PSO 3: Understand the applications of Applied Zoology in Apiculture, Aquaculture, Agriculture and Medical zoology.

PSO 4: Acquired knowledge about Research Methodologies and Skills of problem solving methods.

PSO 5: Students will Contributes the knowledge for Nation building and Society welfare.

SEMESTER V

B. Sc. Part – III Semester -V ZOOLOGY

DSC-IX: 2DSC03ZOO51: MOLECULAR BIOLOGY

Credits: 02

Theory: 30hrs.

Marks-50

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

CO1: Recall fundamental concepts related to molecular biology

CO2: Understand the basics of molecular mechanisms in biology

CO3: Apply the knowledge of molecular biology in various fields

CO4: Develop skills in molecular biology techniques

Unit I

15hrs.

1. Nucleic acid as the genetic material
2. Watson and Crick's model of DNA structure
3. Replication of DNA: Types of DNA replication
4. DNA replication in prokaryotes and eukaryotes
5. Transcription: Transcription in prokaryotes and eukaryotes
6. Post-Transcriptional Modifications -Capping of mRNA, Splicing, Polyadenylation
7. Genetic Code and Wobbel hypothesis

Unit II

15hrs.

8. Translation in prokaryotes and eukaryotes
9. Gene regulation- lac operon: structure, function, and regulation
10. DNA damage- Sources, mechanism and types
11. Consequences of DNA damage: Mutagenesis, cancer, aging, neurological disorders
12. DNA repair mechanisms: Direct repair, nucleotide excision repair, base excision repair, mismatch repair, etc.

Suggested Readings:

1. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., & Levine, M. (2021). *Molecular biology of the gene* (7th ed.). Pearson Education.
2. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., & Bretscher, A. (2020). *Molecular cell biology* (8th ed.). W.H. Freeman and Company.
3. Tropp, B. E. (2018). *Principles of molecular biology* (5th ed.). Jones & Bartlett Learning.
4. Campbell, N. A., & Reece, J. B. (2020). *Biology* (11th ed.). Pearson Education.
5. Gupta, P. K. (2015). *Molecular biology* (4th ed.). Rastogi Publications.
6. Singh, B. D. (2007). *Genetics* (3rd ed.). Kalyani Publishers.
7. Satyanarayana, U., & Chakrapani, U. (2006). *Biochemistry* (2nd ed.). Books & Allied (P) Ltd.
8. Jain, S. K. (2009). *Principles of molecular biology*. S. Chand Publishing.

9. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular biology of the gene* (Indian ed.). Pearson Education.

B. Sc. Part – III Semester -V ZOOLOGY

DSC-X: 2DSC03ZOO52: ANIMAL BIOTECHNOLOGY

Credits: 02

Theory: 30hrs.

Marks-50

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

CO1: Understand the basic concepts of Animal Biotechnology and its scope

CO2: Apply the knowledge of biotechniques to comprehend the GMO

CO3: Analyse results by using different techniques of Animal Biotechnology

CO4: Develop research aptitude and a scientific advancement

UNIT I:

15hrs.

1. Introduction to Animal Biotechnology- Concept and Scopes of Biotechnology
2. Restriction enzymes and other enzymes used in RDT: Nomenclature and its types, DNA modifying enzymes: Nucleases, Polymerases, Phosphatases and ligases, Ligation of adaptors, and linkers.
3. Vectors: Characteristics and types of vectors
 - a. Cloning Vector: Plasmid, Cosmid, Phagemid, Lambda
 - b. Expression Vector: Ti plasmid of Agrobacterium-clamps, Adenoviral vectors, Baculovirus
4. Recombinant DNA in medicines: Insulin production
5. Transformation techniques: Calcium chloride method, liposomal Mediated gene transfer, DNA microinjection and Electroporation
6. Blotting techniques: Southern, northern and western blotting

UNIT II:

15hrs.

7. Polymerase chain reaction (PCR)
8. DNA fingerprinting

9. Method of DNA sequencing: Sanger's method
10. Construction of genomic and cDNA libraries
11. Production of cloned animals- Nuclear Transplantation
12. Production of transgenic animals
13. Gene therapy- Types and Applications
14. Application of biotechnology in animal husbandry, medicine and agriculture

Suggested Readings:

1. Arora, M. P. (2003). Biotechnology 1 st Himalaya Publication House
2. Beauchamp, T. I. and Childress, J. F. (2008). Principles of Biomedical Ethics. 6 th Edition,
3. Das, H. K. (2007). Textbook of Biotechnology 3 rd Wiley India pvt. Ltd
4. Glick, B. R. and Pasternak, J.J. (2009). Molecular Biotechnology Principles and applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.
5. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. 9th Edition. Freeman and Co., N.Y., USA.
6. Satyanarayana, U. and Chakrapani, U. (2005) Biotechnology. Books & Allied Ltd.
7. Singh B. D. (2010). Biotechnology Expanding Horizons. Kalyani Publishers
8. Snustad, D. P. and Simmons, M.J. (2009). Principles of Genetics. V Ed, John Wiley and Sons Inc.
9. Watson, J. D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA Genes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y., USA.

