"Dissemination of Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur

(An Empowered Autonomous Institute)

DEPARTMENT OF ZOOLOGY

B.Sc. Part - III
Semester-V&VI

SYLLABUS

As per NEP-2020

To be implemented from Academic Year 2025-26

Departmental Teaching and Evaluation scheme

Third Year Semester-V & VI

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
Semester-V										
1	DSC-IX	DSC03ZOO51	Molecular Biology	2	-	40	10	-	50	2
2	DSC-X	DSC03ZOO52	Animal Biotechnology	2	-	40	10	-	50	2
3	DSC-XI	DSC03ZOO53	Ecology	2	-	40	10	-	50	2
4	DSE-I	DSE03ZOO51	Biostatistics & Bioinformatics	2	-	40	10	-	50	2
		DSE03ZOO52	Biology of Insect							
5	VSC-PR-IV	VSC03ZOO59	Pearl Culture	-	4	-	-	25	25	2
6	FP	FPR03ZOO51	Field Project	-	4	-	-	50	50	2
7	DSC-PR-V	DSC03ZOO59	DSC Zoology Lab-5	-	12	-	-	75	**75**	6
8	MIN-IX	MIN03ZOO51	Parasitology	2	-	40	10	-	50	2
9	MIN-PR-V	MIN03ZOO59	MIN Zoology Lab-5	-	4	-	-	25	25	2
Semester –V Total				**10**	**24**	**200**	**50**	**175**	**425**	**22**
Semester-VI										
1	DSC-XII	DSC03ZOO61	Immunology	2	-	40	10	-	50	2
2	DSC-XIII	DSC03ZOO62	Developmental Biology	2	-	40	10	-	50	2
3	DSC-XIV	DSC03ZOO63	Aquatic Biology	2	-	40	10	-	50	2
4	DSE-II	DSE03ZOO61	Reproductive Biology	2	-	40	10	-	50	2
		DSE03ZOO62	Comparative Anatomy of Vertebrates							
5	VSC-PR-V	VSC03ZOO69	Poultry farming	-	4	-	-	25	25	2
6	OJT	OJT03ZOO61	On Job Training	-	4	-	-	50	50	2
7	DSC-PR-VI	DSC03ZOO69	DSC Zoology Lab-6	-	12	-	-	75	75	6
8	MIN-X	MIN03ZOO61	Economic Zoology	2	-	40	10	-	50	2
9	MIN-PR-VI	MIN03ZOO69	MIN Zoology Lab-6	-	4	-	-	25	25	2
Semester –VI Total				**10**	**24**	**200**	**50**	**175**	**425**	**22**

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

Note:
Minimum passing for 10 marks Internal evaluation = 04 marks
Minimum passing for 40 marks Theory paper = 16 marks
Minimum passing for 25 marks Practical = 10 marks
Minimum passing for 50 marks Practical /FP/OJT = 20 marks
Minimum passing for 100 marks Practical/FP = 40 marks

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

Separate passing for each Head - ESE, CIE and Practicals

B. Sc. Part – III Semester -V ZOOLOGY

DSC-IX: DSC03ZOO51: 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

CO5: Design experimental approaches using molecular biology

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 Wobble 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. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular biology of the gene* (Indian ed.). Pearson Education.
2. Campbell, N. A., & Reece, J. B. (2020). *Biology* (11th ed.). Pearson Education.
3. Gupta, P. K. (2015). *Molecular biology* (4th ed.). Rastogi Publications.
4. Jain, S. K. (2009). *Principles of molecular biology*. S. Chand Publishing.
5. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., & Bretscher, A. (2020). *Molecular cell biology* (8th ed.). W.H. Freeman and Company.

6. Satyanarayana, U., & Chakrapani, U. (2006). *Biochemistry* (2nd ed.). Books & Allied (P) Ltd.
7. Singh, B. D. (2007). *Genetics* (3rd ed.). Kalyani Publishers.
8. Tropp, B. E. (2018). *Principles of molecular biology* (5th ed.). Jones & Bartlett Learning.
9. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., & Levine, M. (2021). *Molecular biology of the gene* (7th ed.). Pearson Education.

