



**Deccan Education Society's**  
**Fergusson College (Autonomous),**  
**Pune**

Learning Outcomes-Based Curriculum  
for 3/4 years B. Sc. /B. Sc. (Honours) Programme  
as per guidelines of  
**NEP-2020**

for  
**F. Y. B. Sc. (Zoology)**  
With effect from Academic Year  
**2023-2024**

### Program Outcomes (POs) for B.Sc.

|            |                                                                                                                                                                                                                                                                                                                  |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PO1</b> | <b>Disciplinary Knowledge:</b><br>Demonstrate comprehensive knowledge of the disciplines that form a part of an graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.                                                   |
| <b>PO2</b> | <b>Critical Thinking and Problem solving:</b><br>Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.                                                                                                                      |
| <b>PO3</b> | <b>Social competence:</b><br>Display the understanding, behavioural skills needed for successful social adaptation , work in groups, exhibits thoughts and ideas effectively in writing and orally.                                                                                                              |
| <b>PO4</b> | <b>Research-related skills and Scientific temper:</b><br>Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.                  |
| <b>PO5</b> | <b>Trans-disciplinary knowledge:</b><br>Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.                                                                                                            |
| <b>PO6</b> | <b>Personal and professional competence:</b><br>Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics. |
| <b>PO7</b> | <b>Effective Citizenship and Ethics:</b><br>Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.                                                       |
| <b>PO8</b> | <b>Environment and Sustainability:</b><br>Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.                                                                                                        |
| <b>PO9</b> | <b>Self-directed and Life-long learning:</b><br>Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.                                                                                                                                      |

| PSO<br>No.  | <b>Program Specific Outcomes(PSOs)</b><br><b>Upon completion of this programme the student will be able to</b>                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PSO1</b> | <b>Academic competence:</b><br>(i) Develop deeper understanding of key concepts of Zoology at biochemical, molecular, cellular, physiological, histological and systematic level.<br>(ii) Understand the ecological impact on the evolutionary history of not only mankind but also unfolding the secrets of origin of life and classical Zoology.<br>(iii) Assess environmental impact on applied and skill-based branches of Zoology                                              |
| <b>PSO2</b> | <b>Personal and Professional Competence:</b><br>(i) Carry out analysis of biological data, perform laboratory procedure with suitable technique in Histology, Physiology, Immunology, Bio- chemistry, molecular biology, environment biology, organic evolution, animal pathology, Endocrinology and biological techniques.<br>(ii) Identify animals on the basis of comparative morphology and anatomy.                                                                            |
| <b>PSO3</b> | <b>Research Competence:</b><br>(i) Integrate and explore biological data.<br>(ii) Use current laboratory setup, instrumentation, statistical and biological techniques in the collection, organization, analysis, interpretation and manipulating the data related to Zoology discipline and allied branches.<br>(iii) Identify and interpret research literature, formulate ideas, write reports and review articles related to the subject.                                       |
| <b>PSO4</b> | <b>Entrepreneurial and Social competence:</b><br>(i) Empower the students by enhancing their self-sustainability capabilities through a thorough understanding of skill-based subjects and techniques by learning<br>(ii) culturing techniques of economically important animals in applied and classical zoology.<br>(iii) Develop social competence including listening, speaking, observational, effective interactive skills and presenting skills to meet global competencies. |

Fergusson College (Autonomous), Pune  
Proposed First Year Curriculum as per NEP 2020

**Department of Zoology**  
**Structure for Major / Minor**

| Sem       | Paper Code             | Paper Title                                           | Type              | Credits  |
|-----------|------------------------|-------------------------------------------------------|-------------------|----------|
| <b>I</b>  | <b>ZOO-100 (Major)</b> | Systematics & Diversity of Life Lab                   | <b>Practical</b>  | <b>2</b> |
|           | <b>ZOO-101 (Major)</b> | Systematics & Diversity of Life                       | <b>Theory</b>     | <b>4</b> |
|           | <b>ZOO-120 (GE/OE)</b> | Vector Diseases and Control                           | <b>Theory</b>     | <b>2</b> |
|           | <b>ZOO-121 (GE/OE)</b> | Global Environmental Issues                           | <b>Theory</b>     | <b>2</b> |
|           | <b>ZOO-130 (VSC)</b>   | Dairy Production and Technology                       | <b>Voc. Skill</b> | <b>2</b> |
|           | <b>ZOO-140 (SEC)</b>   | Good Laboratory Practices                             | <b>Skill</b>      | <b>2</b> |
|           | <b>IKS-101 (IKS)</b>   | Indian Knowledge Systems                              | <b>IKS</b>        | <b>2</b> |
| <b>II</b> | <b>ZOO-150 (Major)</b> | Genetics Lab                                          | <b>Practical</b>  | <b>2</b> |
|           | <b>ZOO-151 (Major)</b> | Genetics                                              | <b>Theory</b>     | <b>4</b> |
|           | <b>ZOO-160 (Minor)</b> | Animal Systematics                                    | <b>Theory</b>     | <b>2</b> |
|           |                        |                                                       |                   |          |
|           | <b>ZOO-170 (GE/OE)</b> | Human Physiology                                      | <b>Theory</b>     | <b>2</b> |
|           | <b>ZOO-171 (GE/OE)</b> | Biodiversity Conservation and Sustainable Development | <b>Theory</b>     | <b>2</b> |
|           | <b>ZOO-180 (VSC)</b>   | Bee Keeping                                           | <b>Voc. Skill</b> | <b>2</b> |
|           | <b>ZOO-190 (SEC)</b>   | Public Health and Hygiene                             | <b>Skill</b>      | <b>2</b> |

**Teaching and Evaluation (Only for FORMAL education courses)**

| Course Credits | No. of Hours per Semester<br>Theory/Practical | No. of Hours per Week<br>Theory/Practical | Maximum Marks | CE<br>40 % | ESE<br>60% |
|----------------|-----------------------------------------------|-------------------------------------------|---------------|------------|------------|
| <b>1</b>       | <b>15 / 30</b>                                | <b>1 / 2</b>                              | <b>25</b>     | <b>10</b>  | <b>15</b>  |
| <b>2</b>       | <b>30 / 60</b>                                | <b>2 / 4</b>                              | <b>50</b>     | <b>20</b>  | <b>30</b>  |
| <b>3</b>       | <b>45 / 90</b>                                | <b>3 / 6</b>                              | <b>75</b>     | <b>30</b>  | <b>45</b>  |
| <b>4</b>       | <b>60 / 120</b>                               | <b>4 / 8</b>                              | <b>100</b>    | <b>40</b>  | <b>60</b>  |

**Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)**

| F.Y.B.Sc. Semester I                                                                              |                                                                                                                                                                                                                    |                                 |
|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>ZOO-100</b>                                                                                    | <b>Systematics and Diversity of Life Lab<br/>(Major-Practical)</b>                                                                                                                                                 | <b>Credits: 2<br/>Hours: 60</b> |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                                                                                                                                    |                                 |
| CO1                                                                                               | Recall the classification system of Invertebrates and chordates animals. Identify the animals belonging to different phylum of animals. Retrieve the data of animals from field visit.                             |                                 |
| CO2                                                                                               | Classify the invertebrates and vertebrate's animals belonging to various classes. Understand the morphological features of animals, diagram and label it. Differentiate the fauna based on morphological features. |                                 |
| CO3                                                                                               | Interpret the data of field visit. Organize the animals as per their hierarchy of classification.                                                                                                                  |                                 |
| CO4                                                                                               | Classify and compare and distinguish the chordates and non-chordates based on morphological characters of Animals.                                                                                                 |                                 |
| CO5                                                                                               | Compare the similarities and differences between animals.                                                                                                                                                          |                                 |
| CO6                                                                                               | Construct the classification schemes of animals based on morphological features.                                                                                                                                   |                                 |

Any 10 experiments: 8 compulsory + 1 Activity (Equivalent to Two Practical's)

| <b>Expt. No.</b> | <b>Title of the Experiment</b>                                                                                                                                                                                                                                                                              |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.               | Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Protista, and Porifera. (One Specimen from each class)                                                                                               |
| 2.               | Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Cnidaria and Helminths ( One specimen from each class of Cnidaria and Platyhelminthes, one Specimen from Aphasmodia and one Specimen from Phasmodia) |
| 3.               | Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Annelida and Arthropoda ( One specimen from each class of Annelida and one Specimen from each subphylum of Arthropoda)                               |
| 4.               | Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Mollusca and Echinodermata (One specimen from each class of from Mollusca and Echinodermata)                                                         |
| 5.               | Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from                                                                                                                                                      |

|     |                                                                                                                                                                                                                                                                                                                                                       |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | Protochordata, Cyclostomata and Pisces. (One specimen from each class of from Hemicordata, Urochordata, Cephalochordata and Cyclostomata, One specimen from Chondrichthyes as well Ostichthyes).                                                                                                                                                      |
| 6.  | Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Amphibia and Reptiles. (One specimens from each order of class Amphibia and Reptiles).                                                                                                         |
| 7.  | Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Aves and Mammals. (One specimen from Archaeornithes, One specimen from each super order of Neornithes of class Aves, one Specimen from Prototheria, Metatheria and Eutheria of class Mammals). |
| 8.  | Temporary preparation of slide of Spicules and study of gemmules from Sponges.                                                                                                                                                                                                                                                                        |
| 9.  | Study and temporary preparation of slide of different types scales from Fishes.                                                                                                                                                                                                                                                                       |
| 10. | Study of animals in nature during a survey of a National Park or Forest area.                                                                                                                                                                                                                                                                         |
| 11. | A project work on any five wild animals' species- generic identification, description and illustration with a note on their locality. Also the assessment of their relationship by constructing a cladogram using characters and character states.                                                                                                    |
| 12. | Comparison of two chordate species belonging to same genus (Interspecific difference). Comparison and weighting of characters of two chordates belonging to same family but dissimilar genera.                                                                                                                                                        |

| F.Y.B.Sc. Semester I                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| ZOO-101                                                                                           | Systematics and Diversity of Life<br>(Major- Theory)                                                                                                                                                                                                                                                                                                                                                                                                                | Credits: 4<br>Hours: 60 |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |
| CO1                                                                                               | Define terms related to Multicellularity, animal systematics and outline the various systems of classification.                                                                                                                                                                                                                                                                                                                                                     |                         |
| CO2                                                                                               | Outline the Structure and diversity in Protists, Origin of Metazoans, Cnidarians Bilateria, acoelomates                                                                                                                                                                                                                                                                                                                                                             |                         |
| CO3                                                                                               | Demonstrate the characteristics of Ecdysozoa : Pseudo coelomates; Basic organization and adaptive radiations in roundworms.                                                                                                                                                                                                                                                                                                                                         |                         |
| CO4                                                                                               | Demonstrate the characteristics of The coelomates, Arthropods and Molluscs,                                                                                                                                                                                                                                                                                                                                                                                         |                         |
| CO5                                                                                               | Classify the Chordates – Primitive Chordates and their affinities. Hemichordates, Urochordates and Cephalochordates. Advent of vertebrates: Cyclostomes, their evolutionary status and affinities.                                                                                                                                                                                                                                                                  |                         |
| CO6                                                                                               | Outline the Structure and diversity ,basic organization of fishes, their evolutionary transitions. From Water to Land invasion - Early Tetrapodes. Amphibians diversity and adaptability to dual mode of life. Amniotes: the amniotic egg, adaptive radiations in reptiles; the avian ancestors. Birds: Adaptation ,Origin of Mammals- Special features of Monotremes and Marsupials. Characteristics of other mammalian groups with special reference to primates. |                         |

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | No. of hours |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Origin of Life on Earth, Products of evolutionary process:</b> Multicellularity: from simple collections of poorly differentiated cells to complex body plans. Biological diversity. Animal Systematics and taxonomy. Species concept, clades. Nomenclature and utility of scientific names. Classification: morphological and evolutionary (molecular). Relationship of taxa: phylogenetics and cladistics with special reference to paraphyly, monophyly, apomorphy, plesiomorphy and phenoplasticity | 15           |
| II   | <b>Diversity in Protists and acoelomate Metazoa:</b><br>Structure and diversity in Protists. Origin of Metazoans: Diploblastic and triploblastic organization; symmetries; body cavities; protostomes and deuterostomes. Special features and structural diversity in sponges. Cnidarians: Special features; polymorphism and division of labour; coral reef forming Cnidarians. The Bilateria: Basic characteristics.                                                                                     | 15           |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | The acoelomates: Basic organization and adaptive radiations in flatworms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |
| <b>III</b> | <p><b>Diversity in pseudocoelomate and coelomate:</b></p> <p>Non chordates 1The Ecdysozoa: characteristics of the representative taxa. Pseudo coelomates; Basic organization and adaptive radiations in roundworms.</p> <p>The coelomates: -<br/>Basic organization and diversity in Annelids.<br/>Basic organization and adaptive radiations in Arthropods- Ancestors/ fossil arthropods. Adaptive radiations in Crustaceans, Myriapods, Chelicerates, Insects, etc.<br/>Basic organization and diversity in Molluscs.<br/>Disruption of bilateral symmetry and its significance. Basic organization of Echinoderms; their affinity to Chordates.</p>                                                                                                                 | <b>15</b> |
| <b>IV</b>  | <p><b>Diversity in Protochordates and Chordates:</b></p> <p>Chordates – Primitive Chordates and their affinities. Hemichordates, Urochordates and Cephalochordates. Advent of vertebrates: Cyclostomes, their evolutionary status and affinities.<br/>Basic organization and diversity of fishes, their evolutionary transitions.<br/>From Water to Land invasion - Early Tetrapodes.<br/>Amphibians diversity and adaptability to dual mode of life.<br/>Amniotes: the amniotic egg, adaptive radiations in reptiles; the avian ancestors.<br/>Birds: Adaptation from terrestrial to aerial mode of life.<br/>Origin of Mammals- Special features of Monotremes and Marsupials.<br/>Characteristics of other mammalian groups with special reference to primates.</p> | <b>15</b> |

