Scheme of B.Sc.

Zoology

Year	Course Code	Subject Name	Theory/ Practical	Total Credit	Total Marks	
					Max	Min
First year	ZOOL-1T	Animal Diversity:Non-Chordata and Chordata , Comparative Anatomy and Physiology of Non-chordates	Theory	4	50	17
	ZOOL-2T	Cell Biology , Histology and Comparative Anatomy & Physiology Of Chordates	Theory	4	50	17
	ZOOL-1P	Practical	Practical	2	50	17
Second year	ZOOL-3T	Genetics , Developmental Biology and Evolution	Theory	4	50	17
	ZOOL-4T	Biochemistry and Molecular Biology	Theory	4	50	17
	ZOOL-2P	Practical	Practical	2	50	17
Third year	ZOOL-5T	Animal Behavior , Chronobiology and Ecology	Theory	4	50	17
	ZOOL-6T	Microbiology , Parasitology , Immunology and Applied Zoology	Theory	4	50	17
	ZOOL-3P	Practical	Practical	2	50	17
Total				**30**	**450**	

Note: There shall be four extra credits in all the years of under graduation for internship/apprenticeship. The certificate of extra credits would be provided by the university concern.

Part A: Introduction				
Program: **Certificate Course**		Class: **B.Sc. I Year**	Year: **2022**	Session:**2022-2023**
1	Course Code	ZOOL-1P		
2	Course Title	Lab Course - I		
3	Course Type	Practical		
4	Pre-requisite (if any)	No		
5	Course Learning Outcomes (CLO)	After completion of practical work the outcome will be : • Able to know animal diversity in the form of museum/slide for invertebrate and invertebrates. • Capable to enumerate biology of invertebrates. • Capable to explore anatomy of animas. • Able to understand cytological, histological and osteological configuration for animal life. • Capable to explain hematology of animal system.		
6	Credit Value	2		
7	Total Marks	Max. Marks: 50	Min Passing Marks : 17	

Part B: **Content of the Course**

Total classes: 30

	Content	No. of classes
	Tentative list of practical/exercise :. The practical's work will be based on theory syllabus and the students will be required to show the knowledge of the following – 1. Study of museum specimens representing to invertebrate phyla. 2. Study of permanent slides : Paramecium, Euglena, T. S. Sycon, Sponge Spicules, Sponge gemmule, Obelia colony, Obelia medusa, Ephyra larva, Fasciola larval forms (miracidium, Radia, Cercaria, Metacercaria), Trochophore larva, Zoea larva, Bipinnaria larva. 3. Dissection/ demonstration/ clay model of – a) Phretima : Digestive system, Reproductive system, Nervous system b) Palaemon : Appendages, Nervous system c) Periplaneta : Mouth parts, Digestive system d) Pila : Nervous system 4. Exercise based on cytology : squash preparation from onion root tip and study of cell division. 5. Study of museum specimens representing the chordata from cyclostomes to mammals. 6. Study of permanent slides of chordates – Fish skin, scales, V. S. Skin of frog, reptile, bird, mammal, T.S. liver, pancreas, testes, ovary of frog and mammal. 7. Osteology : Study of girdles of amphibian, reptile, bird and mammal. 8. Temporary mounting : a) Palaemon : Statocyst b) Pila : Ctenidium, osphradium c) Pheretima : Septal nephridia d) Fish scale : Placoid, Cycloid, Ctenoid 9. Exercise based on blood : blood group, blood pressure measure 10. Field visit report : Photography & identification of any five local invertebrate or vertebrate fauna.	30

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Part C - **Learning Resource**
Text Books, Reference Books, Other Resources - 1. Practical zoology Invertebrate : S. S. Lal 2. Practical zoology vertebrate : S. S. Lal 3. A Manual of practical zoology invertebrates : P. S. Verma 4. A Manual of practical zoology Chordates : P. S. Verma 5. Saras Practical zoology Vol. I, Vol. II, N. Arumugam

Part D: **Assessment and Evaluation**
University Exam(UE): Maximum Marks: 50 Marks

DECLARATION

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    Assistant Professor, Govt. Mahamaya College, Ratanpur, Bilaspur
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    Assistant Professor, Govt. Lahiri P. G. College, Chirimiri, Koriya

Date : 31.05.2022

Part A: Introduction				
Program: Certificate Course		Class: B.Sc. I st Year	Year: 2022	Session: 2022-2023
1	Course Code	ZOOL-1T		
2	Course Title	**Animal Diversity: Non-Chordata and Chordata, Comparative Anatomy and Physiology of Non-chordates**		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcomes (CLO)	Upon completion of the course students should be able to : • Learn about the importance of systemic,taxonomy and phylogeny to get a concrete idea of evolution of non-chordate phyla. • Understand the various morphological, anatomical structures and functions ofanimals of different phyla. • Get the knowledge about economic,ecological and medical significance ofvarious animals in human welfare. • Understand the important parasites andtheir control measures. • Comparison of the anatomy and physiology of the different taxa of non-chordates.		
6	Credit Value	4		
7	Total Marks	Max. Marks: 50	Min Passing Marks : 17	

Part B: Content of the Course		
Total Lectures: 60		
Unit	Topics	No. of Lectures
I	**Taxonomy, Protozoa, Porifera** **Taxonomy-** Elementary knowledge of Zoological Nomenclature and International Code. Classification of Animal Kingdom upto Phylum of acoelomate and coelomate non-chordates according to Parker and Haswell7th edition. **Protozoa-** Phylum Protozoa: General characters of the phylum and classification up to order with characters and suitable examples. Structure, life history and pathogenicity of malaria parasite *(Plasmodium vivax)*. Protozoa and disease. **Porifera-** Phylum Porifera: General characters of the phylum and classification up to order with characters and suitable examples. Type study of Sycon.	12
II	**Coelenterata, Platyhelminthes, Nemathelminthes :** **Coelenterata-** PhylumCoelenterata: General characters of the phylum and classification up to order with characters and suitable examples. Type Study of Obelia. **Platyhelminthes** - Phylum Platyhelminthes: General characters of the phylum and classification up to order with characters and suitable examples. Type Studyof Liverfluke. **Nemathelminthes-** PhylumNemathelminthes: General characters of the phylum and classification up to order with characters and suitable examples. Pathogenic nematodes and diseases.	12
III	**Annelida, Arthropoda, Mollusca :** **Annelida-** Phylum Annelida: General Characters of the phylum and classification up to order with characters and suitable examples. Types study of Earthworm (*Pheretima*). **Arthropoda -** Phylum Arthropoda: General Characters of the phylum and classification up to order with characters and suitable examples. Type study of Prawn. Insects as a vector of human disease. **Mollusca -** Phylum Mollusca: General characters of the phylum and classification up to order with characters and suitable examples. Type study of *Pila.*	12