B. Sc. Part – III Semester -V ZOOLOGY

DSC-X: DSC03ZOO52: 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

CO5: Create research proposal and projects by using biotechniques

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
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 first edition Himalaya Publication House.
2. Beauchamp, T. I. and Childress, J. F. (2008). Principles of Biomedical Ethics. 6th Edition,
3. Das, H. K. (2007). Textbook of Biotechnology 3rd 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. 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: DSC03ZOO53: 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

CO5: Interpret ecological data using statistical tools

Unit I **15hrs.**

1. **Ecology**: Abiotic and biotic factors of ecosystem (Forest and Lake)

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); concept of metapopulation
8. **Ecological adaptation** in aquatic, desert & terrestrial animals

Suggested Reading:

1. Begon, M., J.L. Harper and C.R. Townsend. Ecology, Individuals, Populations and
2. Chapman Jr., W.B. Natural Ecosystems. Macmilan Pub. Co. Inc.
3. Cherrett, J.M. Ecological concepts. Blackwell Sci. Publi. Oxford, UK.
4. Clarke, G.L. (1954) Elements of Ecology. John Wiley & Sons, Inc. New York.
5. Communities. Blackwell Science, Oxford, UK.
   Educational Publishers Inc.
6. Giller, P.S. (1984) Community Structure and the Niche. Chapman & Hall.
7. Jorgensen, S.E. Fundamentals of ecological modelling. Elsevier, New York.
8. Odum, E.P. (1971). Fundamentals of Ecology. Saunders, Philadelphia
9. Odum, E.P. (1983). Basic Ecology. Saunders, Philadelphia
10. Odum, E.P. and Barrett, G.W., (2018). Fundamentals of Ecology, 5th Edition.
11. Ricklefs, R.E. and G.L. Miller. (1999) Ecology W.H. Freeman & Company
12. Ricklefs, R.E. and G.L. Miller. (1999) Ecology W.H. Freeman &Company.
13. Smith, R.L. and T.M. Smith (2002) Ecology and Field Biology. Addison – Wesley

B. Sc. Part – III Semester -V ZOOLOGY

DSE-I: DSE03ZOO51: BIOSTATISTICS AND BIOINFORMATICS

Credits: 02 **Theory: 30hrs.** **Marks-50**

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

CO1: Recall basic concepts in biostatistics and bioinformatics

CO2: Explain the application of various statistical tools in life science

CO3: Interpret and analyze the biological data using biostatistics and bioinformatics tools.

CO4: Reframe the biological data using biostatistics and bioinformatic techniques.

CO5: Apply microarray techniques for gene expression analysis

Unit I **15hrs.**

1. **Biostatistics:** Biostatics as a tool in research, Scope of Biostatistics,
2. **Measures of central tendency:** Concept of mean, mode, median
3. **Frequency distribution:** Principles of frequency distribution, Graphical presentation of data (Line diagram, Bar diagram; Pie chart, Histogram- equal and unequal classes, Polygon and frequency curve, Ogive curve)
4. **Tabulation –** Definition requirement of a good table, Part of the table, Type of tabulation, and its application.
5. **Methods of sampling data:** Random sampling, Stratified sampling, Systematic sampling
6. **Tools of biostatistics in life sciences & research:** Correlation: Types and methods of Correlation, Measure of dispersion (standard deviation), mean deviation, Student t-test, Chi-Square test, ANOVA.