## References

1. Barnes, R. S. K.; Calow, P.; Olive, P. J. W.; Golding, D. W.; Spicer, J. I. (2002) The Invertebrates: a Synthesis, Blackwell Publishing.
2. Hickman, C.; Roberts, L.S.; Keen, S.L.; Larson, A. and Eisenhour, D. (2018) Animal Diversity, McGraw-Hill.
3. Holland, P. (2011) The Animal Kingdom: A Very Short Introduction, Oxford University Press.
4. Kardong, K.V. (2006) Vertebrates: Comparative Anatomy, Function, Evolution (4th edition), McGraw- Hill.
5. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
6. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
7. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.

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|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>ZOO-120</b>                                                                                    | <b>Vector, Diseases and Control<br/>(GE/OE-Theory)</b>                                                                                                                                                                                 | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                                                                                                                                                        |                                 |
| CO1                                                                                               | Define terms Vector, types and morphological peculiarities of vectors                                                                                                                                                                  |                                 |
| CO2                                                                                               | Outline Salient features of the vectors belonging to Diptera, Siphonaptera, Siphunculata, Hemiptera, Arachnida, Blattaria, Acarina Structure and diversity in Protists, Origin of Metazoans, Cnidarians, Bilateria, acoelomates.       |                                 |
| CO3                                                                                               | Demonstrate the role of non-blood sucking flies in myiasis; of blood sucking flies in transmission of plague and typhus; of lice (body, head, pubic) in transmission of typhus, relapsing and trench fevers. Examples of few diseases. |                                 |
| CO4                                                                                               | Demonstrate the control of vector flies by screening and different methods.                                                                                                                                                            |                                 |
| CO5                                                                                               | Define biological control by natural parasites and predators, Chemical control, Sterile insect technique.                                                                                                                              |                                 |
| CO6                                                                                               | Demonstrate Legislation and regulation of vectors and diseases.                                                                                                                                                                        |                                 |

| <b>Unit</b> | <b>Contents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>No. of hours</b> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>I</b>    | <b>Vector and vector bionomics</b><br>Brief introduction, types and morphological peculiarities of vectors such as mosquitoes, flies, fleas, lice, bugs, ticks and mites. Host-vector relationship. Primary and secondary vector conpt. Vectorial capacity. Vector bionomics-larval habitats and host biting preferences, human and animal biting indices.                                                                                             | <b>8</b>            |
| <b>II</b>   | <b>Disease vectors and the causes of disease outbreaks</b><br>Salient features of the vectors belonging to Diptera, Siphonaptera, Siphunculata, Hemiptera, Arachnida, Blattaria, Acarina (families Ixodidae and Argasidae) etc. Role of non-blood sucking flies in myiasis; of blood sucking flies in transmission of plague and typhus; of lice (body, head, pubic) in transmission of typhus, relapsing and trench fevers. Examples of few diseases. | <b>10</b>           |
| <b>III</b>  | <b>Vector management strategies</b><br>Control of vector flies by screening, fly traps, electrocution, poison baits and outdoor residual sprays; biological control by natural parasites and predators. Chemical control. Biological control of mosquitoes by the use of viruses, bacteria, fungi, parasites, nematodes and larvivorous fishes. Sterile insect technique,                                                                              | <b>10</b>           |
| <b>IV</b>   | <b>Emerging concepts and approaches to vector management</b><br>Legislation and regulation of vectors and diseases.                                                                                                                                                                                                                                                                                                                                    | <b>2</b>            |

#### References:

1. Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK.

2. Chapman, R.F. (1998). The Insects: Structure and Function.IV Edition, Cambridge University Press, UK.
3. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and other Insect Vector borne Disease.Wiley-Blackwell.
4. Belding, D.L. (1942). Textbook of Clinical Parasitology. Appleton-Century Co., Inc., New York.
5. Roy, D.N. and Brown, A.W.A. (2004). Entomology. Biotech Books, Delhi

| F.Y.B.Sc. Semester I                                                                              |                                                                                                                                     |                                 |
|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>ZOO-121</b>                                                                                    | <b>Global Environmental Issues<br/>(GE/OE-Theory)</b>                                                                               | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                                                     |                                 |
| CO1                                                                                               | Define distinct types of pollution, Recall the concept Eutrophication, their impact and biotechnological approaches for management. |                                 |
| CO2                                                                                               | Understand the fundamental issues of environment. Explain the effect of UV rays, ozone depletion, greenhouse effect.                |                                 |
| CO3                                                                                               | Illustrate the aerobic and anaerobic process of decomposition of sludge.                                                            |                                 |
| CO4                                                                                               | Analyze different sources of environmental problems and methods of measurement of pollution.                                        |                                 |
| CO5                                                                                               | Integrate the data of environmental economics.                                                                                      |                                 |
| CO6                                                                                               | Hypothesize the environmental issue related to pollution.                                                                           |                                 |

| Unit       | Contents                                                                                                                                                                                                                                                                                                                            | No. of hours |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>I</b>   | <b>Environment and Environmental Problems</b><br>Basic concepts and issues, global environmental problems - ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, Fisheries depletion, Eutrophication, their impact and biotechnological approaches for management.                               | <b>8</b>     |
| <b>II</b>  | <b>Environmental Pollution</b><br>Environmental pollution - types of pollution, Air, water and land pollution. sources of pollution, measurement of pollution, fate of pollutants in the environment, Ocean acidification, Bioconcentration, bio/geomagnification.                                                                  | <b>10</b>    |
| <b>III</b> | <b>Environmental Economics</b><br>Environmental Economics: Basic concept; methods of evaluation; Economic growth, Gross National Productivity and the quality of life, Tragedy of Commons, Economics of Pollution control, Cost-benefit ratio and cost effectiveness analysis.                                                      | <b>10</b>    |
| <b>IV</b>  | <b>Use of Microbes in Waste Water Treatment</b><br>Aerobic decomposition process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic decomposition process - anaerobic filters, up- flow anaerobic sludge blanket reactors. Treatment schemes for sewage from | <b>2</b>     |