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IV	**Echinodermata, Hemichordata, Classification of Chordata :** **Echinodermata** - Phylum Echinodermata: General characters of the phylum and classification up to order with characters and suitable examples. Type study of Starfish*(Asterias)*. **Hemichordata** - PhylumHemichordata: General characters of the phylum hemichordate and relationship with non-chordates and chordates. Type study ofBalanoglossus **Classification of Chordata** - Classification of Chordata up to order withcharacters andsuitable examples. Brief account of Urochordata, Cephalochordata and Vertebrata.	11
V	**Comparative Anatomy and Physiology of Non-chordates:** Coelom and coelomductsin Non- chordate. Locomotory organs and locomotion in Non- chordate. Pattern of feeding and digestion in lower Metazoans. Comparative anatomy and physiology of respiration and excretion in Non- chordate. Primitive,diffused and advance nervous system in Non- chordate. Reproduction in Non-chordates.	13
Keywords : Locomotary organ, feeding and digestion, respiration, International Comission on Zoological Nomenclature (ICZN), Classification, Protozoa, Classification, Liver Fluke, Trochophore, Arthropoda, Crustacea larva , Echinodermata larva		

Part C -Learning Resource

1. Text Books, Reference Books, Other Resources –

2. Parker, J, Haswell, WA, "A Text Book of Zoology", VII edition, Vol. I & II, Low Price Publications, Delhi, 1990.
3. Barnes, RD, "Invertebrate Zoology", VII Edition, Cengage Learning, India, 2006.
4. Pechenik, JA, "Biology of the Invertebrates" McGraw-Hill Educations, VII Edition, 2015.
5. Sedgwick, A, "A Students Text Book of Zoology", Vol.I, II & Vol. III., Low Price Publications, Delhi, 1990.
6. Dhami and Dhami, "Invertebrate Zoology" R., Chand & Co., India, 2009.
7. Jordan and Verma, "Invertebrate Zoology," S. Chand & Company, New Delhi, 2013.
8. Agarwal, VK, "Zoology for Degree Students: Non-Chordata", S Chand & Company, 2017.
9. Kotpal, R, "Modem Text Book of Invertebrates", Rastogi Publications, Meerut, 2017.
10. Kotpal, R, "Protozoa to Echinodermata (Phylum Series)", Rastogi Publications, Meerut, 2017.
11. Kardong, K.V. (2006) Vertebrates: Comparative Anatomy, Function, Evolution (4th edition), McGraw-Hill
12. Jordan, E. L. and Verma, P. S. (2013) Chordate Zoology (14th edition).
13. Saxena, R. K. and Saxena,S. (2015) Comparative Anatomy of Vertebrates (2nd edition).

E- Resources –

1. SWAYAM- .https://swayam.gov.in/explorer?searchText=
2. https://academic.oup.com
3. https://medineplus.gov
4. https://ncin.nlon.nih.gov
5. https://zoologylearningpoint.woodpress.com
6. https://zoologyresources.com
7. National digital library – https://ndl.iitkgp.ac.in
8. e-PG Pathshala (MHRD) Portal, https://egpg.inflibnet.ac.in
9. Science Direct Open Access Content – https://www.sciencedirect.com/book/9781843342038/ open – Access
10. https://egyankosh.ac.in

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31-5-2022

Part D: Assessment and Evaluation
Maximum Marks, University exam. - :50

DECLARATION

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    Assistant Professor, Govt. Lahiri P. G. College, Chirimiri, Koriya

Date : 31.05.2022

Part A: Introduction				
Program: **Certificate Course**		Class: **B.Sc. II Year**	Year: **2023**	Session:**2023-2024**
1	Course Code	ZOOL-2P		
2	Course Title	Lab Course - 2		
3	Course Type	Practical		
4	Pre-requisite (if any)	No		
5	Course Learning . Outcomes (CLO)	After completion of practical work the outcome will be : • Able to understand and explain Mendel's Law of Inheritance • Capable to analyze inheritance of gene by pedigree analysis. • Able to know laboratory culture of Drosophila. • Able to understand cytological, histological and osteological configuration for animal life. • Capable to understand Human keryotype and Numerical alteration in chromosomes • Capable to explain Evolution and evidences • Capable of performing tests for identification of biological macromolecules • Able to estimate nucleic acids and Isolation of DNA		
6	Credit Value	2		
7	Total Marks	Max. Marks: 50	Min Passing Marks : 17	

13.6.2022

Part B

Total No. of Lecturer (one hour per week)

Total Periods: 30

	Contents	No. of period
	Tentative list of practical/exercise: 1. Application of probability in the law of segregation with coin tossing. 2. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak. 3. Familiarization with techniques of handling *Drosophila*, identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures. 4. Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome). 5. Types of eggs based on quantity and distribution of yolk: sea urchin, insect, frog, Chick. 6. Comparative study of cleavage patterns in Frog and Amphioxus models. 7. How do cells move, change shape and size during morphogenetic movement of Blastulation, Gastrulation in Frog, Amphioxus, Chick 8. Study of development of chick embryo through incubated chick eggs up to 96 h. 9. Extra embryonic membranes of chick through permanent slides. 10. Some videos to develop understanding on the process of development. 11. Study of adaptive radiations in feet of birds and mouth parts of insects. 12. Understanding embryological evidence of evolution (through charts and videos). 13. Study of types of fossils. 14. Analogy and homology (wings of birds and insects, forelimbs of bat and rabbit). 15. Preparation of models of amino acids and dipeptides. 16. Ninhydrin test for α-amino acids. 17. Determination of pK and pI values of glycine. 18. Benedict's test for reducing sugars. 19. Iodine test for starch. 20. Determination of acid value of oil 21. Preparation of ball and stick model for B-DNA molecule (A=T and G=C base pairs). 22. Estimation of DNA by DPA method. 23. Estimation of RNA by Orcinol method. 24. Isolation of genomic DNA by ethanol precipitation method.	30

Keywords: Genetics, Mendel's law, Interaction of Gene, Embryology, Regeneration, Evolution.

