



**Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS),
PUNE**

Department of Zoology

Syllabus
for
T. Y. B. Sc. (Zoology)

[Pattern 2019]
(B.Sc. Semester-V and VI)

To be implemented

From Academic Year
2021-22

Fergusson College (Autonomous), Pune
Structure of T. Y. B. Sc. (Zoology)
Under CBCS pattern (2019) *effective from June 2021*

Sem.	Paper No.	Course code	Title	Credits	CE maximum Marks	ESE maximum Marks	Total maximum Marks
V	DSE-1A	ZOO3501	Life and Diversity of Animals-V	2	50	50	100
	DSE-1B	ZOO3502	Fundamentals of Histology	2	50	50	100
	DSE-2A	ZOO3503	Biochemistry	2	50	50	100
	DSE-2B	ZOO3504	Ecology and Environmental Biology	2	50	50	100
	DSE-3A	ZOO3515	Immunology	2	50	50	100
		OR					
	DSE-3B	ZOO3506	Insect Pest Management	2	50	50	100
	DSE-1	ZOO3517	Biological Techniques and Bioinformatics	2	50	50	100
		OR					
	DSE-2	ZOO3508	Forensic Entomology	2	50	50	100
	SEC-1*	ZOO3509	Bee Keeping.	2	50	50	100
	SEC-2*	ZOO3510	Vermiculture and Vermicomposting	2	50	50	100
	DSE-1	ZOO3511	Zoology Practical-I	2	50	50	100
	DSE-2	ZOO3512	Zoology Practical-II	2	50	50	100
	DSE-3	ZOO3513	Zoology Practical-III	2	50	50	100
		Total Credits	22			1100	
VI	DSE-4A	ZOO3601	Life and Diversity of Animals-VI	2	50	50	100
	DSE-4B	ZOO3602	Physiology - Life Sustaining Process	2	50	50	100
	DSE-5A	ZOO3603	Molecular Biology	2	50	50	100
	DSE-5B	ZOO3604	Organic Evolution	2	50	50	100
	DSE-6A	ZOO3605	Animal Pathology	2	50	50	100
		OR					
	DSE-6B	ZOO3606	Human Genetics	2	50	50	100
	DSE-7A	ZOO3617	General Endocrinology	2	50	50	100
		OR					
	DEC-7B	ZOO3608	Poultry Science	2	50	50	100
	SEC-3*	ZOO3609	Biostatistics	2	50	50	100
	SEC-4*	ZOO3610	Public health and Hygiene	2	50	50	100
	DSE-1	ZOO3611	Zoology Practical-IV	2	50	50	100
	DSE-2	ZOO3612	Zoology Practical-V	2	50	50	100
	DSE-3	ZOO3613	Zoology Practical-VI	2	50	50	100
		Total Credits	22			1100	

** For SEC courses – CE and ESE exam will be conducted by the department. It will not be conducted centrally.*

Note:

1. **DSE (Department Specific Elective)** – 12 Courses selected by the department. The list provided by UGC CBCS pattern for T.Y.B.Sc. is suggestive in nature and each department has a complete freedom to suggest their own papers under this category based on expertise, specialization, requirements, scope and need.
2. **SEC (Skill Enhancement courses)** – Minimum 4 for T.Y.B.Sc. These courses may be chosen from pool of courses designed to provide value-based and/or Skill-based knowledge and should contain both theory and lab/hands-on-training/field work. The main purpose of these courses is to provide students life-skills in hands on mode so as to increase their employability. The list provided by UGC is suggestive in nature and each department has freedom to suggest their own papers under this category based on expertise, specialization, requirements, scope and need.

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	Life and Diversity of Animals-V ZOO3501	Number of Credits :2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define the systematic position, habit and habitat and external characters of <i>Pila globosa</i> . Describe the body wall and pallial complex and organ system of <i>Pila globosa</i> .	
CO2	Explain the methods of locomotion, nutrition and reproduction in various species of Protozoa. Distinguish the general features of Paramecium.	
CO3	Apply the knowledge in study of various types of canal system in Porifera. Compare the skeletal spicules in sponges.	
CO4	Analyse the polymorphism in various coelenterates and summarize the process of corals and coral reef formation in them.	
CO5	Evaluate the parasitism and parasitic adaptation of helminths and explain the process of regeneration in Planaria. Compare the knowledge of metamerism in Annelida and describe the process of torsion and detorsion in Mollusca.	
CO6	Compile the information and develop skill in identification and classification of rotifers. Explain the general characters and affinities of hemichordates.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Study of <i>Pila globosa</i> with reference to the following; Systematic position, habit and habitat and external characters, Body wall and pallial complex, Functional Anatomy - Digestive, Respiratory, Circulatory, Excretory, Reproductive, Nervous system and Sense organs.	14
II	Study of the major phyla with reference to: Protozoa: locomotion and nutrition; general features of Paramecium, Porifera- canal system and skeleton, Coelenterata-polymorphism, corals, and coral formation Helminthes- Regeneration in planaria, Annelida- Metamerism, Mollusca- Torsion and detorsion in Gastropod, Hemichordata- Affinities of hemichordate with different group of Animal	22

References:

1. Living Invertebrates, 1987: Pearse, Buchsbaum, Blackwell Scientific Publication, California.
2. A Text book of Zoology Invertebrates, Vol. I 1992, 7th Edn. Parker and Haswell edited by Marshall William, C B S publishers and distributors, New Delhi.
3. Life of Invertebrates, 1992; S.N. Prasad, Vikas Publishing House, New Delhi.
4. Invertebrate Zoology, 1992 4th Edn., reprint, P.S. Dhama and J. K. Dhama, R. Chandand Co., New Delhi.
5. Phylum series from Protozoa to Echinodermata- R.L. Kotpal. Rastogi publ., Meerut.
6. Modern text book of Zoology, Invertebrates 10th Edn., 2009, R.L. Kotpal, Ra stogi publ., Meerut.
7. Invertebrates Structure and Function, 2nd Edn.1979, EJW Barrington, John Wiley and Sons Inc.
8. Invertebrates Zoology, 1994, 6th Edition, Ruppert, E. Edward, R. D. Barnes; Saunders college Publishing, USA.
9. Invertebrate Zoology, 1991, P.A. Meglitsch and F. R. Schram, Oxford University Press;New York.
10. Invertebrate: A New synthesis, 1988, R.S.K. Barnes, P. Calow and P.J.W., Olive Blackwell Scientific, U.K.
11. An Introduction to Protochordata, 1990, H. S. Bhamrah and KavitaJuneja, Anmol publication, New Delhi.
12. The invertebrates: Protozoa through Ctenophora Vol. I, 1959, Hyman, Libbie Henrietta, McGraw-Hill Book Co., Inc. New York.
13. A text book of Zoology, Vol. II, 1990, T. J. Parker and W. A. Haswell, Low price Publication, Delhi.
14. Modern Text Book of Zoology, 1992, R. L. Kotpal, Rastogi Publication, Meerut.

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	Fundamentals of Histology ZOO3502	Number of Credits :2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe concept of histology, basic structure of tissues and identify and label microscopic structure of organs.	
CO2	Differentiate between histological structure of different regions of alimentary canal and explain the structure of skin, lungs, and kidney.	
CO3	Illustrate histological structures of various cell types, tissues, and organs.	
CO4	Explain the histological organization of endocrine, exocrine glands, gonads and correlate it with the health issues.	
CO5	Compare the characteristics of epithelial, connective, muscular, nervous tissues and the types of blood vessels.	
CO6	Specify the importance of histological studies for the services provided by clinical and pathological laboratories.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Tissues and Integumentary system. Definition and types of tissues: Epithelial, Connective, Muscular, Nervous and types of glands, Histology of Skin, structure of hair, sweat gland, sebaceous gland.	08
II	Alimentary canal. Histology of tooth and tongue, types of papillae, structure of taste buds, Basic histological organization of alimentary canal, microscopic structure of oesophagus, stomach, small intestine (duodenum and ileum) and large intestine (rectum).	08
III	Mammalian Respiratory organs, Blood vessels. Histology of Trachea and Lung, Histological structure of artery, vein and capillaries.	06
IV	Excretory organs and Reproductive organs. Histology of mammalian kidney, structure of uriniferous tubule, ureter and urinary bladder, Histology of mammalian testes, mature spermatozoa, histology of mammalian ovary and ovarian follicles.	08
V	Endocrine and Exocrine glands: Embryological origin, histological structure, blood supply of Pituitary, Adrenal, Thyroid, Salivary gland, Liver and Pancreas.	06

References:

1. Inderbir Singh's Textbook of Human Histology (With Colour Atlas and Practical Guide), 2014, 7th Edn., Neelam Vasudeva and Sabita Mishra, Jaypee Brothers Medical Publishers, New Delhi, India.
2. Essential Histology, 2001, 2nd Edition, David H. Cormack, Lippincott Williams & Wilkins, Philadelphia.

3. A text book of Histology, 2014, 5th edn. Krishna Garg, Indira Bahl & Mohini Kaul CBS Publication & Distributors, Delhi.
4. Histology, 1977, 4th Edn. R. O. Greep and L. Weiss, McGraw Hill Int. Book Co. New York.
5. Hand book of Basic Mictotechnique, 1964, 3rd Edn. Peter Gray, McGraw Hill Book Co. New York.
6. Bailey's Textbook of Histology - Williams and Wilkins Baltimore and Scientific Book Agency, Culcutta Copenhaver W. M.
7. Text book of Histology - Bloom W. and Fawcett D. W.
8. Histology - Lippinocott, Han A. W.
9. Human Histology - Leslie Brainerd Arey (Khosla Pub. House, Delhi)

T. Y. B.A. Semester V		
Title of the Course and Course Code	Biochemistry ZOO3503	Number of Credits :2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Outline concept of pH and buffer, its importance and explain types of bond and buffers in biological system. Describe structure and properties of water.	
CO2	Classify types of sugars and demonstrate stereochemistry of carbohydrates and their properties.	
CO3	Classify amino acids on the basis of their structures and tell their types. Differentiate structures of proteins, state examples and tell bonds responsible for protein structures.	
CO4	Analyse amino acids on the basis of tests.	
CO5	Grade lipids based on the structure, and functions and explain triglycerides, saponification.	
CO6	Explain the role of vitamins in metabolism, learn structures and develop the knowledge to relate vitamins to the type of deficiency diseases.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Basic Biochemistry: Structure of water molecule (liquid, ice and colloid) Physico-chemical properties of water, Concept of acid and base, pH, Sorenson's scale, derivation of Henderson - Hassel Balch equation and its applications, Concept of Buffer-types of buffer, buffering capacity and buffers in biological system.	08
II	Carbohydrates: Definition and classification of carbohydrates. Properties of carbohydrates- stereoisomerism - Enantiomers, anomers, epimerism, autorotation, racemisation. Detection techniques for carbohydrates, Biological significance of carbohydrates.	08
III	Proteins: Amino acids- structure, properties, and classification Essential, non-essential, non-protein amino acids,	10

	Physical properties of amino acids, Reactions related to R group, COOH group and NH ₂ group, titration curves - (reference to Alanine), isoelectric point, Zwitterion Determination of N-terminal and C- terminals. Types of protein structure and bonds, Responsible for protein structure), Biological significance of proteins	
IV	Enzymes: Introduction and Classification of enzymes Reversible and irreversible enzyme inhibition, Factors influencing enzyme activity, Enzyme kinetics, MM equation and its importance and LB plot. Isoenzyme, co-enzymes (NAD, NADP, FAD, FMN, Co-A, TTP), cofactors, Immobilized enzymes Ribozymes.	10

References:

1. Principles of Biochemistry, 1993, 2nd Edn, Lehninger A. L. Nelson D.L. & Cox M.M. CBH Publisher and distributors, Delhi.
2. Biochemistry, 1995 5th Edn. Zuby G. Wm, C. Brown Communications USA
3. Harper's Biochemistry, 1996, 26th Edn., Murray R. K., Granner D. K., Mayes P. A. & Rodwell V. W. Prentice Hall international USA.
4. Outline of Biochemistry, 1995 5th Edn., Conn E. E., Stumph P. K. Bruening G. & Doi, R. H. John Wiley & Sons, USA
5. Principals of Biochemistry, 1993, 1st Edn., Pattabhiraman T. N., Gajanan Book Publishers and distributors, Bangalore.
6. Clinical Biochemistry, 1994, B. P. Godkar, Bhalini Publishing House, Mumbai.
7. Biochemistry - 1995 5th Edn, Stryer Sanfrancisco, W. H. Freeman & Co.
8. Biochemistry, 1990, 8th Edn., D. Voet & J. Voet, John Willey, New York
9. Principles and techniques of Biochemistry and molecular biology - 2009, 7th Edition, Keith Wilson and John Walker, Cambridge University.
10. Biochemistry- 2012, Seventh International Edition, Jeremy Berg and Tymoczko and Stryer, Freeman and Company, New York
11. Biochemistry - 2011, Fourth International Student Edition, Voet and Voet, John Wiley and Sons.
12. Essentials of Biochemistry -U. Satyarayana, U. Chakrapani Second Edition Books and Allied(P) Ltd.

T. Y. B.A. Semester VI		
Title of the Course and Course Code	Ecology and Environmental Biology ZOO3504	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe basic concept of ecology, structure and function of ecosystem and its management. Define, differentiate and explain the large-scale patterns of temperature regulation. Describe and write about different types of pollutants, their effects, control measures and how they interact in the environment.	
CO2	Interpret and explain how interactions between organisms and their environments drive the dynamics of individuals, populations, communities, and ecosystems.	
CO3	Demonstrate the characteristics of population and its dynamics and illustrate how population data can be analysed using statistics, graphs, life tables, and survivorship curves.	
CO4	Differentiate between environmental conditions of aquatic ecology, terrestrial ecology and desert ecology. Outline the ecological classification of organisms.	
CO5	Describe, analyse and review the role of remote sensing for sustainable development and its application in environmental biology.	
CO6	Develop an in-depth understanding of the interdisciplinary relationship of global environmental issues related to acid rain, ozone depletion and global warming and explain them.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Environmental Biology Introduction, Definition, basic concepts, and scope. Introduction to biodiversity.	3
II	Ecosystem structure and function Concept and definition of ecosystem - structure and function, Abiotic components - temperature relations, water relations, light, humidity and precipitation (rainfall), Biotic components - relationship among organisms, Positive interactions, Negative interactions. Major Ecosystems, Natural ecosystem (one example) Artificial ecosystem (one example), Ecological pyramids, Energy flow in ecosystem and flow models.	10
III	Habitat Ecology Aquatic ecology - Habitat conditions. Ecological classification of organisms. Terrestrial ecology - Environmental conditions. Desert ecology - The great Indian desert (Thar desert)	05
IV	Environmental Pollution: Definition and its types. Introduction to different environmental pollutants.	10

	Air pollution: Definition, Kinds of pollutants, Different sources of air pollutants, Air pollution and its relationship with the following: Acid rain, Greenhouse effect, Ozone layer, Water pollution: Definition, different sources of water pollutants. Effect of pollution on aquatic ecosystem Noise pollution: Definition. different sources of noise pollutants. Effects and control	
V	Population structure and dynamics: Basic concept, Population characteristics	4
VI	Remote sensing for sustainable development: Introduction to remote sensing, Introduction to geographic information system	4

References:

1. Ecology and Environment, P. D. Sharma, Rastogi Publ. Meerut.
2. Environmental Biology, 1996, P. S. Sharma and V. K. Agrawal, S. Chand and Co. New Delhi.
3. Ecology, 1995 Mohan P. Arora Himalaya Publ. House Delhi.
4. Fundamentals of ecology, 1993 M. C. Dash, Tata McGraw Hill, New Delhi.
5. Elements of ecology, George L. Clarke, John Wiley and Sons, New York.
6. Ecology of Natural resources, 1995 John Wiley and Sons, New York.
7. Concepts of Ecology, 1996, E. J. Kormondy, Pentice Hall of India, New Delhi.
8. Modern Concepts of Ecology, H. D. Kumar, Vikas Pub. House, New Delhi.
9. Ecology, E. P. Odum, Oxford & IBM Pub. Co., New Delhi.
10. Environmental Problems and Solution, D. K. Asthana, Meera Asthana, S. Chand Pub. Ramnagar, New Delhi. Immunology

ONLINE READINGS: -

1. <http://www.epa.gov/watertrain/pdf/issue2.pdf>
2. <https://www.encyclopedia.com/science-and-technology/biology-and-genetics/environmental-studies/ecosystems#1014ecosystem>
3. Oxford Advanced Learner's Dictionary.
4. [http://www. ENVIRONMENT, ECOLOGY AND MAN/ online issue/ pdf](http://www.ENVIRONMENT, ECOLOGY AND MAN/ online issue/ pdf)
5. [https://www.researchgate.net/publication/228388875_Meeting_Environmental_Challenges_ The_Role_of_Human_Identity](https://www.researchgate.net/publication/228388875_Meeting_Environmental_Challenges_The_Role_of_Human_Identity)
6. <https://www.pmfias.com/iucn-red-list-india-red-data-list-red-book>
<https://www.iucnredlist.org>