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|  | dairy, distillery, tannery, sugar and pharma industries. |  |
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### References

1. Frances, H. (2012). Global Environmental Issues (2<sup>nd</sup> edition) Willey-Blackwell
2. Mahesh, R. (2007) Environmental Issues in India: A Reader. Pearson-Longman.

| F.Y.B.Sc. Semester I |                                          |                         |
|----------------------|------------------------------------------|-------------------------|
| ZOO-130              | Dairy Production and Technology<br>(VSC) | Credits: 2<br>Hours: 30 |

| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                                                                               | Describe the nutritive value and composition of milk. Identify the various breeds of cattle.                                                                                                                                   |
| CO2                                                                                               | Understand the challenges in management and setting of dairies, Distinguish the cattle breed. Estimates the budgets of dairy farm.                                                                                             |
| CO3                                                                                               | Apply the knowledge of management of Dairy to improve the business profit. Implement the dairy business.                                                                                                                       |
| CO4                                                                                               | Explain History and future of Dairy Industry, Distribution map of dairy farming areas/ major milk producing regions in India. Analyze the various Dairy Products and their nutritive value. Milk, cheese, yoghurt, gluten etc. |
| CO5                                                                                               | Standardize and validates breed selection: Breeds of cattle and buffalo,,and dairy products.                                                                                                                                   |
| CO6                                                                                               | Plan to establish the dairy business.                                                                                                                                                                                          |

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No. of hours |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Planning and maintaining desired cattle breeds</b><br>History and future of Dairy Industry, Distribution map of dairy farming areas/ major milk producing regions in India. Dairy Products and their nutritive value. Milk, cheese, yoghurt, gluten etc; Dairy farm planning Management. Challenges in setting up a dairy farm. Environment and facilities:..Managing Dairy Cattle. Breed selection: Breeds of cattle and buffalo, Native cow varieties, Indian exotic breeds their popularity and performance. | 10           |
| II   | <b>Housing and maternity management</b><br>Housing of Dairy Cattle. Dairy and shed design. Cooling strategies, Cow comfort Management; Cleaning Management. Animal signs Management. Dairy herd Management and growth; Cow health and reproductive performance. Breeding Dairy Cattle. Artificial insemination and conception; Maternity management, The Lactation Cycle. Calf management, Common management procedures. Vaccination.                                                                              | 10           |
| III  | <b>Milk products management</b><br>Management. Gathering cow for milking; Milking machines for smallholders; cleaning and sanitizing dairy equipment; Milking procedure. Dry cow therapy; Milk filtration Management. Milking Hygiene; Post-harvest milk quality.                                                                                                                                                                                                                                                  | 8            |
| IV   | <b>Business prospects, Biosecurity</b><br>Dairy business profit strategies. Common disorders and diseases in Dairy Cattle and calf; Managing Dairy Facilities for sick and lame cows., Manure handling.                                                                                                                                                                                                                                                                                                            | 2            |

## References

1. Klaus, A. J. (2015) Dairy Farming: The Beautiful Way
2. G.C. Banerjee (1998) Animal Husbandry
3. Leitch, A. (2018) The Dairy Farm: Dairy Cattle Methods, and Dairy Farm Management

| F.Y.B.Sc. Semester I                                              |                                                                                                                  |                                 |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>ZOO-140</b>                                                    | <b>Good Laboratory Practices (SEC)</b>                                                                           | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b>                                      |                                                                                                                  |                                 |
| <b>On completion of the course, the students will be able to:</b> |                                                                                                                  |                                 |
| CO1                                                               | Describe the biohazard agents, risk groups and Biosafety, safety measures in laboratories                        |                                 |
| CO2                                                               | Understand the preparation of labels of reagents and preparation of chemicals by considering basis like molarity |                                 |
| CO3                                                               | Illustrate weighing and staining procedure                                                                       |                                 |
| CO4                                                               | Classify reactive dyes and monochrome                                                                            |                                 |
| CO5                                                               | Review whole mount and tissue preparation methods                                                                |                                 |
| CO6                                                               | Interrogate key relevant problems and association in zoology research                                            |                                 |

| Unit       | Contents                                                                                                                                                                                                                                                                                          | No. of hours |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>I</b>   | Laboratory Safety, Biohazardous Agents, Risk Groups and Biosafety Levels, Laboratory Acquired Infections, Safety Measures in Laboratory                                                                                                                                                           | <b>5</b>     |
| <b>II</b>  | Understanding the details on the label of reagent bottles. Preparation of solutions. Molarity and normality of common acids and bases. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes and Maintenance of equipment's.                    | <b>10</b>    |
| <b>III</b> | Weighing and staining procedures, classification and chemistry of stains. Staining equipment. Reactive dyes and fluoro-chromes (including genetically engineered protein labeling with GFP and other tags). Cytogenetic techniques with squashed tissues.                                         | <b>5</b>     |
| <b>IV</b>  | Whole mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin; Preparation of thin and ultrathin sections. | <b>10</b>    |
| <b>V</b>   | History; Key relevant problems associated in Zoology research areas, their solution and basic understanding of animal models used in Zoology Research.                                                                                                                                            | <b>5</b>     |

## References

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2. Garner, W.Y., Barge, M.S. and Ussary, P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.
3. Basic Separation Techniques in Biochemistry, 1998, Okotore R. O., New Age International, New Delhi.
4. Cytological techniques: The Principles Underlying Routine Methods, 1963, Baker J. R., Methuen & Co., London.
5. Davenport H. A.: Histological and Histochemical techniques.
6. Handbook of basic Microtechnique, 1958, 2nd ed., Gray P., McGraw - Hill, USA
7. Staining methods (Histological and Histochemical), 1960, Mc Manus J. F. A. and Mowry R. W., Paul B. Hoeber, Inc.; Harper & Brothers, NY.
8. Elementary Microtechnique, 1973, 4th Edn., Peacock H. A., Edward Arnold Publ. Ltd., UK.
9. Good Laboratory Practice- Handbook, UNDP/World Bank?WHO