B. Sc. Part – III Semester -V ZOOLOGY

DSC-XI: 2DSC03ZOO53: ECOLOGY

Credits: 02

Theory: 30 hrs.

Marks-50

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

CO1: Remember basic concepts of Ecology

CO2: Understand and evaluate information about ecological principles

CO3: Demonstrate the structure and function of ecosystems

CO4: Analyze the interaction between organism and their environment

Unit I

15hrs.

1. Introduction to ecology

2. **Ecosystem:** Structure and function, types of ecosystem (terrestrial and aquatic), Food chain, food web, and ecological pyramids, Biogeochemical cycles (Nitrogen, Carbon, Phosphorus and Water) and its importance & applications
3. **Habitat and Niche:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche
4. **Species interactions-** types of interaction (competition, predation, commensalism, parasitism, mutualism, Amensalism)

Unit II

15hrs.

5. **Community Ecology:** Nature of communities, characteristics (species richness, dominance, diversity, abundance), ecotone and edge effect.
6. **Ecological Succession** -Types of succession (primary, and secondary),stages of succession, mechanisms of succession, types of seres (hydrosere, lithosere).
7. **Population Ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection);
8. **Ecological adaptation** in aquatic, desert & terrestrial animals

Suggested Reading:

1. Begon, M., J.L. Harper and C.R. Townsend. Ecology, Individuals, Populations and Communities. Blackwell Science, Oxford, UK.
2. Chapman Jr., W.B. Natural Ecosystems. Macmilan Pub. Co. Inc.
3. Cherrett, J.M. Ecological concepts. Blackwell Sci. Publi. Oxford, UK.

4. Giller, P.S. (1984) Community Structure and the Niche. Chapman & Hall.
5. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.
6. Odum, E.P. (1971). Fundamentals of Ecology. Saunders, Philadelphia
7. Odum, E.P. (1983). Basic Ecology. Saunders, Philadelphia
8. Odum, E.P. and Barrett, G.W., (2018). Fundamentals of Ecology, 5th Edition. Clarke, G.L. (1954) Elements of Ecology. John Wiley & Sons, Inc. New York.
9. Ricklefs, R.E. and G.L. Miller. (1999) Ecology W.H. Freeman & Company Ricklefs, R.E. and G.L. Miller. (1999) Ecology W.H. Freeman & Company
10. Smith, R.L. and T.M. Smith (2002) Ecology and Field Biology. Addison – Wesley Educational Publishers Inc.

B. Sc. Part – III Semester -V ZOOLOGY
DSE-I: 2DSE03ZOO51: PARASITOLOGY

Credits: 02

Theory: 30hrs.

Marks-50

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

- CO1. Define the basic terminologies in parasitology.
- CO 2. Remember the concepts of animal association with examples
- CO 3. Describe and identify the morphology and life cycle of the common parasites
- CO 4. Interpreted the phenomenon of the host-parasite relationship

Unit I

15 hrs.

1. Introduction and Concepts to Parasitology
2. Definition: Parasitism, Parasite, Parasitoid, Host, Vector, Zoonosis
3. Types of Parasites with examples: Ectoparasites, Endoparasites, Facultative Parasite, Obligatory Parasites.
4. Types of Hosts with examples: Definitive host, Intermediate host, Facultative host
5. Host-Parasite relationship, Host specificity, Types of host specificity: Structural specificity, Physiological specificity, and Ecological specificity. Effects of parasite on host,
6. Factors affecting the host-parasite relationship.
7. Parasitism, Symbiosis, Commensalisms, and Mutualism with suitable example.

Unit II

15 hrs.

8. Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- Parasitic Protists- *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Giardia lamblia*
9. Parasitic helminth -*Taenia solium*, *Ascaris lumbricoides*
10. Morphology, Life Cycle, Pathogenicity and Control measures of- Parasitic Arthropoda- *Head louse*, *Rat fleas*, *Bed bugs*
11. Parasitic Vertebrates - A brief account of parasitic vertebrates; *Cookiecutter Shark*, *Candiru*, *Hood Mockingbird*, and *Vampire bat*

Suggested Reading:

1. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007). Biology of Disease. Taylor and Francis Group.
2. Arora, D. R and Arora, B. (2001). Medical Parasitology. II Edition. CBS Publications and Distributors.
3. Bogitsh, B. J. and Cheng, T. C. (2000). Human Parasitology. 2nd Ed. Academic Press, New York.
4. Cheng, T. C. (1986). General Parasitology. 2nd ed. Academic Press, Inc. Orlando's.
5. Gunn, A. and Pitt, S.J. (2012). Parasitology: an Integrated Approach. Wiley Blackwell.
6. Paniker, C.K.J., Ghosh, S. (2013). Paniker's Text Book of Medical Parasitology. Jaypee, New Delhi.
7. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributors, Medical Books Publishers, Chennai, Delhi.
8. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.
9. Roberts, L.S and Janovy, J. (2009). Smith & Robert's Foundation of Parasitology. 8th. Edn. McGraw Hill.

B. Sc. Part – III Semester -V ZOOLOGY

DSE-II: 2DSE03ZOO52: BIOLOGY OF INSECTS

Credits: 02

Theory: 30hrs.