Unit II **15hrs.**

7. **Introduction to Bioinformatics:** Definition, Basic concepts in bioinformatics, importance and role of bioinformatics in life sciences
8. **Elementary knowledge of computer:** Organization of computer, input and output devices, elementary idea of software, hardware
9. **Information Resources:** Introduction, aim and objectives, National Centre for Biotechnology Information(NCBI), National Library of Medicine (NLM), and National Institute of Health (NIH), EBI, Sequence retrieval system(SRS): Entrez, DBGet.
10. **Genomics and Genome databases:** Introduction, Databases, Data, Nucleic acid sequence database, Gene Bank, EMBL, DDBJ, Human Genome Project (HGP), Goal and applications of Genomics
11. **Gene Expression Analysis:** Microarray data analysis

12. **Proteomics:** Introduction, Types of proteomics, UniProt, Protein structure databases (PDB), Analysis of proteomics, Applications of proteomics

Suggested Reading:

1. Baxevanis, A.D. and Francis Ouellellette, B.F., (1998); Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. John Wiley & Sons, UK.
2. David W. Mount (2004), "Bioinformatics: Sequence and Genome Analysis" Cold Spring Harbor Laboratory Press.
3. Khan & Khanum (2004), Fundamentals of Biostat, Revised Edition, Ukaaz Pub.
4. N. Gurumani (2021), An introduction to Bio-Statistics, 1st Edn, MJP Pub, 290pp.
5. P. N. Arora and P. K. Malhan. Biostatistics, Himalaya Publishing House, New Delhi.
6. Pevsner, Jonathan (2009), "Bioinformatics and functional genomics", Wiley-Blackwell, 2nd edition, 1168pp.
7. Schaum's Outline Statistics (2007), M.R. Spiegel & L. J. Stephens, 4th edition, McGraw Hill Companies, 577pp.

B. Sc. Part – III Semester -V ZOOLOGY

DSE-II: DSE03ZOO52: 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

CO5: Assess the importance of insects in life sciences

Unit I: **15**

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 honey bee

Unit II: **15**

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

Suggested Readings

1. Agrawal N., (2021), Practical Manual Classification of Insects, Department of Entomology College of Agriculture Chandra Shekhar Azad University of Agriculture and Technology, Kanpur
2. Bernays, E. A., and Chapman, R. F. (1994), Host plant selection by phytophagous insects, Chapman and Hall, New York, USA
3. Chapman, R. F. (2012), The Insects: Structure and function, Cambridge University Press, UK
4. Donald J.B. (1981), Introduction to the study of insects, 5th Edition, Saunders College Publication, USA
5. Gullan, P. J., and Cranston, P. S. (2014), The Insects, An outline of Entomology, 5th Edition, Wiley Blackwell, UK
6. Imms, A. D. (1923), A general text book of entomology, Chapman & Hall, UK
7. James L. Nation, Sr. (2022), Insect Physiology and Biochemistry, 4th edition CRC Press, USA
8. Klowden, M. J. (2013), Physiological system in Insects, 3rd Edition, Academic Press, USA
9. Prasad, T.V., (2019), Handbook of Entomology (4th Edition), New Vishal Publication, New Delhi
10. Snodgrass, R. E. (1935), Principles of Insect Morphology, Cornell Univ. Press, USA

B. Sc. Part – III Semester -V ZOOLOGY

VSC-PR-IV: VSC03ZOO59: PEARL CULTURE

Credits: 02 **Marks-25**

(Four lectures of 60 minutes per week per batch)

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

CO1: Recall the basic concepts of pearl culture

CO2: Explain morphological and anatomical aspects of fresh water mussels

CO3: Construct pearl culture unit

CO4: Analyze the various techniques used in pearl culture

CO5: Develop self-employment and marketing skills in pearl culture

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1. Study of common species of fresh water pearl mussel used for pearl culture
2. Study of morphology and anatomy of fresh water pearl mussel
3. Study of life cycle of fresh water pearl mussel
4. Study of construction of fresh water pearl culture unit
5. Maintenance of fresh water pearl culture unit
6. Embedding beads in suitable mussel for pearl culture
7. Isolation and processing of pearl
8. Study of diseases and predators of fresh water pearl mussel
9. Study of pearl formation and it's chemical composition
10. Study of types of pearls – (Natural pearl and Cultured pearl)
11. Testing of natural and artificial pearl
12. Economic importance and marketing of pearl
13. Visit to any pearl culture unit

Suggested Readings:

1. Alexander, E. F. (1986). Pearls: Natural, Cultured, and Imitation, (U.S.A.) Butterworth Heinemann Publications.
2. Dobilet, D. (1995). Pearl Farming. (Australia) Nat Geographic Mag publication.
3. Haws, M. (2002). The basics of pearl farming: a Layman's manual: (U.S.A). CTSA Publications.
4. Le Jia Li. (2014). New technologies to promote freshwater pearl culture. (China) Ocean Press Publications.
5. Yuan Cha Da. (2014). Environmental effects Pearl farming. (China) Jiangxi People Publishing House.