Part C - **Learning Resource**
Text Books, Reference Books, Other Resources

Suggested Readings:

Text Books:

1. Practical Hand Book of Genetics: Vikas Pali Kalyani Publication
3. Essential Practical Handbook of Cell Biology & Genetics, Biometry & Microbiology, A Laboratory Manual Debarati Das, Academic Publishers.
4. Cytogenetics:Mohan P Arora, Himalayan Publishing House
5. Modern Experimental Biochemistry by Rodney F. Boyer
6. Molecular Cloning: A Laboratory Manual by Joe Sambrook
7. Practical Manual for Biochemistry : By GG Kaushik, CBS Publication

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cy32/preview
2. https://www.classcentral.com/course/swayam-experimental-biochemistry-12909
3. https://jru.edu.in/studentcorner/lab-manual/bpharm/Lab%20Manual%20-%20Biochemistry.pdf
4. Fundamentals of Genetics.pdf (jru.edu.in)

Part D: **Assessment and Evaluation**
Practical Exam(UE): Maximum Marks: 50 Marks

DECLARATION

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Assistant Professor, Govt. Mahamaya College, Ratanpur, Bilaspur

11. Dr. Hema Kulkarni - Member -
Assistant Professor, Shahid Domeshwar Sahu Govt. College, Jamgaon (R), Durg

Date: 13.06.2022.

Part A: Introduction				
Program: **Certificate Course**		Class: **B.Sc. I Year**	Year: **2022**	Session:**2022-2023**
1	Course Code	ZOOL- 2T		
2	Course Title	Cell Biology, Histology and Comparative Anatomy & Physiology of Chordates		
3	Course Type	Theory		
4	Pre-requisite (if any)	To study this course, a student must have/had the subject Biology in class 12th.		
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able : • Understand the basic structure, functioning of the cell and cell organelles and understand the intricate cellular mechanisms involved. • Understand the tissues, how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor. • Develop an understanding of the evolution of vertebrates thus integrating structure, function and development. • Understand the morphological, anatomical and physiological adaptation in diverse habitats. • 5. Develop an understanding of the evolution of vertebrates thus integrating structure, function and development.		
6	Credit Value	Theory : 4		
7	Total Marks	Max. Marks: 50	Min Passing Marks : 17	

Part B: **Content of the Course** Total Lecturer: 60		
Unit	Topics	No. of Lectures
I	**Prokaryotic and Eukaryotic cells :** General structure of prokaryotes, bacteria, archaea and eukaryotes. Ultra structure and function of endoplasmic reticulum, ribosomes, Golgi apparatus, lysosome, Mitochondria, nuclear apparatus. **Cell membrane and transport mechanism :** Structure, composition, models and function. Fluid mosaic model Junctional complexes, membrane receptor modifications : microvilli, desmosomes and plasmodesmata.	12
II	**Cell cycle, cell signaling and cell culturing :** Cell cycle, cell division – mitosis and meiosis. Cell division check points and their regulation. Role of growth factors. Programmed cell death (Apoptosis). **Cell regulation and cell signaling :** Signaling molecules and their receptors. Functions of cell surface receptors. Regulation of signaling pathways. **Cell culture :** Types of cell culture – monolayer and suspension culture. Types of culture media. Basic characteristics of tissue culture media. Tissue culture and engineering.	12
III	**Structure and functional significance of animal tissues :** Introduction to tissues. Epithelial tissue: types, structure and characteristics. Exocrine and endocrine glands: type and structure. Structure and function of loose, dense and adipose tissue. Muscular tissue: Ultra structure of smooth, skeletal and cardiac muscles. Muscle contraction. Membrane of the brain and spinal cord.	11
IV	**Structure and function of integument, skeletal, digestive, circulatory system :** **Integument :** Structure of integument from fish to mammals. Function of integument. Epidermal and dermal derivatives of integument and their functional significance. **Skeletal system :** Comparative account of pelvic and pectoral girdles from fishes (cartilaginous and bony) to mammals. **Digestive system :** Dentition in mammals. Comparative study of alimentary canal and digestive glands from fish to mammal. Physiology of digestion in mammal.	13

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	Circulatory system: Evolution of aortic arches and their significance. Structure and evolution of heart in vertebrates. Cardiac cycle. Blood : Composition and function.	
V	**Structure and function of circulatory, respiratory, excretory, reproductive and endocrine system :** **Respiratory system :** Aquatic and terrestrial respiration. Comparative anatomy of lungs in amphibian, reptile, bird and mammals. **Excretory system :** Physiology of excretion, urine formation. **Reproductive system :** Comparative details of testes and ovaries from fishes to mammals. Estrous and menstrual cycle. **Endocrine system :** Types and functional significance of endocrine glands and hormones.	12

Keywords: Tissue, Endocrine glands, Girdles, Cell signaling, Cell culture, Excretion, Circulatory system, Aortic arches, Heart, Reproductive cycle.