Marks-50

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

CO1: Recall the general characteristics, classification and morphology of insect

CO2: Understand the structure and function of insect organ systems

CO3: Illustrate insect development and metamorphosis

CO4: Differentiate between various insect orders based on morphological & anatomical features

Unit I:

15hrs

1. General features of insects and its distribution
2. Basis of insect classification; Classification of insects up to orders
3. Morphology of Insects- Head, Eyes, Types of antennae, Mouth parts w.r.t. feeding habits, Thorax: Wings and wing articulation, Types of Legs, Abdominal appendages and genitalia.
4. Sexual dimorphism in insects (Honey bee)

Unit II:

15hrs

5. Anatomy of Insect system (Cockroach/Grasshopper)- Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, nervous system, and sensory receptors.
6. Life cycle of insect (Drosophila/ Honey bee)
7. Metamorphosis in insects (Drosophila/ Honey bee)
8. Social organization and social behaviour in honey bee / ant/ termite
9. Insects as mechanical and biological vectors, Brief account on houseflies and mosquitoes as important insect vectors

Suggested Readings

1. Imms, A. D. (1923), A general text book of entomology, Chapman & Hall, UK
2. Chapman, R. F. (2012), The Insects: Structure and function, Cambridge University Press, UK
1. Snodgrass, R. E. (1935), Principles of Insect Morphology, Cornell Univ. Press, USA
2. Donald J.B. (1981), Introduction to the study of insects, 5th Edition, Saunders College Publication, USA
3. Bernays, E. A., and Chapman, R. F.(1994), Host plant selection by phytophagous insects, Chapman and Hall, New York, USA
4. Klowden, M. J. (2013), Physiological system in Insects, 3rd Edition, Academic Press, USA
5. Gullan, P. J. , and Cranston, P. S.(2014), The Insects, An outline of Entomology, 5th Edition, Wiley Blackwell, UK

6. James L. Nation, Sr. (2022), Insect Physiology and Biochemistry, 4th edition CRC Press, USA
7. Agrawal N., (2021), Practical Manual Classification of Insects, Department of Entomology
College of Agriculture Chandra Shekhar Azad University of Agriculture and Technology,
Kanpur
8. Prasad, T.V., (2019), Handbook of Entomology (4th Edition), New Vishal Publication, New
Delhi

B. Sc. Part – III Semester -V ZOOLOGY

DSC-PR-V: 2DSC03ZOO59: DSC Zoology Lab-5

**Practicals Based on Paper Molecular Biology (DSC03ZOO51), Animal Biotechnology
(DSC03ZOO52), Ecology (DSC03ZOO53), Parasitology (DSE03ZOO51), Biology of Insect
(DSE03ZOO52)**

A. Practicals Based on Paper Molecular Biology (DSC03ZOO51)

1. Handling, calibration, and applications of micropipettes
2. Preparation of agarose gel for electrophoresis
3. Preparation of buffers for electrophoresis (TAE and TBE)
4. Demonstration of equipments used in molecular biology- Electrophoresis, Gel documentation, Hot plate, Centrifuge, UV Transilluminator, Vortex mixer
5. Isolation of the genomic DNA from *E. coli* cells
6. Extraction of DNA from goat liver/whole blood
7. Isolation of RNA from animal tissue
8. Separation of DNA by agarose gel electrophoresis
9. Analysis of DNA fragment size (molecular weight) using DNA ladder
10. Separation of protein by SDS-PAGE
11. Study of DNA sequencing, PCR, and DNA fingerprinting through photographs
12. Visit molecular biology laboratory/ institution

B. Practicals Based on Paper Animal Biotechnology (DSC03ZOO52)

1. Sterilization technique
2. Preparation of microbial culture media
3. Preparation of Bacterial Culture
4. Plasmid DNA isolation from bacteria
5. Estimation of RNA by Orcinol Method
6. Estimation of DNA by Diphenylamine method
7. Restriction digestion of plasmid DNA.
8. Construction of circular and linear restriction map from the data provided.
9. Demonstration of ligation of DNA strands
10. Preparation of competent cells in bacteria
11. Demonstration of bacterial transformation
12. Study of equipments used in Animal biotechnology
13. Study of blotting techniques with photographs- Southern, Northern and Western Blotting

14. Submission of reports on transgenic animals

C. Practicals Based on Paper Ecology (DSC03ZOO53)

1. Construction of ecological pyramids with suitable example
2. Study of food chain and food web
3. Study the biotic components of a pond
4. Determination of pH from the given water sample
5. Measurement of the water-holding capacity of the soil
6. Study the characteristics of different types of soils
7. Estimation of moisture content from different soil samples
8. Example based on species richness and abundance
9. Estimation of biomass in a given area (Terrestrial ecosystem)
10. Determination of relative humidity of the atmosphere using hygrometer
11. Study of animals in relation to adaptation (Aquatic and Desert)

12. Submission of report on fauna of college campus

D.1 Practicals Based on Paper Parasitology (DSE03ZOO51)