B. Sc. Part – III Semester -V ZOOLOGY

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

Practicals Based on Paper Molecular Biology (DSC03ZOO51), Animal Biotechnology (DSC03ZOO52), Ecology (DSC03ZOO53), Biostatistics & Bioinformatics (DSE03ZOO51), Biology of Insect (DSE03ZOO52)

Credits: 06 **Marks-75**

A. Practicals Based on Paper Molecular Biology (DSC03ZOO51)

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

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. Visit to stem cell/ tissue culture laboratory

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
13. Visit to Sanctuary/ National park / Seashore/ Freshwater ecosystem etc.

D.1 Practicals Based on Paper Biostatistics & Bioinformatics (DSE03ZOO51)

1. Calculate the mean, mode and median using given data (Any three examples)
2. Calculate the standard deviation using the given data.
3. Draw a line/ Bar/ Pie diagram using the given data.
4. Example based on student t-test.
5. Example based on Chi-square test
6. Example based on ANOVA
7. Draw a Histogram by using given data (equal unequal distribution)
8. Examples based on correlation (Any two examples)
9. Introduction to PUBMED Central database using the ENTREZ search engine.
10. Getting the amino acid and gene sequences by exploring and querying the protein and nucleic acid Sequence database.
11. Similarity search for nucleotide and protein using the BLASTn, BLASTp and interpretation of the results.
12. Protein and nucleic acid pair-wise sequence alignment by using ClustalW

13. Calculation of PI/MW of protein and Prediction of the secondary structure of protein using ExPasy web tool (GOR method).
14. Interpretation of gene expression results from microarray data
15. Project-based learning: Students will typically undertake a research project applying bioinformatics techniques to analyze biological data related to their area of interest (e.g., cancer genomics, microbial ecology, evolutionary biology).

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

1. General characters of class Insecta and its classification upto order
2. Study of different types of mouth parts in insects
3. Study of different kinds of antennae and legs in insects
4. Study of insect wings and their venation.
5. Study of insect trachea and spiracles
6. Morphological studies of various castes of *honey bees*
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. The collection, preservation and identification of insects.
11. Demonstration of insect vectors
12. Social behaviour in honey bee
13. To study insecticides and their compositions

Suggested Readings:

1. Bhatia, S.C. (2012). Molecular Biology: Principles and Applications. CBS Publishers & Distributors.
2. Dubey, R.C**.** (2003). *A Textbook of Practical Zoology*. S. Chand & Company Ltd.
3. Dubey, R.C**.** (2009). Practical Manual of Animal Biotechnology. S. Chand Publishing.
4. Glower D. M. and Hames B. D. (1995) DNA cloning: A practical approach IRL Press, oxford.
5. Gupta, P.K. (2007). Practical Manual of Molecular Biology. Rastogi Publications.
6. Mahajan R., Sharma, R. and Mahajan R. K. (2020) Practical Manual of Biotechnology. Vayu Education of India
7. Rao, M.S.M.P.K.N. (2015). Animal Biotechnology: Methods and Applications. Springer.

8. Singh B. R. and Kumar R. (2022) Practical Techniques in Molecular Biotechnology. Cambridge University Press
9. Timbre D. B. (2010) Techniques in life Sciences. Himalaya publishing House. 1-463
10. Verma, P.S., & Agarwal, V.K. (2007). *Practical Zoology* (Vol. 1). S. Chand Publishing.

B.Sc. Part III Semester-V ZOOLOGY

MIN-IX MIN03ZOO51: 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

CO 5. Evaluate and compare the importance of parasites with examples

Unit I **15 hrs.**

1. **Introduction and Concepts to Parasitology**

   Definition: Parasitism, Parasite, Parasitoid, Host, Vector, Zoonosis

   Types of Parasites with examples: Ectoparasites, Endoparasites, Facultative parasite Obligatory parasites.