## Webliography

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2. [Home page - OECD](#)
3. [Good Laboratory Practices \(GLP\) - SOP & Guideline - Pharma Beginners \(pharmabeginners.com\)](#)

| F.Y.B.Sc. Semester I                                                                              |                                                                                                          |                                 |
|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>IKS-101</b>                                                                                    | <b>Indian Knowledge Systems (IKS)</b>                                                                    | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                          |                                 |
| CO1                                                                                               | Recall the basic concepts of Indian Knowledge System (IKS)                                               |                                 |
| CO2                                                                                               | Articulate the foundation of IKS and explain historical and cultural context of Indian knowledge systems |                                 |
| CO3                                                                                               | Use the knowledge of IKS to understand discipline specific case studies.                                 |                                 |
| CO4                                                                                               | Develop critical thinking and problem-solving skills in the context of Indian knowledge systems.         |                                 |

| Unit      | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No. of hours |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>I</b>  | <b>Overview of IKS</b> <ul style="list-style-type: none"> <li>Survey of IKS Domains: A broad overview of disciplines included in the IKS, and historical developments.</li> <li>Sources of IKS knowledge, classification of IKS texts, a survey of available primary texts, translated primary texts, and secondary resource materials. Differences between a sutra, bhashya, karika, and vartika texts. Fourteen/eighteen vidyasthanas, tantrayukti</li> <li>Vocabulary of IKS: Introduction to Panchamahabhutas, concept of a sutra, introduction to the concepts of non-translatables (Ex. dharma, punya, aatma, karma, yagna, shakti, varna, jaati, moksha, loka, daana, itihaasa, puraana etc.) and importance of using the proper terminology. Terms such as praja, janata, loktantra, prajatantra, ganatantra, swariva, surajya, rashtra, desh.</li> <li>Philosophical foundations of IKS: Introduction to Samkhya, vaisheshika and Nyaya</li> <li>Methods in IKS: Introduction to the concept of building and testing hypothesis using the methods of tantrayukti. Introduction to pramanas and their validity, upapatti; Standards of argumentation in the vada traditions (introduction to concepts of vaada, samvaada, vivaada, jalpa, vitanda). Concept of poorvapaksha, uttarapaksha.</li> </ul> | <b>15</b>    |
| <b>II</b> | <b>Case Studies (Few of these may be selected as appropriate)</b> <ul style="list-style-type: none"> <li>Mathematics of Madhava, Nilakantha Somayaji</li> <li>Astronomical models of Aryabhata</li> <li>Wootz steel, Aranumula Mirrors, and lost wax process for bronze castings</li> <li>Foundational aspects of Ayurveda</li> <li>Foundational aspects of Ashtanga yoga</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>10</b>    |

|            |                                                                                                                                                          |          |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|            | <ul style="list-style-type: none"> <li>• Foundational aspects of Sangeeta and Natva Shastra</li> <li>• Discipline Specific Case Study</li> </ul>         |          |
| <b>III</b> | <b>India and the World:</b><br>Influence of IKS on the world, knowledge exchanges with other classical civilizations. and inter-civilizational exchanges | <b>5</b> |

### References:

1. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).
2. Indian Knowledge Systems: Vol I and I, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).
3. The Beautiful Tree: Indigenous India Education in the Eighteenth Century. Dharampal, Biblia Impex, New Delhi, 1983. Reprinted by Keerthi Publishing House Pvt Ltd. Combatores, 1995.
4. Indian Science and Technology ni the Eighteenth Century, Dharampal. Delhi: Impex India, 1971. The British Journal for the History of Science.
5. The Wonder That Was India, Arthur Llewellyn Basham, 1954, Sidgwick& Jackson.
6. The India they saw series (foreigner visitors on India ni history from 5CE to 17th century), Ed. Meenakshi Jain and Sandhya Jain, Prabhat Prakashan

| F.Y.B.Sc. Semester II                                                                             |                                                                                                                                                                                                              |                         |
|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| ZOO-150                                                                                           | Genetics Lab<br>(Major- Practical)                                                                                                                                                                           | Credits: 2<br>Hours: 60 |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                                                                                                                              |                         |
| CO1                                                                                               | Recall the fundamental concepts of genetics, sex linked inheritance, multiple alleles and mutation.                                                                                                          |                         |
| CO2                                                                                               | Discuss, techniques of handling Drosophila flies and identify different mutants.                                                                                                                             |                         |
| CO3                                                                                               | Demonstrate Drosophila culture technique, applications DNA fingerprinting and thermal cycler. Apply principles of inheritance to solve problems based on monohybrid, dihybrid crosses and genic interaction. |                         |
| CO4                                                                                               | Detect A, B, AB, O and Rh blood groups.                                                                                                                                                                      |                         |
| CO5                                                                                               | Evaluate different genetic traits in human being and analyze the human karyotype                                                                                                                             |                         |
| CO6                                                                                               | Compile the data of different syndromes in human beings and prepare a report                                                                                                                                 |                         |

Any 12 experiments: 10 compulsory + 1 Activity (Equivalent to Two Practical)

| Expt. No. | Title of the Experiment                                                                                                                             |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.        | To solve problems based on Monohybrid and dihybrid crosses. (Two problems each).                                                                    |
| 2.        | To solve problems based on deviation from Mendelian inheritance.                                                                                    |
| 3.        | Frequency of the following genetic traits in human: widow's peak, attached ear lobe, dimple in chin, hypertrichosis, colour blindness, PTC tasting. |
| 4.        | Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak.                                          |
| 5.        | Familiarization with techniques of handling Drosophila, identifying males and females.                                                              |
| 6.        | Demonstration of setting up Drosophila culture and observing wild type and mutant (white eye, wing less, curly wings) flies.                        |
| 7.        | Demonstration of multiple allelism and determination of blood groups (ABO AND Rh).                                                                  |
| 8.        | Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome).                                      |
| 9.        | Application of DNA fingerprinting (photograph of electrophoretic pattern to be                                                                      |

|     |                                                             |
|-----|-------------------------------------------------------------|
|     | given for interpretation by the students).                  |
| 10. | Study of principle and applications of thermal cyclers.     |
| 11. | Study of genetic disorders from human population (any two). |
| 12. | Study of techniques of animal cloning.                      |

| F.Y.B.Sc. Semester II                                                               |                                                                                                                                                                                                              |                         |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| ZOO-151                                                                             | Genetics<br>(Major-Theory)                                                                                                                                                                                   | Credits: 4<br>Hours: 60 |
| Course Outcomes (COs)<br>On completion of the course, the students will be able to: |                                                                                                                                                                                                              |                         |
| CO1                                                                                 | Define different terminology of genetics. Describe the concepts of Genetics, gene interaction, lethal genes, euploidy, aneuploidy, sex linked inheritance and principles of inheritance.                     |                         |
| CO2                                                                                 | Understand the cause and effect of alterations in chromosome number and structure.                                                                                                                           |                         |
| CO3                                                                                 | Apply the principles of Mendelian inheritance.                                                                                                                                                               |                         |
| CO4                                                                                 | Relate the conventional and molecular methods for gene manipulation in other biological systems.                                                                                                             |                         |
| CO5                                                                                 | Appraise and differentiate between multiple alleles and multiple genes. Explain the pattern of inheritance of complementary, supplementary, inhibitory and duplicate factors, methods of sex determinations. |                         |
| CO6                                                                                 | Integrate the knowledge to find new avenues of joining research in related areas such as genetic engineering of cells, cloning, genetic disorders, human fertility programme, etc.                           |                         |