1. Study of parasitic association with their example - a) Commensalism. b) Parasitism.
2. To study the life cycle, pathogenicity, diagnosis and treatment of *Entamoeba histolytica* through permanent slides or microphotographs.
3. To study the life cycle, pathogenicity, diagnosis and treatment of *Plasmodium vivax* through permanent slides or microphotographs
4. To study the life cycle, pathogenicity, diagnosis and treatment of *Ascaris lumbricoides* through specimens, permanent slides or microphotographs.
5. To study the life cycle, pathogenicity, diagnosis and treatment of *Taenia solium* through specimens, permanent slides or microphotographs.
6. Study of following parasites with their role as vector- *Pediculus humanus*, *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides or photographs.
7. Study of effects of parasites on host body (ectoparasite and endoparasite)
8. Study of the pathogenicity and control measures of ticks (Any two).
9. Study of the pathogenicity and control measures of Mite

10. Study of parasites from the gut of any vertebrate (Fish)
11. Study of parasitic vertebrates-Photographs
12. Collection and identification of parasites from cow dung
13. Collection & submission of various parasites/vectors (Any five parasites)

D.2 Practicals Based on Paper Biology of Insects (DSE03ZOO52)

1. The collection, preservation and identification of insects.
2. Morphological studies of various castes of *honey bees*
3. Study of different types of mouth parts in insects
4. Study of different kinds of antennae and legs in insects
5. Study of insect wings and their venation.
6. Study of insect trachea and spiracles
7. Study of any three insect pests and their damages
8. Study of any three beneficial insects and their products
9. Study of any three types of harmful insects
10. Study of insect vectors
11. Study of social behaviour in honey bee
12. Submission of report on any five insects from college campus

Suggested Readings:

1. Glower D. M. and Hames B. D. (1995) DNA cloning: A practical approach IRL Press, oxford.
2. Mahajan R., Sharma, R. and Mahajan R. K. (2020) Practical Manual of Biotechnology. Vayu Education of India
3. Singh B. R. and Kumar R. (2022) Practical Techniques in Molecular Biotechnology. Cambridge University Press
4. Tembhare D. B. (2010) Techniques in life Sciences. Himalaya publishing House. 1-463
5. Dubey, R.C. (2009). Practical Manual of Animal Biotechnology. S. Chand Publishing.
6. Bhatia, S.C. (2012). Molecular Biology: Principles and Applications. CBS Publishers & Distributors.
7. Gupta, P.K. (2007). Practical Manual of Molecular Biology. Rastogi Publications.
8. Rao, M.S.M.P.K.N. (2015). Animal Biotechnology: Methods and Applications. Springer.
9. Verma, P.S., & Agarwal, V.K. (2007). Practical Zoology (Vol. 1). S. Chand Publishing.

10. Dubey, R.C. (2003). A Textbook of Practical Zoology. S. Chand & Company Ltd.
11. Goswami, S.K.K. (2015). Practical Parasitology: A Laboratory Manual. New Central Book Agency.
12. Green, M.B.S. (2011). Veterinary Parasitology: A Practical Guide. Wiley-Blackwell.
13. Kundu, K.K.K. (2009). Practical Parasitology: A Manual for Students. New Age International Publishers.
14. Lunt, D.J. (2004). Practical Parasitology: Protozoa and Helminths. University Press.
15. Shinde, B.L. (2013). Practical Parasitology for Medical and Clinical Laboratory. CBS Publishers & Distributors.
16. Tiwari, A.P. (2010). Essentials of Parasitology: Practical Manual. Agrobios Publishers.

SEMESTER VI

B.Sc. Part III Semester-VI ZOOLOGY
DSC-XII 2DSC03ZOO61: IMMUNOLOGY

Credits -02

Theory 30hrs.

Marks 50

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

CO1. Define the terms in the immune system

CO2. Understand and explain the functioning of immune system

CO3. Apply knowledge and identify the components of immune system

CO4. Analyse and compare immune system mechanisms

Unit I:

15 hrs.

1. Introduction to basic concepts in immunology
2. The components of the immune system.
3. Types and features of immunity- Innate and Adaptive
4. Haematopoiesis
5. Cells in the immune system
6. Organs of the immune system- Primary lymphoid organ- bone marrow, thymus, Secondary lymphoid organ- lymph node, spleen
7. Other lymphoid tissues- Tonsils, Peyer's patches, mucosal-associated lymphoid tissue (MALT)
8. Primary and secondary immune responses

Unit II:

15 hrs.

9. Antigen: Basic properties of antigens
10. B and T Epitopes, haptens and adjuvants
11. Antibodies: Structure, types and function
12. Antigen-antibody interactions.
13. Types of ELISA
14. Hybridoma technology
15. Monoclonal vs Polyclonal antibodies. Application of monoclonal antibody
16. Introduction to Vaccines- Properties and types of vaccines

Suggested Readings:

1. Abbas, A. K. and Lichtman A. H. (2003). Cellular and Molecular Immunology, 5th edn., Saunders Publication
2. C. V. Rao (2002). An Introduction to Immunology Narosa Publishers.

3. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, 7th Edition, Mosby, Elsevier Publication.
4. Delves P., Martin S., Burton D. and Roitt (2011) Essential Immunology (Essentials), 12th Edition.
5. Guyton C. and John E. H, (2003), Textbook of Medical Physiology 3rd Edition, Saunders Elsevier Publication.
6. Hildeman, W.H. (2002) "Essentials of immunology", Elsevier Scientific. 2002
7. Price C. P. and Newman D. J. (1997) Principles and Practice of Immunoassay, 2nd Sub Edition, M Stockton press, Palgrave Macmillan Publication India
8. Sites, D.P., Stobo, J.D. and Wells, J.U (1982), "Basic and clinical immunology", Prentice Hall.

B. Sc. Part – III Semester -VI ZOOLOGY

DSC-XIII: 2DSC03ZOO62: DEVELOPMENTAL BIOLOGY

Credits: 02

Theory: 30hrs.

Marks-50

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

CO1: Define different terminologies related to developmental biology

CO2: Understand stages of animal development

CO3: Illustrate the process of development using diagrams and models

CO4: Analyze the role of genes and molecular signaling pathway in animal development

UNIT I:

15hrs

1. Introduction to Developmental biology, types of eggs, types and pattern of cleavages, Morphogenetic cell movements
2. **Control of Development:** Gene activation, specification, determination, induction, Differentiation, morphogenesis, Intercellular communication
3. **Early and late Embryonic Development in human:** Gametogenesis (Spermatogenesis & Oogenesis), Structure of mature egg and sperm, Fertilization process & prevention of polyspermy, Cleavage, blastula, gastrula, fate of three germ layer, Implantation, formation of placenta and its functions

UNIT II:

15 hrs

- 3. Early Development in Frog:** Structure of mature egg and its membranes, Cleavage, Blastula and its fate map, Process of gastrulation, Neurulation, Metamorphosis in frog and its hormonal regulation
- 4. Extra-Embryonic Membranes and Early Development in Chick:** Development, structure and functions of yolk sac, amnion, chorion and allantois, Structure of hen's egg, Cleavage, blastula, gastrulation, Origin and structure of primitive streak, Structure of 18, 24, 33 and 48 hrs chick embryos

Suggested readings:

1. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
2. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.
3. Gilbert, S. F. (2006). Developmental Biology, 8 th Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
4. Jonathan M. W. Slack (2012). Essential Developmental Biology, 3 rd Edition, Willey Blackwell Publishing.
5. Lewis Wolpert, Cheryll Tickle, and Alfonso Martinez Arias (2019). Principles of Development, 6 th Edition, OUP Oxford publisher
6. Werner A. Müller (2012). Developmental Biology, Springer; 1997th edition (6 December 2012)

B. Sc. Part – III Semester -VI ZOOLOGY
DSC-XIV: 2DSC03ZOO63: AQUATIC BIOLOGY

Credits: 02

Theory: 30hrs.

Marks-50

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

CO1: Develops the skills of managing aquatic resources and use of techniques and instruments

to develop remedies to manage aquatic resources

CO2: Identify and classify different aquatic organisms

CO3: Understand freshwater, marine, and estuarine ecosystems

CO4: Analyze water quality and pollution

Unit I

15hrs.

1. **Limnology:** Introduction and Importance of limnology
2. **Aquatic biome:** Freshwater ecosystem (Lentic & Lotic), Estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone
3. **Ponds and lakes:** Origin, Classification, Characteristics, Physicochemical properties, Thermal stratification, Primary production, Role of plankton in the aquatic food chain
4. **Streams:** Types of streams, physicochemical environment, conservation of streams, adaptation of hill stream fishes
5. **Wetland:** Types, classification, and significance of wetland

Unit II

15 hrs.

6. **Properties of seawater-** Concept of chlorinity, and salinity of seawater.
7. **Coral & coral reefs:** Types & economic importance
8. **Continental shelf and adaptations of deep-sea organisms**
9. **Estuaries:** Definition, Classification, Characteristics
10. **Management of Aquatic Resources-** Freshwater pollution, causes of pollution (sewage, Agricultural runoff, industrial discharge), eutrophication, Management

Suggested Reading:

1. Anathakrishnan: Bioresources Ecology 3rd Edition
2. Goldman: Limnology, 2nd Edition
3. Odum and Barrett: Fundamentals of Ecology, 5th Edition
4. Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition
5. Trivedi and Goyal: Chemical and biological methods for water pollution studies Welch: Limnology Vols. I-II
6. Sharma and Khan (2004).“ Ozone Depletion and Environmental Impacts”, Pointer publishers

7. Pandey Kamleshwar, Shuklar, J. P. & Trivedi S. P. (2005). Fundamental of toxicology, New central book agency Pvt. Ltd. Kolkata
8. Walter Dodds and Matt Whiles (2010). Freshwater Ecology -Concepts and Environmental Applications of Limnology 2nd Edition: Academic Press

B. Sc. Part – III Semester -VI ZOOLOGY

DSE-II: 2DSE03ZOO61: REPRODUCTIVE BIOLOGY

Credits: 02

Theory: 30hrs.

Marks-50

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

CO1: Recall the anatomy and physiology of male and female reproductive systems

CO2: Identify key hormones involved in reproductive regulation (e.g., FSH, LH, estrogen, testosterone)

CO3: Interpret the physiological changes during pregnancy, parturition, and lactation.