Part C - **Learning Resource**

Text Books, Reference Books, Other Resources -

1. Books of M. P. Hindi Granth Academy
2. Rastogi V. B. : Introduction to Cytology
3. Cell Biology and Molecular Biology : N. Arumugam
4. Cell Biology : N. Arumugam
5. Molecular Cell Biology : N. Arumugam
6. Cell Biology, Genetics, Molecular Biology and Evolution : Verma P. S., Agrawal V. K.
7. Sheelar and Binachi : Cell and Molecular Biology
8. Karp : Cell and Molecular Biology
9. De Robertis : Cell and Molecular Bology
10. Powar C. B. : Cell Biology
11. A Textbook of Animal Histology : A. K. Berry, Emkey Publication, Delhi
12. A Textbook of Histology and Practical guide: J. P. Gunasegram
13. Animal Cell Culture : R. Freshney
14. Animal Cell and Tissue Culture : Shivangi Mathur
15. Chordate Zoology : R. L. Kotpal & P. S. Verma
16. Modern Text Book of Zoology – Vertebrate : R. L. Kotpal
17. A Text Book of Chordates : A. Thangamani, N. Arumugam, Saras Puplication
18. Biology of Animals, Volume – II, Sinha, Adhikari, Ganguly
19. Comparative Anatomy of vertebrates, 2nd edition : R. K. Saxena, Sunita Saxena
20. Comparative Anatomy and Developmental Biology : Kotpal, Shastry and Shukla
21. Chordata and Comparative Anatomy : R. L. Kotpal
22. Chordate Zoology : Jordan E. L. and Verma P. S.
23. Anatomy of Chordates, 4th edition : Weichert C. K.
24. Comparative vertebrate Anatomy : L. H. Hyman

E-Resources –

1.SWAYAM- .https://swayam.gov.in/explorer?searchText=
2. https://academic.oup.com
3. https://medineplus.gov
4. https://ncin.nlon.nih.gov
5. https://zoologylearningpoint.woodpress.com
6. https://zoologyresources.com
7. National digital library – https://ndl.iitkgp.ac.in
7. e-PG Pathshala (MHRD) Portal, https://egpg.inflibnet.ac.in
8. Science Direct Open Access Content – https://www.sciencedirect.com/book/9781843342038/ open – Access
9. https://egyankosh.ac.in

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31/5/2022

Part D: Assessment and Evaluation	
University Exam(UE): Maximum Marks:	50 Marks

DECLARATION

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    Assistant Professor, Govt. Lahiri P. G. College, Chirimiri, Koriya

Date : 31.05.2022

Part A: Introduction				
Program : Degree course		**Class: B.Sc.III Year**	**Year -2024**	**Session :-2024-2025**
1	**Course code**	**ZOOL-3P**		
2	**Course Title**	**Lab course - 3**		
3	**Course Type**	**Practical**		
4	**Pre-Requisite(If Any)**	No		
5	**Course Learning Outcome (CLO)**	At The end of Course Students will be able to - • Learn a wide range of practical techniques used to study animal behaviour. • Develop skills, concepts and experience to understand all aspects of animal behaviour. • Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives. • Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild. • Consider and evaluate behaviour of all animals, including humans, in the complex ecological world, including the urban environment. • Understand causative agents, pathogenesis, diagnosis, prophylaxis, and chemotherapy for various bacterial, viral, protozoan, and helminthic diseases. • Understand the concept of immune mechanisms, their pathways, acquired immunity, hypersensitivity, and autoimmune disorders. • Understand the aquaculture techniques, their problems, and commercial viability. • Understand the techniques and commercial significance of apiculture, sericulture, and lac culture. • Understand the basic and technical skills related to dairy management, poultry, and vermicomposting.		
6	Credit Value	2		
7	Total marks	Maximum marks : 50 Minimum marks: 17		

13.6.2022

Part : B Content of course	
Total lecture-30	
Tentative Practical List	**Note :This is tentative list .The teacher concern can add per requirement** 1. Orientation of an animal to light. 2. Chemical communication in ants. 3. Predatory behaviour of a carnivorous animal. 4. Nests and nesting habits of the birds and social insects 5. To study geotaxis behaviour in earthworm. 6. To study the phototaxis behaviour in insect larvae. 7. Study of circadian functions in humans (daily eating, sleep and temperature patterns). 8. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of 9. Making an ecosystem in a wide-mouthed bottle. 10. Constructing a food web by observing and collecting organisms from a given area. 11. Studying the impact of herbivore on plant species (planted in pots under specific conditions) 12. Estimation of the ratio of the producers and consumers. 13. Studying insect diversity in a habitat. 14. Study of permanent slides and specimens of parasitic protozoans and helminthes. 15. Pathological examination of sputum, blood, urine and stool. 16. Staining and identification of Gram positive and Gram negative bacteria. 17. RBC and WBC counting. 18. Identification of Blood group. 19. Demonstration of antigen-antibody interaction in gel. 20. Morphological characterization of common fish species. 21. Identification of two major carps – Labeo *rohita* and Catla *catla* and their life cycles. 22. Through charts/specimens- study of bees. 23. Worker honey bee with emphasis on leg modifications (through specimens/charts). 24. Life cycle of mulberry silkworm, Bombyx mori and tasar silkworm (model/chart/specimens). 25. External morphology and nomenclature of dairy animals. 26. Determination of the specific gravity of milk by using a mercury lactometer. 27. Test for good quality eggs (Floating test, cracking test) and for fertilized and unfertilized eggs (Light test, Cracking test). 28. External morphology of poultry birds (model). 29. Project report on visit to dairy farm and visit to Poultry farm (Poultry management).

Part-C Learning Resource
Text books, References, Books Other Resource :
1. Practical Ecology, Anmol Publications. 2. Practical Methods in Ecology and Environmental Science,R. K. Trivedy, P. K. Goel, C. L. Trisal Enviro Media Publications, 1987. 3. Ethology practical Vilmos Altbäcker Márta Gácsi András Kosztolányi Ákos Pogány Gabriella Lakatos Péter Pongrácz. 4. Animal Behaviour Reena Mathur Rastogi publication. 5. ANIMAL BEHAVIOUR Practical work and data response exercises for sixth form students Michael D. 6. Animal Cell Culture and Technology Michel butcher Publisher : .Taylor & Francis 7. Our Animal Resources: Animals and Their Economic Importance Hardcover. 8. Publisher Holt, Rinehart, and Winston : 9. Practical Microbiology D.K. Maheshwari. 10. practical microbiology R.C. Dubey. 11. microbiology textbook. Dr Arora. 12. Microbiology: A Laboratory Manual - Book by James G. Cappuccino and Natalie Sherman. 13. Micro extremely Lecturio and sketchy rock's. 14. Lehninger – Biochemistry. 15. Kuby – immunology. 16. Ananthnarayan- medical Microbiology. 17. Tortora- for studying diseases caused by the normal flora and antibiotic classes. 18. Stanbury and Whittekar -fermentation Microbiology. 19. Genes by Lewis- for Genetics/ molecular biology and genetic engineering 20. Watson- Molecular biology. 21. Kooper - Cell biology.