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | No. of hours |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Concept Genes and Genomics</b><br><br>Genetics: scope and importance. Elements of heredity and variation: Classical and Modern concept of Gene (Cistron, muton, recon), Alleles etc. Mendel's laws of inheritance, Chromosomal basis of inheritance and its applications. Exceptions to Mendelian Inheritance:<br>Incomplete dominance, Codominance, Multiple allelism, Lethal alleles, Pleiotropy, Epistasis - Recessive, Double recessive and double dominant. Genomic imprinting, Penetrance and expressivity, Polygenic inheritance. Mendelian traits in man. Applications of Genomics. | 15           |
| II   | <b>Extra nuclear inheritance and sex determination in organisms</b><br>Organelle inheritance (Mitochondrial) Extra-nuclear inheritance, Maternal Inheritance, Sex Chromosomes and sex-linkage: XX/XO, XX/XY, ZZ/ZW and haploidy/diploidy types, Gene dosage Compensation, meiotic consequences in structural heterozygotes. Autosomal dominant and autosomal recessive, X-linked dominant, and X-linked recessive. Haplodiploidy, intersex, gynandromorphs. Hormonal influence on sex determination-Free martin and sex reversal. Role of environmental factors- Bonellia and Crocodile.       | 15           |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>III</b> | <b>Human Genetics/ Introduction to inborn errors</b><br>Human Genetics: Morphological and molecular organization of chromosome, banding and nomenclature of chromosome subdivisions. Pedigree analysis. Karyotype, Structural and numerical alterations of chromosomes, Genetic disorders: chromosomal aneuploidy (Down, Turner and Klinefelter syndromes), chromosome translocation (Chronic Myeloid Leukemia) and deletion ("cry of cat" syndrome), gene mutation (sickle cell anemia). Inborn errors of metabolisms- PKU, AKU. Albinisms. | <b>15</b> |
| <b>IV</b>  | <b>Application of Genetics</b><br>Utility of the model organisms: Escherichia coli, Arabidopsis thaliana, Caenorhabditis elegans, Drosophila melanogaster & Mus musculus. Genetic counselling, Gene therapy. Concept of genetic engineering, principle and applications of PCR, DNA fingerprinting and its applications. Animal cloning.                                                                                                                                                                                                     | <b>15</b> |

### References

1. Gardner, E.J. et al. (2006) Principles of Genetics (John Wiley).
2. Russell, P.J. (2010) Genetics (Benjamin Cummings).
3. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. (VIII edition) Wiley India.
4. Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. (V edition) John Wiley and Sons Inc.
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6. Carroll S.B.; Doebley J.; Griffiths, A.J.F. and Wessler, S.R. (2018) An Introduction to Genetic Analysis. W. H. Freeman and Co. Ltd.

| <b>F.Y.B.Sc. Semester II</b> |                                              |                                 |
|------------------------------|----------------------------------------------|---------------------------------|
| <b>ZOO-160</b>               | <b>Animal Systematics<br/>(Minor-Theory)</b> | <b>Credits: 2<br/>Hours: 30</b> |

| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                          |
|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| CO1                                                                                               | Define terms related to animal systematics and outline the system of classification.                     |
| CO2                                                                                               | Outline the general characters of chordates and illustrate their salient features.                       |
| CO3                                                                                               | Demonstrate the culturing method of paramecium and explain its morphology.                               |
| CO4                                                                                               | Explain modes of migration in fishes, birds and parental care in Amphibians.                             |
| CO5                                                                                               | Classify the invertebrates on the basis of comparative morphology of animals and justify the reasons.    |
| CO6                                                                                               | Write the field report on the basis of comparative morphology of animals by conducting the field survey. |

| Unit | Contents                                                                                                                                                                                                                                   | No. of hours |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Principles of classification</b><br>Origin, development and Definition of systematics, Systematics-Linnaean hierarchy, Binomial nomenclature, Six kingdom classification system                                                         | 6            |
| II   | <b>Outline of classification with salient features of the following phyla:</b> (up to class with one example)<br>Phylum Protozoa, Porifera, Coelenterata (Cnidaria), Platyhelminthes, Aschelminthes Annelida, Arthropoda and Echinodermata | 11           |
| III  | <b>General topics:</b><br>Study of Paramecium (External characters and culture)                                                                                                                                                            | 3            |
| IV   | General characters of Chordates and classification of chordates up to class with one example.                                                                                                                                              | 5            |
| V    | <b>General Topics</b><br>Migration in fishes (Andramous and Catadromous) and Migration in Birds. Parental care in Amphibians.                                                                                                              | 5            |

### References

1. Life of Vertebrates by Young, JZ., III Edition, ClarendonPress, London
2. General Zoology by Goodnight and others IBH Publishing Co.
3. Invertebrate zoology By Jordan EL., and Verma PS., S.Chand and Co., New Delhi.
4. Textbook of Invertebrate Zoology, By Kotpal, RL., Rastogi and Co. Meerut
5. Phylum Protozoa By Kotpal, RL.,Rastogi and Co. Meerut
6. Phylum Porifera By Kotpal, RL.,Rastogi and Co. Meerut
7. Phylum Coelentrates By Kotpal, RL.,Rastogi and Co. Meerut
8. Phylum Helminthes By Kotpal, RL.,Rastogi and Co. Meerut
9. Phylum Annelida By Kotpal, RL.,Rastogi and Co. Meerut.