CO4: Analyze the role of environmental and lifestyle factors in fertility and reproductive disorders.

Unit I:

15Hrs

1. Reproductive hormones of the pituitary gland and its control mechanism

2. Functional anatomy of female reproductive system

- a. Structure of female reproductive system
- b. Female sex hormones
- c. Menstrual cycle and hormonal regulation
- d. Diagnostic features of pregnancy and hormonal regulation
- e. Mechanism and hormonal regulation of Parturition and Lactation

3. Functional anatomy of male reproductive System:

- a. Structure of male reproductive System
- b. Histology of testis
- c. Male sex hormones
- d. Epididymal functions and sperm maturation
- e. Sperm transportation in male genital tract
- f. Hormonal control of Testicular activities

Unit II:

4. Reproductive Health

- a. **Infertility in Male:** Causes, diagnosis and management
- b. **Infertility in Female:** Causes, diagnosis and management
5. **Assisted Reproductive Technology:** Sperm bank. Frozen embryos. Intrauterine Transfer (IUT). Zygote Intrafallopian Tube Transfer (ZIFT) Gamete Intrafallopian Transfer (GIFT). Intracytoplasmic Sperm Injection (ICSI).
6. **In vitro fertilization (IVF):** Ovarian stimulation, Egg retrieval, Sperm retrieval, Fertilization and Embryo transfer
7. **Contraceptive Methods:** Temporary & Permanent Methods

Suggested readings:

1. Austin, C.R. and Short, R.V. (1886), Reproduction in Mammals. Cambridge University Press.
2. Degroot, L.J. and Jameson, J.L. (2010), Endocrinology. 7th edition W.B. Saunders and Company.
3. Hatcher, R.A. et al.(1997), The Essentials of Contraceptive Technology. Handbook of clinical staff. Population Information Programme.
4. Gilbert, S. F. (2020). Developmental Biology (12th ed.). Sinauer Associates.
5. Knobil, E., & Neill, J. D. (Eds.). (2006). The Physiology of Reproduction (3rd ed.). Elsevier.
6. Strauss, J. F., & Barbieri, R. L. (Eds.). (2018). *Yen & Jaffe's Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management* (8th ed.). Elsevier.
7. Wassarman, P. M. (Ed.). (2019). *Gametogenesis, Fertilization and Early Development* (Current Topics in Developmental Biology, Vol. 135). Academic Press.

B. Sc. Part – III Semester -VI ZOOLOGY

DSE-II: 2DSE03ZOO62: COMPARATIVE ANATOMY OF VERTEBRATES

Credits: 02

Theory: 30hrs.

Marks-50

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

CO1: Identify the basic structural features of vertebrate anatomy.

CO2: Describe comparative structure and function of various organ systems in vertebrates.

CO3: Illustrate anatomical similarities and differences among vertebrates using diagram.

CO4: Analyze the adaptive modification in different vertebrate organ systems.

Unit I:

15hrs.

1. **Integumentary System**- Generalized structure of integument , Functions of Integument , Soft epidermal derivatives , Hard epidermal derivatives
2. **Skeletal System**- Types of vertebrae based on centrum, Vertebral column, Appendicular skeleton
3. **Digestive System**- Brief account of alimentary canal and digestive glands
4. **Respiratory System**- Brief account of Gills, lungs, air sacs and swim bladder

Unit II:

15hrs.

5. **Circulatory System** -Evolution of heart and aortic arches
6. **Evolution of Kidney**-Succession of kidney
7. **Nervous System**- Comparative account of brain
8. **Sense Organs**- Comparative account of ear and eye of vertebrates

Suggested Readings:

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition
2. The McGraw-Hill Companies. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and SonsWalter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
3. Outlines of comparative anatomy, Romer & Parsons, Central Book Depot, The Vertebrate Body (Saunders).
4. Biology of Vertebrates Walter & Sayles; (McMillan).
5. Chordate Zoology, P.S. Dhami & J. K. Dhami - R. Chand & Co., New Delhi.
6. Modern Textbook of Zoology, R. L. Kotpal, Rastogi Publications, Meerut.
7. The Life of Vertebrates, 3rd Edition, 1993, J. Z. Young E. L. B.S. Oxford.

8. Chordate Zoology - E.L. Jordan, S. Chand & Co., New Delhi.

9. Comparative Anatomy of the Vertebrates G. C. Kent.

B. Sc. Part – III Semester -VI ZOOLOGY

DSC-PR-VI: 2DSC03ZOO69: DSC Zoology Lab-6

Practicals Based on Paper Immunology (DSC03ZOO61), Developmental Biology (DSC03ZOO62), Aquatic Biology (DSC03ZOO63), Reproductive Biology (DSE03ZOO61), Comparative Anatomy

of Vertebrates (DSE03ZOO62)