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: University exam (UE) : Maximum Marks: 50		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	Not Applicable

DECLARATION

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13.6.2022

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Assistant Professor, Govt. Mahamaya College, Ratanpur, Bilaspur

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Assistant Professor, Shahid Domeshwar Sahu Govt. College, Jamgaon R. Dist -Durg

Date : 13.06.2022.

Part A: Introduction				
Program: **Certificate Course**		Class: **B.Sc. II Year**	Year: **2023**	Session:**2023-2024**
1	Course Code	**ZOOL - 3T**		
2	Course Title	**Genetics, Developmental Biology & Evolution**		
3	Course Type	Theory		
4	Pre-requisite (if any)	NO		
5	Course Outcome	After successfully completing this course, the students will be able to: • Apply the principles of Mendelian inheritance on interaction of genes. • Various methods of sex determination in animal kingdom. • Understand the cause and effect of alterations in chromosome number and structure. • Know the Recent Assisted Reproductive Techniques • Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis. • Understand the general patterns and sequential developmental stages during embryogenesis and understand how the developmental processes lead to establishment of body plan of multicellular organisms. • Understand evolution through natural selection, and other forces.		
6	Credit Value	Theory : 4		
7	Total Marks: 50	Max. Marks: 50	Min Passing Marks : 17	

Part B : Content of Course		
Total No. of Periods : 60		
Unit	**Topics**	**No. of Period**
I	**Concept of Genes and The recombination and interaction of Genes :** Elements of heredity and variation - Classical and Modern concept of Gene (Cistron, muton, recon), Alleles. Mendel's laws of inheritance - Incomplete dominance, Codominance, Multiple alleles. Interaction of Genes - Lethal alleles, Pleiotropy, Epistasis, Supplementary Gene, Complementary genes, Polygenic inheritance. Linkage and crossing over, Linkage Map. Extra chromosomal and Maternal Inheritance. Sex Chromosomes and sex-linkage. Sex Determination	12
II	**Regulation of Gene expression & Human Population Genetics :** Gene Expressions and regulation - One gene-one enzyme hypothesis /one polypeptide hypothesis. Concept of Operon - Concept of Operon of bacteria and bacteriophages. Bacterial transposons. Transformation, transfection and transduction. Utility of the model organisms - *Escherichia coli*, & *Drosophila melanogaster*. Structural and numerical alterations of chromosomes - meiotic consequences in structural heterozygotes. Genetic disorders - Chromosomal Aneuploidy, Chromosome Translocation and Deletion, Single gene Disorders, Epigenetics, Pedigree analysis. Genetic counselling.	12

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III	**Developmental Biology :** Gametogenesis, Structure of Gametes and Types of Eggs. Fertilization - external and internal. Structural and biochemical changes in gametes during and after fertilization block to polyspermy, causes of Infertility. Establishment of the major embryonic axis, polarity. Cleavage - Types and patterns. Body plan and symmetries. Development of frog and Chick up to formation of three germ layers. Tubulation. Morphogenesis, Fate maps. Organogenesis - formation of gut, heart, kidney and muscles. Inhibition, induction, and recruitment. Concept of competence, determination and differentiation and growth, Pleuropotency.	12
IV	**Biology of development and Recent Techniques :** Parthenogenesis. Regeneration - epimorphosis, morphollaxis and compensatory regeneration. Extra embryonic membranes. Amniocentesis. Placenta - Types structure and functions. Recent Assisted Reproductive Techniques (ART) – Stem cell (Types and their uses), Gene bank, Sperm Bank, Superovulation, Cryopreservation, Invitro fertilization (IVF), Embryo transfer (ET).	12
V	**Evolution :** Origin of Life on Earth, Early life on Earth - Indirect evidences & direct evidence of early life. Evidences of Organic evolution. Theories of Organic evolution. Sources of variation - Mutation, recombination, Isolation, Genetic drift, Neutral and Artificial evolution. Evolution of Human.	12

Keywords: Genetics, Mendel's law, Interaction of Gene, Sex Linkage, Sex Determination, Gametogenesis, Fertilization, Cleavage, Embryology, Regeneration, Parthenogenesis, Extra embryonic membrane, Placenta, Evolution,

Part C - **Learning Resource**

Text Books, Reference Books, Other Resources

Suggested Readings:

Text Books:

1. Gardner, E.J. *et al.* (2006) Principles of Genetics (John Wiley).
2. Russell, P.J. (2010) Genetics (Benjamin Cumm ings).
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.
5. Klug, W.S., Cummings, M.R. and Spencer, C.A. (2012). Concepts of Genetics. (X edition) Benjamin Cummings.
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.
7. Gerhart, J. et al. (1997) Cells, Embryos and Evolution. Blackwell Science
8. Gilbert, S.F. (2010) Developmental Biology (9th edition).
9. Sinauer Wolpert, L. (2007) Principles of Developmental Biology (3rd edition). Oxford University Press.
10. Campbell, N. and Reece, J. (2014) Biology (10th edition). Benjamin Cummings
11. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing.
12. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
13. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett

Online Resources –

1. National digital Library.-

http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YR201R0cwYXJHV25HSHFacGxtS1h3REZGd1ByL28xcmlleEFFZU5najlCZ1lHdXBBTzBleTBVRGlDSFhkMEtuUkE9PQ

2. E-PG Pathshala.
https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA
3. eGyankosh- Genetics and Evolutionary Biology
4. eGyanKosh: BZYCT-137 Genetics and Evolutionary Biology

Part D: Assessment and Evaluation	
University Exam(UE): Maximum Marks:	50 Marks

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Date : 13.06.2022.