Title of the Course and Course Code	Immunology ZOO3515	Number of Credits :2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define the basic terms and concepts of immunological processes at cellular and molecular level and identify the main mechanisms and types.	
CO2	Explain autoimmune disorders and exemplify the adverse effect of autoimmunity. Illustrate various mechanisms that regulate immune responses.	
CO3	Articulate principle of antigen-antibody reaction and outline basic techniques for identifying them	
CO4	Explain the activities of cells of the immune system and discuss their types, formation process and function.	
CO5	Compare and contrast innate and adaptive immunity.	
CO6	Design a model of Immunoglobulins, discriminate and explain their types.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	<p>1.Introduction of Immune system: Introduction to immunology and immunity. Definition and scope of immunology. Innate Immunity: Definition and characteristics, Innate immunity at species, race, family and individual levels. Mechanism: First line of defence, Second line of defence, Third line of defence. Acquired Immunity: Definition and characteristics.</p> <p>2.Cells of Immune system and their activities: Lymphoid cells: B lymphocytes, T lymphocytes, Null cells. Activities of mononuclear cells: phagocytosis, Antimicrobial and cytotoxic activities, secretion of factors, Mast cells, Dendritic cells.</p> <p>3.Organs of immune system: Primary lymphoid organs: Thymus, bone marrow, Lymphatic system, Secondary lymphoid organs: Lymph nodes, Spleen, Gut associated lymphoid tissue (GALT), Cutaneous associated lymphoid tissue (CALT).</p>	20
II	<p>1.Antigen, antibody, and their interaction: Antigens, Complete antigens and haptens, Determination of antigenicity: foreignness, molecular size, chemical composition and heterogeneity, susceptibility to tissue enzymes. Antigen specificity</p> <p>2.Antibodies: Immunoglobulin (antibodies); Basic structure of immunoglobulin, Structure of typical immunoglobulin, types of immunoglobulins.</p> <p>3.Antigen antibody interactions: General features of antigen - antibody interactions.</p>	12

	<p>Precipitation reaction: Definition, characteristics, and mechanisms, in fluids (tube test) and in gels (slide test). Radial immunodiffusion (Mancini method), Double immune-diffusion (Ouchterlony method), Immuno-electrophoresis, Agglutination reaction: definition, characteristics and mechanism, Haem agglutination (slide and micro-tray agglutination), Bacterial agglutination (tube agglutination), passive agglutination, Coomb's test and agglutination inhibition; MHC, complement pathway.</p>	
III	<p>1.Autoimmune disorders: Study of autoimmune disorders -Myasthenia Gravis, Systemic Lupus Erythematosus, Rheumatoid arthritis, Thyroiditis</p>	04

References:

1. Roitt's Essential Immunology, 13th Edition, Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt.
2. Fundamentals of Immunology, 5th edition, Edited by William E Paul, Lippincott Williams & Wilkins, 2003.
3. Immunology 7th Ed. - D. Male, J. Brostoff, D. Roth, I. Roitt (Elsevier, 2006)
4. Veterinary Immunology, 9th Edition, Ian Tizard
5. Immunology, 4th Ed. Janis Kuby, W. H. Freeman & Co.
6. Immunology, 6th Ed. Ivan M. Roitt
7. Immunology - Goldsby R. A., Kindt T. K., Osborne B. A. and Kuby J. (2003), 5th Edition, W. H. Freeman and Company, New York.
8. Immunobiology - Janeway C. A., Travers P, Walport M. and Shlomchik M. (2001), 6th Edition, Garland Publishing, New York.

Title of the Course and Course Code	Insect pest management ZOO3506	Number of Credits :2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define the Insect Pest	
CO2	Outline the classification of insects up to orders. <i>Explain</i> life cycles in various insects. <i>Distinguish</i> mouthparts in different insect. Compare the food and feeding of various insects. <i>Summarize</i> various types of larvae in insects	
CO3	<i>Explain</i> the insect pest of cereals and pulses, vegetables, stored grains, and fruit plants.	
CO4	<i>Classify</i> insecticides on the basis of their chemical nature <i>Distinguish the insecticide on the basis of</i> mode of entry and mode of action. <i>Write an application of</i> power and hand operated pest control equipment	
CO5	<i>Compile the knowledge of</i> integrated Pest Management. <i>Review the</i> Methods and process of IPM. <i>Illustrate</i> PM practices in India	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Introduction to Insect Pest Introduction and definition of insect pest, a brief outline of classification of insects up to orders, Food and feeding Types of mouthparts in insect, Types of life cycles in insects Types of larvae in insects	10
II	Insect Pests Insect pest of cereals and pulses – (Nature of damage, diagnostic features, life history and control measures) Insect pests of vegetables – (Nature of damage, diagnostic features, life history and control measures) Insect pests of stored grains – (Nature of damage, diagnostic features, life history and control measures) Insect pests of fruit plants – (Nature of damage, diagnostic features, life history and control measures)	12
III	Control Measures of Insect Pests Classification of insecticides on the basis of their chemical nature, mode of entry and mode of action, Applications of power and hand operated pest control equipment	08
IV	Integrated Pest Management Methods of IPM Process of IPM, IPM practices in India	06

References:

1. Insect Biology - A Textbook of Entomology, H. E. Evans, 1984. (Addison-Wesley Publ. Co.).
2. General Entomology, M. S. Mani, 1982, (Oxford & IBH Publ. Co.)
3. Insects, M. S. Mani, 1995. (National Book Trust, India).
4. Destructive and Useful Insects, C. L., Metcalf & W. P. Flint, 1962. (Tata McGraw-Hill Publ. Co.Ltd.)
5. Agricultural Pests of India and South-East Asia by A. S. Atwal.
6. Taxonomy - A Text and Reference Book by Kapoor V. C., 1983, John Wiley & Sons, New York.
7. Theory and Practice in Animal Taxonomy by Black Welder R. E., 1967, Oxford & IBH, New Delhi.
8. Principles and Procedures of Plant Protection by Chattopadhyay S. B. 1985, Oxford & IBH, New Delhi.
9. Insecticides: Toxicology and Uses by Gupta H. C., 1999, Agrotech Publ., Udaipur.
10. Integrated Pest Management - Concepts and Approaches, Dhaliwal G. S. & Arora R., 2003, Kalyani Publ., New Delhi,
11. Essentials of Agricultural Entomology, Dhaliwal G. S., Singh R. & Chillar B. S., 2006. Kalyani Publications, New Delhi.