   Types of Hosts with examples: Definitive host, Intermediate host

2. **Host-Parasite relationship**

   Host specificity, types of host specificity: structural specificity, physiological specificity, and ecological specificity. Effects of parasite on host, Factors affecting the host-parasite relationship. Parasitism, Symbiosis, Commensalisms, and Mutualism with suitable example.

Unit II **15 hrs.**

3. **Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of-**

   Parasitic Protists- *Plasmodium vivax, E. histolytica, Trypanosoma, giardia lambia*

   Parasitic helminth -*Taenia solium, Ascaris lumbricoides*

4. **Morphology, Life Cycle, pathogenicity and control measures of-**

   Parasitic Arthropoda- Head louse, Rat fleas, Bed bugs

   Parasitic Vertebrates - A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird, and Vampire bat

Readings:

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 & Distributers, 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

MIN-PR-V: MIN03ZOO59: MIN Zoology Lab-5

Practicals Based on Paper Parasitology

Credits 2 **Marks: 25**

(Four lectures of 60 minutes per week per batch)

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1. Study of parasitic association with their example - a) Commensalism. b) Parasitism.
2. To study the life cycle, pathogenecity, diagnosis and treatment of *Entamoeba histolytica* through permanent slides or microphotographs.
3. To study the life cycle, pathogenecity, 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 invertebrate (Insect)
11. Study of parasites from the gut of any vertebrate (Fish)
12. Study of parasites of the earthworm
13. Study of parasitic vertebrates-Photographs
14. Collection and identification of parasites from cow dung
15. Collection & submission of various parasites/vectors (Any five parasites)

Suggested Readings:

1. Goswami, S.K.K. (2015). Practical Parasitology: A Laboratory Manual. New Central Book Agency.
2. Green, M.B.S. (2011). Veterinary Parasitology: A Practical Guide. Wiley-Blackwell.
3. Kundu, K.K.K. (2009). Practical Parasitology: A Manual for Students. New Age International Publishers.
4. Lunt, D.J. (2004). Practical Parasitology: Protozoa and Helminths. University Press.
5. Shinde, B.L. (2013). Practical Parasitology for Medical and Clinical Laboratory. CBS Publishers & Distributors.
6. Tiwari, A.P. (2010). Essentials of Parasitology: Practical Manual. Agrobios Publishers.

B.Sc. Part III Semester-VI ZOOLOGY

DSC-XII DSC03ZOO61: 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. Analyze and compare immune system mechanisms

CO5. Explain and evaluate the working of immune system

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. Hematopoiesis
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, payers patches, mucosal-associated lymphoid tissue (MALT)
8. Primary and secondary immune responses

Unit II: **15 hrs.**

9. Antigens**:** 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 Litchman A. H. (2003). Cellular and Molecular Immunology, 5th edn., Saunders Publication
2. Abbas, A. K. and Litchman A. H. (2004). Basic Immunology: Functions and disorders of the immune system, 2nd edn.
3. C. V. Rao (2002). An Introduction to Immunology Narossa Publishers.
4. D. Mole, J. Bronstoff, D. Roth, I. Roitt, Mosbey (2006). Immunology 7th International edn. Elsevier publication.
5. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, 7th Edition, Mosby, Elsevier Publication.
6. Delves P., Martin S., Burton D. and Roitt (2011) Essential Immunology (Essentials), 12th Edition.
7. Hildeman, W.H. (2002) "Essentials of immunology", Elsevier Scientific. 2002
8. Janeway C. A., Travers P., Walport M. and Shlomchik M. (2005). Immunology: The immune system in health and disease 6th edn. Garland Science Pub.
9. Kindt T. J., Osborne B. A. and Goldby R. A. (2013) Kuby Immunology, 7th Edition.

10. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, 6th Edition. W.H. Freeman and Company.
11. Roitt's Essential Immunology (2006) 11th edition. Blackwell publication.