10. Life of Invertebrates by Prasad, ASN, Vikas Publishing House, New Delhi
11. Zoology by S.A. Miller and J.P. Harley - The McGraw Hill Co.
12. Biology of Animals by Ganguly, B. B., Sinha, A. K., Adhikari, S., New Central Book Agency, Kolkata
13. Introduction to Amphibia By Bhamrah, M. S., Juneja, K., Anmol Publication, Delhi
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15. General Zoology by Goodnight and others IBH Publishing Co.
16. Life of Vertebrates by Young, J. Z., III Edition, Clarendon Press, London.
17. General Zoology by Goodnight and others IBH Publishing Co.
18. Textbook of Vertebrate Zoology, by Kotpal, R. L., Rastogi and Co. Meeru.
19. Animal Diversity by Kershaw, D. R., Redwood Burn Ltd., Trowbridge

| F.Y.B.Sc. Semester II                                                                             |                                                                     |                                 |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------|
| <b>ZOO-170</b>                                                                                    | <b>Human Physiology<br/>(GE/OE-Theory)</b>                          | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                     |                                 |
| CO1                                                                                               | Understand the process of digestion and its control                 |                                 |
| CO2                                                                                               | Develop understanding in muscle structure and contraction mechanism |                                 |
| CO3                                                                                               | Discuss the process of respiration and transport of gases           |                                 |
| CO4                                                                                               | Determination of kidney structure and regulation of urine formation |                                 |
| CO5                                                                                               | Understand heart structure and functioning                          |                                 |
| CO6                                                                                               | Understand function of endocrine glands and formation of gametes    |                                 |

| Unit       | Contents                                                                                                                                                                                                                                                                                                                     | No. of Hours |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>I</b>   | <b>How are processes of digestion accomplished in man?</b><br>Digestive glands: Structure and function. Digestion and absorption of nutrients: carbohydrates, fats and proteins. Neural and hormonal control of digestion.                                                                                                   | <b>7</b>     |
| <b>II</b>  | <b>An overview of muscular function in man</b><br>Structure of smooth, skeletal and cardiac muscles. Neuromuscular junction. Mechanism of muscle contraction. Respiration: Ventilation, External and internal respiration. Transport of carbon dioxide and oxygen in blood and tissues. Factors affecting gaseous transport. | <b>6</b>     |
| <b>III</b> | <b>Cardiovascular functions in man</b><br>Structure of heart. Coordination of heartbeat; control of heart beat (neural and hormonal) Blood cells and blood vessels. Cardiac cycle. ECG. Lymph and lymph vessels.                                                                                                             | <b>7</b>     |

|           |                                                                                                                                                                                                                                                      |    |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>IV</b> | <b>Endocrine and reproductive physiology</b><br>Structure and function of endocrine glands viz., pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries and testes. Fertilization and implantation. Menstrual cycle. Pregnancy and Parturition. | 10 |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|

### References

1. Tortora, G.J. and Derrickson, B.H. (2009) Principles of Anatomy and Physiology (12th edition) John Wiley and Sons, Inc.
2. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology (9th edition) McGraw Hill.
3. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology (12th edition) Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Marieb, E. (1998) Human Anatomy and Physiology (4th edition) Addison-Wesley.
5. Kesar, S. and Vashisht, N. (2007) Experimental Physiology, Heritage Publishers

| <b>F.Y.B.Sc. Semester II</b>                                                                      |                                                                                                                                                                                                         |                                 |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>ZOO-171</b>                                                                                    | <b>Biodiversity Conservation and Sustainable Development<br/>(GE/OE-Theory)</b>                                                                                                                         | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                                                                                                                         |                                 |
| CO1                                                                                               | Describe Anthropogenic impact on environment, and threats to biodiversity and extinction of species.                                                                                                    |                                 |
| CO2                                                                                               | Discuss the judicious utilisation of natural resources                                                                                                                                                  |                                 |
| CO3                                                                                               | Apply the concept of green technology and the eco-friendly practises and other prospects of environment protection                                                                                      |                                 |
| CO4                                                                                               | Analyse and practice appropriate legal/regulatory and ethical issues in the context of the work environment.                                                                                            |                                 |
| CO5                                                                                               | Assess the importance of bio diversity and the consequences of bio diversity loss                                                                                                                       |                                 |
| CO6                                                                                               | Design research projects to collect information to assess the effectiveness of current practices, and interpret the results of a statistical analysis of data, and use this to make informed decisions. |                                 |

| <b>Unit</b> | <b>Contents</b>                                                                                                                                                                                                                                                                                                                                                                                       | <b>No. of hours</b> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>I</b>    | <b>Anthropogenic impact on environment</b><br>Man as an animal species in the ecosystem. Population explosion. carrying capacity, exploitation of resources due to urbanization, industrialization and agricultural practises. Generation of agricultural, municipal, industrial waste; Pollution of air, water, soil and noise; radioactive pollution. Eutrophication. Deforestation, Afforestation, | <b>7</b>            |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | Reforestation; Threats to biodiversity, Extinction of species.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |
| <b>II</b>  | <b>Depletion and contamination of resources</b> Natural resources: Land resources. Air and water resources. Bioresources. Conventional Fuel, wood, fossil fuels. Non-conventional or alternate sources of energy: sun, wind, bio-energy, geothermal, ocean, nuclear etc. Green house effect and global warming; climate change; Shrinking of glaciers. Threats to sustainable development.                                                                                                                                                                                                               | <b>6</b>  |
| <b>III</b> | <b>Biodiversity and resource conservation programmes</b><br>Management of wastes and disposal. Concepts of three Rs: reduce, reuse and recycle. Methods of prevention and control of Eutrophication. Bioremediation. Biodiversity conservation– In-situ e.g., Sanctuaries, National Parks, Biosphere Reserves, World Heritage Sites; Ex-situ e.g., botanical gardens, gene banks, cryopreservation etc. Contour farming, reforestation; Rainwater harvesting, groundwater water recharge. Green technologies, Eco-cities, Social and Joint forestry.                                                     | <b>7</b>  |
| <b>IV</b>  | <b>Sustainable development and green technology</b><br>Sustainable Development; Brundlandt Report. Biosafety of GMOs and LMOs. Environmental movements. Public awareness of Environment problems. Role of Government, NGO's, Ecological footprint, International treaties and conventions. organizations, International efforts (Vienna Convention, Montreal Protocol, UNFCCC, Kyoto Protocol, Copenhagen Summit, etc.; IPCC; Environmental laws and acts. National Environmental Policy. NBPGR, BSI, ZSI, WWF, IUCN, Convention on Biological diversity; Ramsar Convention, other conservation efforts. | <b>10</b> |

## References

1. Joseph, B. (2008) Environmental studies, Tata McGraw Hill.
2. Miller, G.T. (2002). Sustaining the earth, an integrated approach. (5th edition) Books/Cole, Thompson Learning, Inc.
3. Chapman, J.L. and Reiss, M.J. (1999). Ecology: Principles and applications (2nd edition) Cambridge University Press.
4. Ghosh, S.K. and Singh, R. (2003). Social forestry and Forest Management. Global Vision Pub.
5. Wilson, E.O. (1986) Biodiversity, Academic press Washington
6. Wagher, R.H. (1974) Environment and Man. (Second Edition), Norton, New York.