Title of the Course and Course Code	Biological Techniques and Bioinformatics ZOO3517	Number of Credits :2
Course Outcomes (COs)		
On completion of the course, the students will be able to:		
CO1	Outline principle and applications of biological techniques.	
CO2	Explain and illustrate the concepts of separation techniques.	
CO3	Apply different Separation techniques and Microscopic techniques.	
CO4	Analyze different blood related parameters and their clinical significance.	
CO5	Determine the concentration and strength of chemicals/solutions for an experiment.	
CO6	Prepare a report on different Biological databases.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Good Laboratory Practices Laboratory Safety, Biohazardous Agents, Risk Groups and Biosafety Levels, Laboratory Acquired Infections, Safety Measures, Laboratory Practices, Basic Requirements of Laboratory.	6
II	Separation Techniques Principle and Applications, techniques related to isolation, purification and characterization of biomolecules, Chromatography-Gas Chromatography, Ion-Exchange, Gel filtration and Column Chromatography, Electrophoresis,	10

	Native, Agarose and Polyacrylamide, Centrifugation-Ultracentrifugation, Colorimetry and Spectroscopy	
III	Microscopy and Micrometry Principle, Working and Applications, Simple and Compound Microscope, Phase Contrast Microscope, and Electron Microscope (SEM and TEM)	10
IV	Introduction to Bioinformatics Internet and Web site, Search engines and computer programs useful in Biology Definition - Bioinformatics Applications and Research -Bioinformatics Databases - Characteristics - Categories - Navigating Databases – Information, Three levels of Bioinformatics in structural Biology, Applications of Bioinformatics in life sciences Tools used in Bioinformatics and Types of sequences used in Bioinformatics Biological Databases	10

References:

1. Introduction of Medical Laboratory Technique, 1998, 7th Edn., Baker F. J., Silverton R. E., Pallister C. J., Butterworth-Heinemann, UK.
2. Hematology: Basic Principles and Practice, 2008, 5th Edn., Ronald Hoffman, Bruce Furie, Philip McGlave, Churchill Livingstone Elsevier, USA.
3. Histological and Histochemical Methods, Theory and Practice, 2008, 4th ed., John A. Kiernan, Scion Publishing Ltd., UK.
4. Basic Separation Techniques in Biochemistry, 1998, Okotore R. O., New Age International, New Delhi.
5. Cytological techniques: The Principles Underlying Routine Methods, 1963, Baker J. R., Methuen & Co., London.
6. Davenport H. A.: Histological and Histochemical techniques.
7. Handbook of basic Microtechnique, 1958, 2nd Edn., Gray P., McGraw - Hill, USA.
8. The microscope and how to use it, 1970, George Stehli, Dover Publications Inc., New York.
9. Histopathological technique and Practical Histochemistry, 1976, 4th ed., Lillie R. D. McGraw Hill, USA.
10. Staining methods (Histological and Histochemical), 1960, Mc Manus J. F. A. and Mowry R. W., Paul B. Hoeber, Inc.; Harper & Brothers, NY.
11. Notes on Microscopical Techniques for Zoologist, 1964, Pantin C. F. A.: Cambridge University Press.
12. Elementary Microtechnique, 1973, 4th Edn., Peacock H. A., Edward Arnold Publ. Ltd., UK.
13. Histochemistry, 1968, Pearse A. G. E., Vol. I & II, W. B. Saunders Company (WBS) of Philadelphia.
14. Microscope and microscopic life, 1979, 2nd Edn., Peter Healey, Hamlyn, UK.
15. Biological Instrumentation and methodology, 2008, 2nd Revised Edition, P. K. Bajpai, S. Chand and Co. Ltd., New Delhi.

Title of the Course and Course Code	Forensic Entomology ZOO3508	Number of Credits :2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe the concepts of forensic entomology, its medicolegal importance and rigor mortis. Explain the life cycle of insects of forensic importance and use of insects to determine post-mortem interval.	
CO2	Discuss the factors stimulating rigor mortis and post-mortem damages caused by predators and also the role of aquatic insects in forensic investigation.	
CO3	Apply the knowledge of forensic entomology in detection of poisoning cases and investigation.	
CO4	Explain and analyse the data obtained at crime scene to find out causes death and also to determine time interval between the death and the onset of post-mortem changes.	
CO5	Discriminate the features of somatic, molecular and brain death and review its medicolegal aspects.	
CO6	Compile the data of some crime cases and aquatic and terrestrial ecosystem and write the forensic report.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Introduction to Forensic Science Definition, Scope, History and Development of Forensic Science, Concept of Forensic Entomology, Scope and Medico legal aspects of Forensic Entomology What is Death? Somatic and Molecular Death, Brain Death and it's medico legal aspects	08
II	Determination of Post-Mortem Interval Rigor Mortis and conditions stimulating Rigor Mortis, Post-Mortem damage by predators, use of insects in determination of Post-Mortem interval	06
III	Insects of Forensic Importance Life Cycle patterns of Calliphoridae and Sarcophillidae insects (Any 1 examples each). Use of insects in determination in displacement of body, detection of poisoning cases by use of insects.	06
IV	Role of Aquatic Insects in Forensic Investigation Introduction, Decomposition in Aquatic Ecosystems Freshwater Ecosystems: First Stage - Submerged Fresh, Second Stage - Early Floating, Third Stage - Floating	08

	Decay, Fourth Stage - Bloated Deterioration, Fifth Stage - Floating Remains, Sixth Stage - Sunken Remains, Marine Ecosystems	
V	Crime Scene Investigation Reporting of crime scene, analysis of data obtained at crime scene and use of data for post-mortem interval determination.	04
VI	Case Study Some crime cases solved by using Forensic Entomology: Any 1 case from Aquatic Ecosystem. Any 1 case from Terrestrial Ecosystem	04

References:

1. Forensic Entomology edited by Jayson Byrd and James Castner.
2. Crime Scene Intelligence, an experiment in Forensic Entomology by Albert Cruz.
3. Handbook of Forensic Science, US Department of Justice, Federal Bureau of Investigation.
4. Text Book of Forensic Medicine and Toxicology: Principles and Practice by Krishnan Vij.
5. DNA in Forensic Science: Theory, Techniques and Applications (1st edition), by James Robertson.
6. DNA evidence and Forensic Science by David Newton.
7. Forensic Science: Modern Methods of solving Crime by Max M. Houck.
8. Forensic Art and Illustration by Karen T. Taylor.