Part A:Introduction				
Program: **Certificate Course**		Class: **B.Sc. II Year**	Year: **2023**	Session:**2023- 2024**
1	Course Code	**ZOOL- 4T**		
2	Course Title	**Biochemistry and Molecular Biology**		
3	Course Type	**Theory**		
4	Pre-requisite (if any)	No		
5	**Course Learning Outcomes (CLO)**	At the end of this course, the students will be able • Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids. • Understand the concept of enzyme, its mechanism of action and regulation. • Learn the preparation of models of peptides and nucleotides. • Learn biochemical tests for amino acids, carbohydrates, proteins and nucleic acids. • Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario. • Understand the process of DNA replication, transcription and translation.		
6	Credit Value	4		
7	Total Marks	Max. Marks: 50	Min Passing Marks: 17	

Part B: Content of the Course		
Total No. of Periods: 60		
Unit	Topics	No. of Peroid
I	**Biomolecules:** Amino Acids, Peptides, and Proteins- structure of amino acids, peptide bond, Primary, secondary, tertiary and quaternary structure of proteins and their biological functions. Carbohydrates- Biological roles of carbohydrates, Structure of monosacharides- Hexoses and pentoses. Disacharides-Sucrose, lactose, maltose. Storage and structural polysaccharides-Glycogen, starch and cellulose. Lipids- Role of lipids in cellular architecture and functions. Definition and classification of lipids. Structure and function of fatty acids, triacylglycerols, phospholipids and sterols. Nucleic Acids- Role of nucleic acids in living system. Composition of nucleic acids-the purine and pyrimidine bases.	12
II	**Enzymes and Metabolic Pathways:** Enzyme - Nomenclature and classification, general properties, specificity, cofactors, isozymes and mechanism of enzyme action. Protein metabolism- Transamination and deamination, Urea cycle. Carbohydrate metabolism- Glycolysis, gluconeogenesis, Cori-cycle, TCA cycle, HMP shunt, glycogenolysis & glycogenesis (Glycogen synthesis) . Lipid Metabolism- Mobilization of triglycerides, metabolism of glycerol, β-oxidation of fatty acids, Ketogenesis and significance.	12

13.6.2022

III	**Structure of chromosomes, Nucleic acids and DNA replication:** Structure of nucleic acids- Structure of DNA, forms of DNA, supercoiling of DNA, Nucleosomes, Histones, Structure of chromatin, chromosomes, packaging of DNA in the nucleus. Structure of RNA- Ribosomal RNA (rRNA), Transfer RNA (tRNA), Messenger RNA (mRNA), Noncoding RNA. DNA replication- Chemistry of DNA replication, enzymes involved, Unit of replication, replication origin and replication fork, accuracy during flow of genetic information, proof reading activity; Comparison of replication in prokaryotes and eukaryotes.	12
IV	**Central dogma, RNA transcription, RNA processing:** Central Dogma of Molecular Biology. Trancription (RNA Synthesis) - DNA-dependent RNA polymerases, sigma factor, bacterial promoters, the three stages of RNA synthesis- initiation, elongation and termination, rho dependent and rho-independent termination. Transcription in eukaryotes. RNA processing-splicing of hnRNA into mRNA, 5'-capping and 3'-polyadenylation of mRNA, differential RNA Processing, rRNA and tRNA modifications and processing.	12
V	**Ribosomes and Translation (Protein Synthesis):** Structure and types of Ribosome. Genetic Code- triplet codons, Wobble base, synonymous codons, degeneracy of codons, missense-, nonsense- and frame shift mutations. Translation- protein synthesis in *Prokaryote and its comparison with* eukaryote., Aminoacylation of tRNA, initiation, elongation, peptide bond formation, translocation, termination, recycling of ribosome. Regulation of protein synthesis and codon bias - Post-translational modifications and processing of proteins.	12
Keywords: Biomolecules, biochemical pathways, Metabolism, Central dogma, Nucleic acids, chromosome, DNA replication, RNA Synthesis (Transcription), Protein Synthesis (Translation), Genetic code.		

Part C - **Learning Resource**
Text Books, Reference Books, Other Resources

Suggested Readings:

Text Books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman & Company (New York), ISBN: 13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.
2. Berg, J.M.; Tymoczko, J.L. and Stryer, L. (2012) Biochemistry (7th edition) Freeman.
3. Conn, E.E.; Stumpf, P.K.; Bruening, G. and Doi, R.H. (2006) Principles of Biochemistry (5th edition) Wiley.
4. Stryer, Lubert (1981) Biochemistry, 2nd Edition. W. H. Freeman and Company, New York.
5. Watson, J.D. *et al.* (2013) Molecular Biology of the Gene (7th edition) CSHL Press Pearson.
6. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition, John Wiley & Sons. Inc.
7. Walter, P. (2007) Molecular Biology of the Cell (5th edition) Garland Science.
8. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter(2002) Molecular Biology of the Cell, 4th edition. New York: Garland Science.
9. Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger,

Freeman(2003) Molecular Cell Biology, 5th edition. W. H. & Company.

Online resources (Try to include similar course available on SWAYAM/NPTEL/CEC etc.)

https://onlinecourses.nptel.ac.in/noc20_cy10/preview
https://www.classcentral.com/course/swayam-biochemistry-iitm-22920
https://onlinecourses.swayam2.ac.in/cec20_ma13/preview
https://www.classcentral.com/course/swayam-molecular-biology-19952

Part D: Assessment and Evaluation
University Exam (UE) : Maximum Marks: 50

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Date : 13.06.2022.