B. Sc. Part – III Semester -VI ZOOLOGY

DSC-XIII: DSC03ZOO62: 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

CO5: Acquire skills to design experiments in developmental biology

UNIT I: **15hrs**

1. **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
2. **Control of Development**: Gene activation, determination, induction, Differentiation, morphogenesis, Intercellular communication, Cell movements and cell death

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: DSC03ZOO63: 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

CO5: Develop Research and Field Technique skills

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. Ananthakrishnan, T. N. (1982). Bioresources Ecology (3rd ed.). Oxford & IBH Publishing. 159 pp.
2. Goldman, C. R., & Horne, A. J. (1994). Limnology (2nd ed.). McGraw-Hill Science/Engineering/Math. 480 pp.
3. Odum, E. P., & Barrett, G. W. (2004). Fundamentals of Ecology (5th ed.). Cengage Learning. 624 pp.
4. Wetzel, R. G. (2001). Limnology: Lake and River Ecosystems (3rd ed.). Academic Press. 1006 pp.
5. Trivedi, R. K., & Goel, P. K. (1986). Chemical and Biological Methods for Water Pollution Studies (Series in Methodology). Environmental Publications, Karad. 220 pp.
6. Welch, P. S. (2010). Limnology (Reprint). Narendra Publishing House. 538 pp. (Originally published: 1952, McGraw-Hill)
7. Markandeya, D. K. (2004). Environmental Biotechnology. APH Publishing. 210 pp.
8. Pandey, K., Shukla, J. P., & Trivedi, S. P. (2005). Fundamentals of Toxicology. New Central Book Agency Pvt. Ltd., Kolkata. 528 pp.
9. Dodds, W. K., & Whiles, M. R. (2010). Freshwater Ecology: Concepts and Environmental Applications of Limnology (2nd ed.). Academic Press. 829 pp.

B. Sc. Part – III Semester -VI ZOOLOGY

DSE-II: DSE03ZOO61: 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.

CO5: Assess the ethical implications of assisted reproductive technologies (ART)

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: **15Hrs**

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. Gilbert, S. F. (2020). Developmental Biology (12th ed.). Sinauer Associates.

4. Knobil, E., & Neill, J. D. (Eds.). (2006). The Physiology of Reproduction (3rd ed.). Elsevier.
5. Strauss, J. F., & Barbieri, R. L. (Eds.). (2018). *Yen & Jaffe's Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management* (8th ed.). Elsevier.
6. Wassermann, 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: DSE03ZOO62: 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.

CO5: Develop a comparative chart or model, highlighting key anatomical features across vertebrates.

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. Dhami, P. S., & Dhami, J. K. (2000). *Chordate zoology*. R. Chand & Co.

2. Hilderbrand, M., & Goslow, G. E. (1985). *Analysis of vertebrate structure* (5th ed.). John Wiley & Sons.
3. Jordan, E. L., & Verma, P. S. (2006). *Chordate zoology and elements of animal physiology*. S. Chand & Co.
4. Kardong, K. V. (2005). *Vertebrates: Comparative anatomy, function, evolution* (4th ed.). McGraw-Hill Higher Education.
5. Kent, G. C., & Carr, R. K. (2000). *Comparative anatomy of the vertebrates* (9th ed.). McGraw-Hill.
6. Kotpal, R. L. (2012). *Modern textbook of zoology: Vertebrates*. Rastogi Publications.
7. Romer, A. S., & Parsons, T. S. (1986). *The vertebrate body* (6th ed.). Saunders College Publishing.
8. Walter, H. E., & Sayles, L. P. (1970). *Biology of vertebrates*. McMillan Publishing.
9. Young, J. Z. (1981). *The life of vertebrates* (3rd ed.). Oxford University Press.