Bee keeping		
Title of the Course and Course Code	Bee keeping ZOO3509	Number of Credits : 2
Course Outcomes (COs)		
On completion of the course, the students will be able to:		
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. No.	Title of Unit and Contents	No. of Lectures
I	Introduction to Apiculture 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.	04
II	Biology of Honeybee 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.	08
III	Honey – its properties and application in various fields 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.	06
IV	Bee keeping equipments. ISI Type Hives, Langstroth Hives, Honey Extractor, Smoker, Bee Veil, Gloves, Knife etc.	04
V	Honeybee Plants and Floral Calendar 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.	05
VI	Honey Processing and Economics of Beekeeping 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.	05
VII	How to start Bee keeping? 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	04

Reference:

1. Prospective in Indian Apiculture - R.C. Mishra
2. Rearing queen bees in India - M.C. Suryanarayana et. al.
3. Bee Keeping in India - G. K. Ghosh
4. Technology and value addition of Honey - Dr. D. M. Wakhle and K. D. Kamble.
5. ABC & XYZ of Bee culture - A. I. Root
6. Indian Bee Journal - All India Bee Keeping Association
7. Asian Bee Journal.

Title of the Course and Course Code	Vermiculture and Vermicomposting (Skill Enhancement) ZOO3510	Number of Credits :
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define the Vermiculture and vermicomposting , explain difference between vermiculture and vermicomposting .	
CO2	<i>Identify</i> the various genus of Earthworm and <i>compare</i> usefulness. <i>Distinguish</i> types of vermicompost pit- small- and large-scale pit method, heap method. <i>List</i> out and compare the problems of traditional composting and vermicomposting. <i>Summarize</i> the physio-chemical parameters of vermicompost	
CO3	<i>Explain</i> the various techniques and process of vermiculture. Selection of site for vermiculture and collection of species mono and poly culture.	
CO4	<i>Revise</i> the important parameters for vermiculture like bedding, harvesting of worms, general manual, self-harvesting, and mechanical method	
CO5	<i>Compile the knowledge of nutritive</i> value of vermicompost, storing and packing of compost. <i>Standardize</i> vermicomposting for Rural. <i>Explain the</i> applications of vermicomposting in agricultural and horticultural practices.	
CO6	Define the Vermiculture and vermicomposting , explain difference between vermiculture and vermicomposting .	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Scope of vermitechology- Vermiculture and vermicomposting – difference between vermiculture and vermicomposting, Earthworm diversity: - study various genus and their identification & usefulness, Physio-chemical parameters of vermicompost, Organic waste sources – problems in traditional composting, vermicomposting, Types of vermicompost pit, small and large-scale pit method, heap method.	18
II	Vermiculture techniques – vermiculture process – site selection - Selection and collection of species mono and poly culture, Essential parameters for vermiculture – bedding, methods of harvesting worms’ general manual methods, self-harvesting method, mechanical method, Nutritive value of vermicompost, storing and packing of compost, Vermicomposting for Rural, Applications of vermicomposting in agricultural and horticultural practices, Economic of vermiculture.	18

References-

1. Vermitechnology by M Seethalekshmy, R Santhi
2. R. K. Bhatnagar & R. K. Palta- Earthworm Vermiculture and Vermicomposting, Kalyani Publishers, No. 1, Mahalakshmi Street, T. Nagar, Chennai -600 017.
3. P.K. Gupta - Vermi Composting for Sustainable Agriculture. AGROBIOS (India), Agro House, Behind Nasrani Cinema, Chopasani Road, Jodhpur – 342 002.
4. Sathe, T. V.- Vermiculture and Organic Farming. Daya Publishing House
5. Sultan Ahmed Ismail, - The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
6. Bhatt J.V. & S.R. Khambata (1959)- Role of Earthworms in Agriculture. Indian Council of Agricultural Research, New Delhi.
7. Dash, M.C., B. K. Senapati, P.C. Mishra (1980) - Worms and Vermicomposting. Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, Jyoti Vihar, Orissa.
8. Edwards, C.A. and J.R. Lofty (1977)- Biology of Earthworms. Chapman and Hall Ltd., London.
9. Lee, K.E. (1985)- Earthworms: Their ecology and Relationship with Soils and Land Use Academic Press, Sydney.
10. Kevin, A and K. E. Lee (1989)- Earthworm for Gardeners and Fisherman” (CSIRO, Australia, Division of Soils)
11. Rahudakar V.B. (2004)- Gandul khatashivay Naisargeek Paryay, Atul Book Agency, Pune.
12. Satchel, J.E. (1983)- Earthworm Ecology Chapman Hall, London. Wallwork, J.A. (1983)-Earthworm Biology. Edward Arnold (Publishers) Ltd. London.

Title of the Course and Course Code	Zoology Practical – I (Life and Diversity of Animals - V and Fundamentals of Histology) ZOO3511	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify and describe the process of cyclosis, binary fission, conjugation in paramecium and life cycle of different helminth parasites	
CO2	Identity and explain the permanent slides of Balanoglossus.	
CO3	Demonstrate the method for preparation of paramecium culture medium and the study of Rotifers from the fresh water.	
CO4	Compare the histological structures of different organs and explain their characteristics.	
CO5	Apprise the procedures of preparation of various fixatives and outline the method of preservation of tissues.	
CO6	Assemble the set of microtomy to prepare permanent slides of different tissues and prepare a flowchart for staining the permanent slides.	