| <b>F.Y.B.Sc. Semester II</b>                                                                      |                              |                                 |
|---------------------------------------------------------------------------------------------------|------------------------------|---------------------------------|
| <b>ZOO-180</b>                                                                                    | <b>Bee Keeping<br/>(VSC)</b> | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                              |                                 |

|     |                                                                                                                                                                                                                                                                 |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Describe the concepts of apiculture, importance of bee keeping, traditional and modern bee keeping methods. Explain the role of Khadi Gramodyog and Village Development Corporation in development and spread of apiculture in India.                           |
| CO2 | Discuss the medical properties of honey and its application in various fields, its nutrients and composition.                                                                                                                                                   |
| CO3 | Apply the knowledge of bee keeping in establishment and maintenance of bee colonies and for the use of various equipment to obtained bee products like honey, bee wax, royal jelly etc. Demonstrate the technique of handling the bees and processing of honey. |
| CO4 | Explain the social organization and division of labour in the honeybees. Compare the indigenous and exotic species of honeybees and differentiate queen, workers and drone bees.                                                                                |
| CO5 | Appraise the importance of propagation of bee flora and its role in the agricultural crop pollination. Evaluate the impact of pesticides on honeybees.                                                                                                          |
| CO6 | Design the calendar for management of bee colonies. Prepare the proposal for financial assistance from banks for starting a bee keeping project.                                                                                                                |

| Unit       | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | No. of hours |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>I</b>   | <b>Introduction to Apiculture</b><br>History of bee keeping, Scope and importance of bee keeping, Bee keeping in world and in India. Traditional bee keeping, Modern beekeeping. Role of Khadi Gramodyog and Village development Corporation in apiculture development in India.                                                                                                                                                                                                                          | <b>4</b>     |
| <b>II</b>  | <b>Biology of Honeybee</b><br>Indigenous and exotic species, Morphology of Bees and Anatomy of Bees, Social organization in honeybees: Colony life and social organization – Queen, drone, worker. Annual biological cycle of the bee colony.                                                                                                                                                                                                                                                             | <b>8</b>     |
| <b>III</b> | <b>Honey</b><br>its properties and application in various fields<br>Medicinal properties of Honey, application in various fields, other valuable by products of honeybees, Value added honey products. Properties of honey products, Nutrients and composition of honey, Acid content and flavor effects. Types of value added honey products.<br><br><b>Bee keeping equipments.</b><br>ISI Type Hives, Langstroth Hives, Honey Extractor, Smoker, Bee Veil, Gloves, Knife etc.<br>Bee products- Propolis | <b>10</b>    |
| <b>IV</b>  | <b>Honeybee Plants and Floral Calendar</b><br>Bee flora - importance propagation - congenial conditions for starting up of apiculture. Migratory Bee Keeping - designing floral Calendar Improved Agricultural practices - crop pollination - Pesticides impact on Honey bees                                                                                                                                                                                                                             | <b>4</b>     |

|   |                                                                                                                                                                                                                                                          |   |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|   | Honey Processing and Economics of Beekeeping<br>Honey extraction & handling – Quality control standards – Honey testing kit, Processing of honey. Other valuable by products of honey bees, Bee venom & Royal jelly extraction, Economics of bee keeping |   |
| V | <b>How to start Bee keeping?</b><br>Funding sources for beekeeping projects., reparation of proposal for financial assistance from bank, Steps involved in starting a beekeeping project, Marketing of honey and honey products.                         | 4 |

## References

1. Abrol , D. P. (1997) Bees and Beekeeping. Kalyani Publisher, New Delhi.
2. Abrol, D. P. (2010) A Comprehensive guide to Bees and Beekeeping. Scientific Publisher, New Delhi.
3. Withhead, S. B. (2010) Honey bees and their management Axis books Publisher, Jodhpur.
4. Nagaraja, N. and Rajagopal , D. (2013) Honey bees: Diseases, Parasites, Pests, Predator and their management. M.J.P Publisher, Chennai.
5. Dharamsing and Singh, D. P. A Handbook of Beekeeping, Agrobios India (Publisher), Jodhpur.

| F.Y.B.Sc. Semester II                                      |                                                                                    |                         |
|------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------|
| ZOO-190                                                    | Public Health and Hygiene<br>(SEC)                                                 | Credits: 2<br>Hours: 30 |
| Course Outcomes (COs)                                      |                                                                                    |                         |
| On completion of the course, the students will be able to: |                                                                                    |                         |
| CO1                                                        | Describe maintenance of personal hygiene.                                          |                         |
| CO2                                                        | Classify food into micro and macro nutrients.                                      |                         |
| CO3                                                        | Explain Non-communicable diseases/Life style diseases.                             |                         |
| CO4                                                        | Discriminate between a pandemic, an epidemic, endemic, and an outbreak .           |                         |
| CO5                                                        | Review Nutrient deficiency diseases                                                |                         |
| CO6                                                        | Compile data of Communicable , non-communicable and nutrition deficiency diseases. |                         |

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                             | No. of hours |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Maintenance of personal hygiene</b><br>Introduction to public health and hygiene- determinants and factors. Pollution and health hazards; water and air borne diseases. Radiation hazards: Mobile Cell tower and electronic gadgets (recommended levels, effects and precaution). Role of health education in environment improvement and prevention of diseases. | 8            |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | Personal hygiene, oral hygiene and sex hygiene.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |
| <b>II</b>  | <b>Nutrient deficiency diseases</b><br>Classification of food into micro and macro nutrients. Balanced diet, dietary plan for an infant, normal adult, pregnant woman and old person. Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies – Anaemia (Iron and B12 deficiency), Rickets, Goitre (cause, symptoms, precaution and cure). Substitution of diet with required nutrients to prevent malnutrition disorders. BMI.                                                                                         | <b>10</b> |
| <b>III</b> | <b>Communicable and contagious diseases</b><br>Infectious agents responsible for diseases in humans. The difference between a pandemic, an epidemic, endemic, and an outbreak. Communicable viral diseases- Covid -19, measles, chicken pox, poliomyelitis, swine flu, dengue, chikungunya, and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus, plague, whooping cough, diphtheria, leprosy. sexually transmitted diseases- AIDS, syphilis. Health education and preventive measures for communicable diseases. | <b>10</b> |
| <b>IV</b>  | <b>Non-communicable diseases and cure</b><br>Non-communicable diseases/Life style diseases- hypertension, stroke, coronary heart disease, myocardial infarction. Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions. Diabetes- types and their effect on human health. Gastrointestinal disorders- acidity, peptic ulcer, constipation, piles (cause, symptoms, precaution and remedy) etc. Obesity (Definition and consequences). Mental illness (depression and anxiety).                                           | <b>2</b>  |

## References

1. Mary Jane Schneider (2011) Introduction to Public Health.
2. Muthu, V.K. (2014) A Short Book of Public Health.
3. Detels, R. (2017) Oxford Textbook of Public Health (6th edition).
4. Gibney, M.J. (2013) Public Health Nutrition.
5. Wong, K.V. (2017) Nutrition, Health and Disease.