B. Sc. Part – III Semester -VI ZOOLOGY

DSC-PR-VI: DSC03ZOO69: 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. Staining of Spleen Sections for T cell and B cell zones
5. Differential WBC count from a given blood sample.
6. Antigen-antibody reaction by double immuno-diffusion method.
7. Antigen-Antibody reactions – Agglutination (Blood group test).
8. Agglutination reactions- Latex agglutination reactions.
9. WIDAL test
10. Direct antiglobulin test (Coomb's test)
11. Demonstration of ELISA (Photograph)
12. Demonstration of immunoelectrophoresis (Photograph)

13. Demonstration of dot blot
14. Report submission on autoimmune diseases/ blood groups/ institutional visit

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 chick embryo and submission of slide
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 slide (chick embryo)
13. Visit to research institutes

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 normal sperm count and its motility
5. Study of stages/phases of menstrual cycle.
6. Surgical techniques: Principles of surgery in endocrinology, Ovariectomy, Tubectomy in rats through demonstration or Video
7. Surgical techniques: Hysterectomy, orchiectomy and vasectomy in rats through demonstration or Video
8. Examination of histological sections from photomicrographs/permanent slides of rat Testis, Epididymis
9. Examination of histological sections from photomicrographs/permanent slides of rat Ovary, Fallopian tube, Uterus (proliferative and secretary stages), Cervix and Vagina
10. Microtechnique-Preparation of histological slide
11. Preparation of permanent slide using HE staining
12. Detection of pregnancy by using kit.
13. Study of contraceptive devices by photographs or models.
14. Visit to IVF center

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. APHA, (2023). Standard methods for examination of water and wastewater. 24th Eds. Washington D.C.,
2. Dr. S. K. Gupta (2004). Practical Manual of Reproductive Physiology and Endocrinology, Campus Books publications.
3. Edmondson, W.T. (1959). Freshwater Biology. Wiley Publ., NY, 1248 pp.
4. Freckleton, R.W. (2008). *Animal Dissection Manual*. Pearson Education.
5. Ghosh, S.C**.** (2009). *Practical Manual of General Zoology*. New Central Book Agency.
6. Gupta, J.L. (2011). *Zoology Practical Manual for Undergraduates*. Rastogi Publications.
7. Kotpal, R.L. (2015). *Practical Zoology: A Manual for Students*. Rastogi Publications.
8. Lal S. S. (2009-2010), Practical Zoology Vertebrate, Rastogi publication.
9. Needham, J. G. and Needham, P. R. (1962). A guide to freshwater biology. Holden Day Ins., San Francisco (USA). PP. 108.
10. Purohit, S.P. (2014). *Zoology Practical Manual*. Book Enclave.

11. S. S. Lal (2018). Practical Zoology Invertebrates, Rastogi publication.
12. Singh, S.P.S.K**.** (2007). *Practical Manual on Comparative Anatomy*. New Age International Publishers.
13. Soni, K.L. (2010). *The Manual of Practical Zoology*. Laxmi Publications.
14. Tonapi, G.T. (1980). Freshwater Animals of India. Oxford & IBH Publ. Co., New Delhi, 341 pp.
15. Trivedi, R. K., Goel, P. K. and Trisal, C. L. (1987). Practical methods in ecology and environmental science.
16. Verma, S.R. (2011). *Practical Zoology: Invertebrates*. Rastogi Publications.

B. Sc. Part – III Semester -VI ZOOLOGY

VSC-PR-V: VSC03ZOO69: 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

CO5: Develop self-employment in poultry farming

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.

B. Sc. Part – III Semester -VI ZOOLOGY

MIN-X: MIN03ZOO61: ECONOMIC ZOOLOGY

Credits: 02 **Theory: 30hrs.** **Marks-50**

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

CO1: Recall facts and basic concepts related to Economic Zoology.

CO2: Interpret how animal by-products are utilized in industries.