D* = Demonstration, E = Experimental [Credits - 2]

Practical No.	Title and Contents
1.	Preparation of culture of paramecium (E)
2.	a. Observation of binary fission and conjugation in Paramecium b. Study of cyclosis and trichocyst in Paramecium (E)
3.	Study of spicule in sponges (D)
4.	Observation of Balanoglossus and slides of T. S. of Balanoglossus passing through proboscis, collar and trunk. (D)
5.	Study of external characters and digestive system of <i>Pila</i> .* (D)
6.	Study of Nervous system of <i>Pila</i> .* (D)
7.	Study of radula, osphradium and statocyst of <i>Pila</i> .* (D)
8.	Preparation of temporary mount from preserved Rodents: Striated muscle fibres and medullated nerve fibre. (E)
9.	Observations of permanent histological slides of mammalian tooth, tongue, oesophagus, stomach, duodenum, ileum, trachea, lung, kidney. (D)
10.	Observations of permanent histological slides of pituitary gland, thyroid gland, adrenal gland, salivary gland, liver, pancreas, testis, ovary. (D)
11.	Preparation of different fixatives for preservation of tissues. (D)
12.	Study of collection and preservation of tissues and block making. (E)
13.	Sectioning and staining of tissues for preparation of permanent slides. (E)
14.	Any other practical suggested by concerned teacher based on syllabus.

Note:

1. No live animals will be used for practical as per ethical guidelines.
2. wherever preserved specimen's stock is exhausted, virtual demonstrations are planned.
3. Any ten practical is to be conducted.
4. *-with the help of images / charts.

Title of the Course and Course Code	Zoology Practical - II (Biochemistry, Ecology and Environmental Biology) ZOO3512	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe concept of pH and buffer and determine pH by pH meter. Specify the role of vitamins in metabolism, learn structures and deficiency diseases of vitamins.	
CO2	Classify types of sugars by specific reagent tests. Determine isolation of Casein by isoelectric precipitation and evaluate proteins by Bradford method from different sources.	
CO3	Carry out enzyme reaction and infer the effect of various factors affecting enzyme activity.	
CO4	Learn and define the basic concept and principle of remote sensing. Compile the data of biotic and abiotic components of any simple ecosystem (natural or human modified ecosystem) and prepare a structure of an ecosystem.	
CO5	Interpret the life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data	
CO6	Differentiate between endangered, threatened and rare species. Analyse the physico-chemical properties of soil sample.	

Practical No.	Title and Contents	
1.	Study of principle and working of pH meter.	(D)
2.	Study the effect of pH, temperature and inhibition etc on urea-urease reaction.	(E)
3.	Identification of carbohydrates (monosaccharide, disaccharides and polysaccharides) with the help of suitable tests.	(E)
4.	Isolation of Casein by isoelectric precipitation.	(E)
5.	Protein estimation by Lowry method.	(E)
6.	Isolation of starch from potato (Microscopic examination of starch) and action of salivary amylase on it.	(E)
7.	Study of biotic and abiotic components of any simple ecosystem (natural or human modified ecosystem).	(D)
8.	Study of the life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data.	(E)
9.	Study of physico chemical properties of soil sample.	(E)
10.	Study any two endangered, threatened and rare species.	(D)
11.	Principle of remote sensing.	(D)
12.	Study of Red data book.	(E)
13	Prepare and submit a study report on different interactions in ecosystem in Fergusson college campus.	(P)

Note:

- 1 No live animals will be used for practical as per ethical guidelines.
2. Any ten practicals are to be conducted.
3. * - with the help of images / charts.
4. Any other practical suggested by the faculty member could be conducted
5. D-demonstration, E- experimental, P-project.

Title of the Course and Course Code	ZOOLOGY PRACTICAL – III (Immunology and Biological Techniques) ZOO3513	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify and describe the cells of immune system.	
CO2	Classify, categorize, and identify differential WBCs of Immune system with functional attributes	
CO3	Study and applications of radial immune diffusion assay, gel electrophoresis, TLC and describe its applications in immunology and molecular biology.	
CO4	Learn autoimmune diseases and their clinical implications	
CO5	Practical use of biological databases, searching of biotechnology information on publicly available databases and understanding the databases.	
CO6	Use of Colorimeter/spectrophotometer in understanding Beer-Lambert's law and its application in biological sciences.	

Sr. No.	Title of Experiment
1	Study of cells of Immune system (Blood smear method). (E)
2	Determination of concentrations of lymphoid cells (Haemocytometer method). (E)
3	Study of antigen-antibody reaction in ABO blood group system. (E)
4	Study of Radial Immune-Diffusion. (E)
5	Isolation and observation of bone marrow cells (goat bone marrow obtained from slaughterhouse). (E)
6	Study of an enzyme-linked immunosorbent assay. (ELISA). (D)
7	Study of autoimmune diseases (Photographs/ charts) (Systemic Lupus Erythematosus, Vasculitis, Graves' disease, Multiple sclerosis, Rheumatoid arthritis). (D)
8	Differential count of W.B.Cs. (E)

9	Laboratory Safety Measures and Study of Laboratory Symbols used in Laboratories. (D)
10	Preparation of Solutions (Normal, Molar etc.) (E)
11	Use and Handling of Micropipettes (E)
12	Thin layer Chromatography of dyes (E)
13	Agarose Gel Electrophoresis and PAGE (D)
14	Determination of Wavelengths of Maximum Absorbance by using Colorimeter / Spectrophotometer (E)
15	Hands on Session on Publicly available Database study and searching: (E) Nucleotide Sequence Databases: NCBI, DDBJ and EMBL Protein Databases: UniProt KB, PDB CATH and SCOPUS Literature Databases: PubMed.