Credits: 06

Marks-75

A. Practicals Based on Paper Immunology (DSC03ZOO61)

1. Histological study of bone marrow, thymus, spleen and lymph nodes
2. Demonstration of lymph node, spleen, mucosal-associated lymphoid tissue (MALT)
3. Study of the types of cells of the immune system (white blood cells).
4. Total leucocyte count from a given blood sample.
5. Differential WBC count from a given blood sample.
6. Antigen-antibody reaction by double immuno-diffusion method.
7. Antigen-antibody reaction by radial immuno-diffusion method.
8. Antigen-Antibody reactions – Agglutination (Blood group test).
9. Agglutination reactions- Latex agglutination reactions.
10. WIDAL test
11. Direct antiglobulin test (Coomb's test)
12. Demonstration of ELISA (Photograph)
13. Demonstration of immunoelectrophoresis (Photograph)
14. Report submission on autoimmune diseases/ data collection on blood groups

B. Practicals Based on Paper Developmental Biology (DSC03ZOO62)

1. Study of sperm in any suitable animal (permanent slides/microphotographs)
2. Study of types of eggs a. Amphioxus egg b. Frog Egg c. Hen's Egg d. Insect Egg
3. Study of developmental stages of frog (permanent slides/microphotographs)-Cleavage
Blastulation, Gastrulation, Neurulation
4. Stages of metamorphosis in frog (permanent slides/microphotographs/specimen)-External gill stage, Internal gill stage, Forelimb stage, Hind limb stage, Tail bud stage, Juvenile stage
5. Study of whole mount of chick embryo – 18, 24, 33, 48 and 72 hours (permanent slides /microphotographs)
6. T.S. of chick embryo – 18, 24, 33, 48 and 72 hours.
7. Preparation of whole mount of developing chick embryo
8. Demonstration of shell-less culture of early chick embryo in vitro.

9. Study of histological structures of the placenta (permanent slide or microphotographs) – Epitheliochorial, Endotheliochorial, Hemochorial, Syndesmochorial, Hemoendothelial
10. Study Morphological Types of placenta (permanent slide or microphotographs) Diffused, Intermediate, Cotyledonary, Zonary: Complete and incomplete, Discoidal: Monodiscoidal and Bidiscoidal
11. Study of developmental stages of *Drosophila*
12. Submission of permanent chick embryo slide

C. Practicals Based on Paper Aquatic biology (DSC03ZOO63)

1. Study of pond ecosystem on field
2. Collection, preservation, and identification of zooplanktons.
3. Study of equipment and instruments used in limnology and their significance
 - a) Thermometer
 - b) pH meter
 - c) Plankton net
 - d) Secchi disc
 - e) Sedgwick rafter cell
 - f) Conductivity meter
4. Study of aquatic insects- Photographs/specimens
5. Study of animals with reference to their respective habitats
 - a. Lentic and lotic (any common carp)
 - b. Estuarine- Shrimps
 - c. Intertidal Zones (Rocky-Sea cucumber; Sandy- Sea star; Muddy- Lungfish)
 - d. Deep sea-Anglerfish/ Ribbon Eel
6. Determine the amount of turbidity/transparency
7. Estimation of dissolved oxygen
8. Determination of BOD in given water sample
9. Determination of COD in given water sample
10. Estimation of free carbon dioxide from the given water sample
11. Determination of alkalinity from the given water sample
12. Determination of the total hardness from the given water sample

13. Determination of chloride from the given water sample
14. Report on a visit to a Sewage treatment plant/Marine bio reserve/ Fisheries Institute

D1. Practicals Based on Paper Reproductive Biology (DSE03ZOO61)

1. Study of Animal house: Set up and maintenance of animal house, Care of normal and experimental animals with the help of model/photographs
2. Study of Breeding techniques with the help of model/photographs
3. Study of structure of human sperm and ovum
4. Study of stages/phases of menstrual cycle.
5. Surgical techniques: Principles of surgery in endocrinology, Ovariectomy, Tubectomy in rats through demonstration or Video
6. Surgical techniques: Hysterectomy, orchiectomy and vasectomy in rats through demonstration or Video
7. Examination of histological sections from photomicrographs/permanent slides of rat Testis, Epididymis
8. Examination of histological sections from photomicrographs/permanent slides of rat Ovary, Fallopian tube, Uterus (proliferative and secretory stages), Cervix and Vagina
9. Microtechnique-Preparation of histological slide
10. Preparation of permanent slide using HE staining
11. Detection of pregnancy by using kit.
12. Study of contraceptive devices by photographs or models.

D1. Practicals Based on Paper Comparative Anatomy of Vertebrate (DSE03ZOO62)

1. Comparative Study of V.S. of the skin of vertebrates
2. Comparative Study of hard derivatives of skin
3. Comparative Study of soft derivatives of skin
4. Comparative Study of Digestive system of vertebrates
5. Comparative Study of Respiratory system of vertebrates
6. Comparative Study of Heart of vertebrates
7. Comparative Study of Brain of vertebrates
8. Comparison of Vertebral Column in Vertebrates

9. Comparative Study of pectoral girdle in vertebrates
10. Comparative Study of pelvic girdle in vertebrates
11. Study of Homologous in Vertebrates
12. Study of Analogous Structures in Vertebrates
13. Dissection of Fish to Study Digestive System
14. Comparative Study of photoreceptor in Vertebrates

Suggested Reading:

1. Verma, S.R. (2011). *Practical Zoology: Invertebrates*. Rastogi Publications.
2. Freckleton, R.W. (2008). *Animal Dissection Manual*. Pearson Education.
3. Singh, S.P.S.K. (2007). *Practical Manual on Comparative Anatomy*. New Age International Publishers.
4. Kotpal, R.L. (2015). *Practical Zoology: A Manual for Students*. Rastogi Publications.
5. Soni, K.L. (2010). *The Manual of Practical Zoology*. Laxmi Publications.
6. Ghosh, S.C. (2009). *Practical Manual of General Zoology*. New Central Book Agency.
7. Gupta, J.L. (2011). *Zoology Practical Manual for Undergraduates*. Rastogi Publications.
8. Purohit, S.P. (2014). *Zoology Practical Manual*. Book Enclave.
9. Practical Manual of Reproductive Physiology and Endocrinology – By Dr. S. K. Gupta
10. Practical Zoology: Chordates – By H. D. Kumar
11. Laboratory Manual for Human Reproductive Physiology – By R. K. Sharma & A. Singh
12. Manual of Reproductive Biology – By P. C. Chattopadhyay
13. Practical Zoology Manual – By S. S. Lal
14. Tonapi, G.T. 1980. Freshwater Animals of India. Oxford & IBH Publ. Co., New Delhi, 341 pp.
15. APHA, Standard methods for examination of water and wastewater. 24th Eds. Washington D.C., 2023.
16. Edmondson, W.T. 1959. Freshwater Biology. Wiley Publ., NY, 1248 pp.
17. Trivedy, R. K., Goel, P. K. and Trisal, C. L. (1987). Practical methods in ecology and environmental science.
18. Needham, J. G. and Needham, P. R. (1962). A guide to freshwater biology. Holden Day Ins., San Francisco (USA). PP. 108.

B. Sc. Part – III Semester -VI ZOOLOGY

VSC-PR-V: 2VSC03ZOO69: POULTRY FARMING

Credits: 02

Marks-25

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

CO1: Recall morphology of poultry birds and different poultry breeds

CO2: Understand rearing systems, houses and equipments used in poultry farming

CO3: Implement scientific nutrition and hatchery management strategies in poultry farming

CO4: Analyze different poultry diseases and their management strategies

1. Poultry farming- Scope and importance
2. Morphology of poultry birds
3. Indigenous breeds and exotic breeds of chicken
4. Types of poultry rearing systems - free-range, intensive, semi-intensive
5. Types of poultry houses and it's equipments
6. Scientific feeding or feed formulation and nutrition management in poultry birds
7. Breeding, incubation and hatchery management
8. Techniques used in processing and preservation of eggs and meat
9. Poultry diseases - bacterial, viral, fungal and parasitic; symptoms, control and management
10. Disease management, prevention and vaccination in poultry birds
11. Poultry waste management
12. Visit to any poultry farm/ hatchery

Suggested Readings:

1. Banerjee, G. C. (2018). A Text Book of Animal Husbandry. Oxford and IBH, Publishers. ISBN: 9788120412606.
2. Ghosh, N. (2015). Poultry Science Practices. CBS Publication & Distributions.
3. Rose, S. (1996). Principles of Poultry Science. CAB Publishers. ISBN 9780851991221.
4. Sreenivasaiah, P. V. (2014). Text Book of Poultry Science. Write and Print Publications. ISBN No. 9788192970592, 8192970590.
5. https://swayam.gov.in/nd2_nou19_ag09/preview
6. <http://www.asciindia.com/BooksPDF/Small%20Poultry%20Farmer.pdf>

VIVEKANAND COLLEGE, KOLHAPUR
(AN EMPOWERED AUTONOMOUS INSTITUTE)
B.Sc. Part- III (Zoology), Semester-V/VI Examination
Paper Name and No-

=====

Nature of Question Paper

Day:

Time: 2 hours

Date:

Marks: 40

Instructions:

- 1) All the questions are compulsory.
 - 2) Figures to the right indicate full marks.
 - 3) Draw neat labelled diagrams wherever necessary.
-

Q.1. A) Multiple choice questions

(8)

i).....

A) B) C) D)

ii).....

A) B) C) D)

iii).....

A) B) C) D)

iv).....

A) B) C) D)

v).....

A) B) C) D)

vi)

A) B) C) D)

vii).....

A) B) C) D)

viii).....

A) B) C) D)

Q.2. Attempt any Two

(16)

i)

ii)

iii)

Q.3. Attempt any Four

(16)

i)

ii)

iii)

iv)

v)

vi)

Vivekanand College, Kolhapur

(An Empowered Autonomous Institute)

B.Sc. Part- III (Zoology) Semester- V/VI

Practical Skeletal Question Paper

Practcals base on DSC, DSE, VSC	
Time 11.00am Onwards	Total Marks: 100
=====	
Time 11.00am Onwards	25 Marks
Q.1. Major Experiment	07 Marks
Q.2. Minor Experiment	04 Marks
Q.3. Minor Experiment	04 Marks
Q.4. Spotting	05 Marks
Q.5. Study tour report/ submission/ Project / Any other	02 Marks
Q.6. Certified journal	03 Marks