CO3: Acquire basic knowledge and skills in economic zoology

CO4: Analyze farm management techniques and economics & marketing strategies

CO5: Develop own business i.e. self-employment

UNIT I: **15hrs.**

1. **Sericulture:** History and present status of sericulture in India**,** Mulberry and non-mulberry silkworm**,** Life cycle of Bombyx mori **,** Silkworm rearing techniques**,** Silkworm diseases & pests and its control measures
2. **Apiculture:** Introduction and present status of apiculture**,** Species of honey bees, Life cycle of honey bee**,** Colony organization, division of labor and communication**,** Bee keeping methods and equipments, Pests and diseases of bees and their management

Unit II **15hrs.**

3. **Dairy Farming:** Importance; scope and management of farm animals, breeds of cows and buffaloes**,** nutrition requirements, housing and hygiene of dairy animals, milk and milk byproducts, processing, preservation and marketing of milk breeding techniques, artificial insemination, dairy equipment's (Milk machines, chaff cutter, milk cans and containers for liquid food)

4. **Goat farming:** Introduction to Goat Farming, Goat Breeds and Selection, Housing & Farm Management, Feeding & Nutrition, Health & Disease Management, Breeding & Reproductive Management, Marketing, Business, and Value Addition

Suggested Readings:

1. Banerjee, G. C. (2019). A textbook of Animal Husbandry (8th ed). Oxford Publishers.
2. Chaudhari, S. (2017). Economic Zoology. NCBA Publishers
3. Eikichi, H. (1999). Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Ganga, G. (2003). Comprehensive Sericulture Vol-II: Silkworm Rearing and Silk Reeling. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Jabde Pradip V (2005). Textbook of applied Zoology, Discovery Publishing House, New Delhi. Deb, R., Chakraborty, S., Singh, U., Kumar, S., & Sharma, A. (2012). Infectious Diseases of Cattle. Serial Publication House
6. Mahadevappa, D., Halliyal, V.G., Shankar, D.G. and Bhandiwad, R., (2000). Mulberry Silk Reeling Technology Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Roger, M (1990). The ABC and Xyz of Bee Culture: An Encyclopedia of Beekeeping, Kindle Edition.
8. Shukla and Upadhyaya (2002). Economic Zoology, Rastogi Publishers

B. Sc. Part – III Semester -VI ZOOLOGY

MIN-PR-VI: MIN03ZOO69: MIN Zoology Lab-6

Practicals Based on Paper Economic Zoology

Credits 2 **Marks: 25**

(Four lectures of 60 minutes per week per batch)

1. Identification of mulberry and non-mulberry silkworms
2. Identification of different larvae of silk worm- using specimens / pictures
3. Mounting of mouth parts of adult silkworm/ silk gland of larva
4. Identification of different types of honey bees
5. Determination of purity of Honey
6. Identification of cattle breeds and their characteristics (indigenous & exotic)

7. Determination of acidity, specific gravity, and density of milk
8. Determination of Fat % in Milk (Gerber Method)
9. Determination of SNF% (Solid-Not-Fat)
10. Estimation of reducing sugars/ lactose /protein/ calcium content from the given milk
11. Identification of breed in goat farming
12. Fodder Preparation Techniques for Goat Farming
13. Determination of adulteration in milk
14. Field visits to a Sericulture /Apiculture / Dairy/Goat farming unit

Suggested Readings:

1. Agarwal, R.C. **(**2012). *Practical Manual of Dairy Farming*. Kalyani Publishers.
2. Sood, M.P. (2013). *Dairy Science and Technology: Practical Manual*. Wiley-Blackwell.
3. Verma, P.S. & Agarwal, V.K. (2011). *Practical Manual on Economic Zoology*. S. Chand & Company Ltd.
4. Verma, S.R. (2014). *Practical Manual of Economic Zoology*. Prentice-Hall India.
5. YadavManju (2003). Economic Zoology, Discovery Publishing House.

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE, KOLHAPUR

(AN EMPOWERED AUTONOMOUS INSTITUTE)

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

Paper Name and No- ……

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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.

Nature of Question Paper (Major/ Minor)

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)

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur

(An Empowered Autonomous Institute)

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

Practical Skeletal Question Paper

Practicals base on DSC, DSE, VSC

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Total Marks: 25

Q.1. Major experiment------	08 Marks
Q.2. Minor experiment--------	05Marks
Q.3. Minor experiment--------	05Marks
Q.4. Spotting ----------	02 Marks
Q.6 Visit/submission/report	02 Marks
Q.5. Certified Journal	03Marks