Part A: Introduction				
Program: **Certificate course**		Class: **B.Sc. III rd. Year**	Year: **2024**	Session **2024:2025**
1	Course code	**ZOOL: 5T**		
2	Course Title	Animal Behaviour, Chronobiology and Ecology		
3	Course type	Theory		
4	Pre requisite	NO		
5	Course learning Out comes (CLO)	After successfully completing this course, the students will be able to: • Learn a wide range of theoretical and practical techniques used to study animal behaviour. • Develop skills, concepts and experience to understand all aspects of animal behaviour. • Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives. • Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild. • Consider and evaluate behaviour of all animals, including humans, in the complex ecological world, including the urban environment. • Know the evolutionary and functional basis of animal ecology. • Understand what makes the scientific study of animal ecology a crucial and exciting endeavour. • Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice. • Solve the environmental problems involving interaction of humans and natural systems at local or global level.		
6	Credit value	4		
7	Total Marks	Max. Marks: 50		Minimum. Passing Marks: 17

13.6.2022

Part B : Content of Course		
Total Periods: 60		
Unit	**Topics**	No. of Period
I	**Concept and pattern and control of behaviour** Animal behaviour: Scope and importance of study. Concept of behaviour : Motivation, Fixed action of pattern, sign stimulus, Innate releasing mechanism, Action specific energy, Physiological Basis, Learning, Imprinting, Behavioural Genetics, and Evolution of Behaviour. Patterns of behaviour : Kinds of behaviour: foraging behaviour, Territorial behaviour. Mate selection and courtship behaviour. Parental care, Defensive behaviour. Stereotyped Behaviours : Orientation: Kinesis and taxes and Simple Reflex. Neural control And Hormonal Control of Behaviour.	12
II	**Innate; Learning behaviour and socio:biology** Innate behaviour: communication by sound (cricket vocalizations), Bird song, Echolocation in Bat. Chemical Signalling: Pheromones (types of pheromones) and bee Dance. Schooling behaviour in fish and Flocking Behaviour in Birds. Types of learning: Habituation, Imprinting and types of imprinting :filial and sexual, Classical conditioning, Instrumental learning, Latent learning and Trial and error learning, insight learning. Social behaviour : aggregation, group selection, kin selection, altruism.	14
III	**Chronobiology :** Biological clocks, biological rhythms: Circadian and circannual rhythms. Tidal, solar and lunar rhythms, entrainments. Biological oscillation. The concept of Average, amplitude, phase and period. Role of melatonin. Applications of Chronobiology: Chrono pharmacology, Chrono medicine, Chronotherapy. Migratory behaviour in birds and fishes.	11
IV	**An overview of ecology, ecosystems and population ecology** Structure and function of ecosystem: Major ecosystems of the world. Law of limiting factors. Ecological succession. Energy flow in ecosystem, food chain and food web. Recycling of nutrients: C, N, P & S cycle. Ecology of populations: Density, natality, mortality, Fertility and fecundity, survivorship curves. Unique and group attributes of population: mortality, age ratio and age pyramid, sex ratio, dispersal. Factors regulating population dispersal and growth: Exponential and logistic growth. Population regulation: Density:dependent and independent factors; r and K strategies.	12

V	**Biotic community, environmental degradation:** Community characteristics: stratification; dominance, diversity, species richness, abundance, evenness, similarity. diversity and food:web indices. ecotone and edge effect. Types of interaction: Positive interactions: commensalism, proto:cooperation, and mutualism. Negative interactions: parasitism and allelopathy; predation and predator:prey dynamics; herbivory. Interspecific competition and coexistence. Environmental ethics; Pollution: Air, water and noise pollution and their control. Natural resources, Mineral, water and forest, their significance and conservation. Types of biodiversity, Hotspots, benefit and threat of conservation strategies.	11
Key words – Innate and Learning Behaviour, Sociobiology, Biological clock, Circadian rhytham, Population, Community, Succession, Pollution, Biological interaction, Biodiversity.		

Part : C Learning Resource

Text books, Reference Books, Other Resources:

1. McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited, London, UK.
2. Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6th edition) Ca
3. Alcock, J. (2005) Animal Behaviour (8th edition) Sinauer Associate Inc., USA.
4. Sherman, P. W. and Alcock, J. (2013) Exploring Animal Behaviour (6th edition) Sinauer Associate Inc., Massachusetts, USA.
5. Dunlap, J. C.; Loros, J.J. and DeCoursey, P. J. (2009)Chronobiology Biological Timekeeping (1st edition) Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.
6. McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited, London, UK.
7. Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6th edition) Ca
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13. McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited, London, UK.

14. Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6th edition) Ca
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17. Dunlap, J. C.; Loros, J.J. and DeCoursey, P. J. (2009)Chronobiology Biological Timekeeping (1st edition) Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.
18. Kumar, V. (2002).Biological Rhythms: Narosa Publishing House, Delhi/ Springer : Verlag, Germany. mbridge, University Press, UK
19. Colinvaux, P. A. (1993) Ecology (2nd edition) Wiley, John and Sons, Inc.
20. Krebs, C. J. (2001) Ecology (6th edition) Benjamin Cummings. 57
21. Odum, E.P., (2008) Fundamentals of Ecology. Indian Edition. Brooks/Cole.
22. Ricklefs, R.E. (2000) Ecology (5th edition) Chiron Press.
23. Southwood, T.R.E. and Henderson, P.A. (2000) Ecologial Methods (3rd edition) Blackwell Sci.
24. Kendeigh, F C. (1984) Ecology with Special Reference to Animal and Man. Prentice Hall Inc.
25. Stiling, P. D. (2012) Ecology Companion Site: Global Insights and Investigations. McGraw Hill Education.

E:Resources:

1. SWAYAM: .https://swayam.gov.in/explorer?searchText=
2. https://academic.oup.com
3. https://medineplus.gov
4. https://ncin.nlon.nih.gov
5. https://zoologylearningpoint.woodpress.com
6. https://zoologyresources.com
7. National digital library – https://ndl.iitkgp.ac.in
8. e:PG Pathshala (MHRD) Portal, https://egpg.inflibnet.ac.in
9. Science Direct Open Access Content
10. https://www.sciencedirect.com/book/9781843342038/ open Access
11. https://egyankosh.ac.in
12. https://Sciencedirect .com
13. https://Britannica.com> science > animal :behaviour
14. https://www nontesonzoology . com>animal behaviour
15. https://www biologyonline.com
16. https://www sciencing.com> Science > Biology > Ecology
17. https://www2 . hcmuf.edu.vn
18. https://wwwresearchgate . net

Part D: **Assessment and Evaluation**
University Exam(UE): Maximum Marks: 50 Marks

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    Assistant Professor, Shahid Domeshwar Sahu Govt. College, Jamgaon R. Dist -Durg

Date : 13.06.2022.

Part A: Introduction				
Program: **Certificate Course**		**Class:**B.Sc. III rd Year	**Year:**2024	**Session:**2024-2025
1	**Course Code**	**ZOOL – 6 T**		
2	**Course Title**	**Microbiology, Parasitology, Immunology and Applied Zoology**		
3	**Course Type**	Theory		
4	**Pre-requisite (if any)**	No		
5	**Course Learning Outcomes (CLO)**	After completing this course, the students will be able to - • Understand causative agents, pathogenesis, diagnosis, prophylaxis, and chemotherapy for various bacterial, viral, protozoan, and helminthic diseases. • Understand the concept of immune mechanisms, their pathways, acquired immunity, hypersensitivity, and autoimmune disorders. • Understand the aquaculture techniques, their problems, and commercial viability. • Understand the techniques and commercial significance of apiculture, sericulture, and lac culture. • Understand the basic and technical skills related to dairy management, poultry, and vermicomposting.		
6	**Credit Value**	4		
7	**Total Marks**	Max. Marks: 50	Min Passing Marks : 17	

Part B: Content of the Course		
Total Periods: 60		
Unit	**Topics**	**No. of Period**
I	**Microbiology and Parasitology :** Bacterial diseases – Caused by *Salmonella typhi, Helicobactor pyloriand, Mycobacterium tuberculosis* with their pathogenesis, diagnosis, prophylaxis, and chemotherapy. Viral diseases – Hepatitis, influenza, AIDS, with their pathogenesis, diagnosis, prophylaxis, and chemotherapy. Protozoan diseases – Amoebiasis, Malaria, Trypanosomiasis, and Leishmaniasis with the life cycle of pathogen and possible treatments. Helminthic diseases – Schistosomiasis, Taeniasis, Ascariasis, and Filariasis with the life cycle of pathogen and possible treatment.	12
II	Immunology : Cells and organelles of the immune system. Characteristics of antigen, Antigenicity, Immunogenicity, Epitopes, Haptens, Adjuvant. Immunoglobulin : Classification, properties, and function of immunoglobulin. Antigen, and Antibody interaction. Humoral and cell:mediated immune response. The role of B and T cells in immunity. MHC complex, Hypersensitivity. Autoimmune disorders: Thyroid problem, Rheumetoid Arthritis . Monoclonal antibodies. Concept of vaccine.	12
III	**Aquaculture :** Prawn culture – Prawn culture in freshwater, its preservation, and processing. Pearl culture – Biology and technology followed (Fresh & Marine). Fish culture –Maintainance of fresh water fish farm and Breeding, Composite fish farming.	12
IV	**Apiculture, Sericulture, Lac culture :** Apiculture – types of the honey bee and culture technology. Lac culture – cultivation process with the life cycle of lac insect. Sericulture – types of silkworm and technology for mulberry silk worm culture. Economic values of Apiculture, Sericulture and Lac culture.	11
V	**Dairy Management, Poultry farming, and Vermicomposting :** Dairy Management : Techniques for dairy management; Cattle disease. Poultry – Types of breeds, rearing methods and diseases. Biology and rearing method of earthworm *Eisenia foetida/ Pharitima Posthuma.* The technology of Vermicompost production.	13
Keywords: Micro organism, Parasites, Immune System, Economic Zoology, Dairy Management, Poultry Management, Vermicomposting.		

13.6.2022

Part C :Learning Resource
Text Books, Reference Books, Other Resources – 1. Jawetz, M., and Adelberg (2015) Medical Microbiology (27 th edition). 2. Chatterjee, K.D. (2015) Parasitology (13 th edition). 3. Goldsby, R.A.; Kindt, T.J. and Kuby, J. (2006) Immunology (6th edition). 4. Roitt, I.; Brostoff, J. and Male, D. (2012) Immunology (8th edition). 5. Shukla, G.S. and Upadhyaya, V.B. (1999:2000). Economic Zoology (Rastogi Publishers). 6. Mani, M.S. (2006). Insects, NBT, India. 7. Jabde, P.V. (2005) Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture.
E: Resources – 1. SWAYAM: .https://swayam.gov.in/explorer?searchText 2. https://academic.oup.com 3. https://medineplus.gov 4. https://ncin.nlon.nih.gov 5. https://zoologylearningpoint.woodpress.com 6. https://zoologyresources.com 7. National digital library – https://ndl.iitkgp.ac.in 8. e:PG Pathshala (MHRD) Portal, https://egpg.inflibnet.ac.in 9. Science Direct Open Access Content – https://www.sciencedirect.com/book/9781843342038/ open Access 10.https://egyankosh.ac.in

Part D: Assessment andEvaluation
Maximum Marks, University exam. (UE) : : **50**

DECLARATION

This is to certify that the syllabus is framed by the central board of study (Zoology) as per the guidelines of the department of higher education, Chhattisgarh government.

1. Dr. K. R. Sahu - Chairman -
   Assistant Professor, Govt. Pandit Madhav Rao Sapre College, Pendra Road
2. Dr. Ajit Hundet - Member -
   Professor, Govt. D. B. Girls College, Raipur
3. Dr. Prem Prakash Singh - Member -
   Professor, Govt. College, Kusmi, Balrampur
4. Dr. Shubhada Rahalkar - Member -
   Professor, Govt. Bilasa Girls P. G. College, Bilaspur
5. Dr. Anil Kumar Shrivastava - Member -
   Professor, Govt. V. Y. T. P. G. Autonomous College, Durg
6. Dr. R. K. Tamboli - Member -
   Assistant Professor, Kirodimal Govt. Arts & Science College, Raigarh

7. Dr. Parmita Dubey - Member -
Assistant Professor, Govt. J. Y. Chhattisgarh College, Raipur

8. Dr. Shashi Gupta - Member -
Assistant Professor, Govt. Nagarjuna P. G. College of Science, Raipur

9. Dr. L. P. Miri - Member -
Assistant Professor, Govt. J.P. Verma P. G. Arts & Commerce College, Bilaspur

10. Dr. Rajesh Kumar Rai - Member -
Assistant Professor, Govt. Mahamaya College, Ratanpur, Bilaspur

11. Dr. Hema Kulkarni - Member -
Assistant Professor, Shahid Domeshwar Sahu Govt. College, Jamgaon R. Dist -Durg

Date : 13.06.2022.