Note:

- 1 No live animals will be used for practical as per ethical guidelines.
2. Any ten practicals are to be conducted.
3. * - with the help of images / charts.
4. Any other practical suggested by the faculty member could be conducted
5. D-demonstrations-experiments, P-project.

Zoology Practical – III (Insect Pest Management and Forensic Entomology)		
Title of the Course and Course Code	Zoology Practical – III (Insect Pest Management and Forensic Entomology) ZOO3513	Number of Credits : 2
Course Outcomes (COs)		
On completion of the course, the students will be able to:		
CO1	Identify household insect pests and explain their morphological features.	
CO2	Explain the characteristics of different types of larvae of insect pest and demonstrate the temporary mounting of moth parts, legs and wings of crop pest.	
CO3	Illustrate the different types of appliances used to control of insect pests. Explain the life history of important insect pests of fruits, vegetables and stored grains.	
CO4	Identification of various insects of forensic importance and explain their life cycle.	
CO5	Compare the life cycle stages of Calliphorids (Blow fly) and Sarcophilids (Fly flies).	
CO6	Specify the features to determine time duration of the different stages of forensic insects at various temperature.	

D* = Demonstration, E = Experimental [Credits - 2]

Practical No.	Title of the practical
1.	Study of morphological features of household insect pests - cockroach, mosquito, flea and bedbugs (D)
2.	Study of different types of insect control appliances. (Any four) (D)
3.	Collection, preservation, identification and submission of any five insect pests. (E)
4.	Temporary mounting of mouthparts, legs and wings of any five crop pests. (E)
5.	Study of different types of larvae of insect pest. (D)
6.	Study of life history of important insect pest (Any one stored grain pest, fruit plant pest and vegetable pest. (D)
7.	Temporary mounting of mouth parts of three major insect pests. (E)
8.	Identification of Insects of Forensic importance (D)
9.	Study of Life Cycle Stages of Calliphorids (Any 1 Blow Fly) (D)
10.	Study of Life Cycle Stages of Sarcophilids (Any 1 Fly Flies) (D)
11.	Determination of time duration of different stages of Calliphorids and (D) Sarcophilids at various temperatures
12.	Any other practical suggested by concerned teacher based on syllabus.

Note:

1. No live animals will be used for practical as per ethical guidelines.
2. wherever preserved specimen's stock is exhausted, virtual demonstrations are planned.
3. Any ten practical's are to be conducted.
4. * - with the help of images / charts.

Title of the Course and Course Code	Life and Diversity of Animals-VI ZOO3601	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define the systematic position, habit, habitat and external characters of Amphioxus. Describe the organ system of Amphioxus.	
CO2	Compare the evolution and structures of aortic arches, heart, kidney and brain of vertebrates.	
CO3	Define the systematic position, habit, habitat and external characters of <i>Calotes versicolor</i> . Explain the structure of body skin, various types of scale and coelom of <i>Calotes versicolor</i> and describe its organ system	
CO4	Differentiate the modifications in habit and habitat and morphological characters of lung fishes. Describe the accessory respiratory organs; compare electric organs and explain the various types of migration in fishes. Compute the knowledge of parental care and neoteny in various species of amphibia.	
CO5	Discriminate the temporal vacuities in skull type of reptiles. Explain the general characters of Rhyncocephalia.	
CO6	Compile the knowledge of flight adaptation of birds. Explain the dentition in mammals and design the dental formulae of various mammals.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Study of <i>Calotes</i> with reference to the following: Systematic position, habit and habitat and external characters, Functional Anatomy - Digestive, Circulatory, Excretory, Reproductive, Nervous system and Sense organs.	14
II	Comparative study of following topics in vertebrates. Heart: Structure of heart of Shark, Frog, <i>Calotes</i> , Pigeon & Rat, Kidney: Evolution of Archinephros, Pronephros, Mesonephros, Metanephros, Brain: Morphological variation in the different regions of the brain of Shark, Frog, <i>Calotes</i> , Pigeon and Rat.	07
III	Study of following groups with reference to; Pisces: Dipnoi, Accessory respiratory organs, Migration and Electric organs, Amphibia: Parental care and Neoteny. Reptilia: Temporal vacuities or skull type, General characters of Rhyncocephalia Mammalia: Dentition in mammals.	15

References:

1. Chordate Zoology, 1982, P. S. Dhami and J. K. Dhami, R. Chand and Co., New Delhi.
2. The life of Vertebrates, 3rd edn.1993, J. Z. Young, Oxford University Press, USA.
3. The Phylum Chordata: Biology of Vertebrates and their Kin, 1987, H. H. Newman, Distributor Satish book enterprise, Agra.
4. A text book of Zoology, 1984, R. D. Vidyarthi, S. Chand and Co., New Delhi.
5. Comparative Anatomy of the Vertebrates, G. C. Kent, R. K Carr,9th Edn., 2001, McGraw Hill, Boston, USA.
6. Vertebrate Practical Zoology, 11th revised Edition, 2014, S. S. Lal, Rastogi publ., Meerut.
7. The anatomy of the garden lizard (*Calotes versicolor*, Boulin) 1974, S. Y. Paranjape. The Poona University Press, Poona-7.
8. Chordate Zoology, 2009 reprint, E. L. Jorden, S. Chand and Co., New Delhi.
9. Text book of Zoology, Vertebrates, Vol. II, T.J. Parker and W.A. Haswell, edited by
10. Marshall and Williams, CBS Publications, New Delhi.
Text Book of Vertebrate Zoology, R. L. Kotpal, Rastogi Publication, Meerut.

Title of the Course and Course Code	Physiology: Life Sustaining Processes ZOO3602	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe the concepts of physiology, its importance, functions of organs and organ systems. Explain the process of digestion, respiration, excretion, and thermoregulation.	
CO2	Discuss the mechanism of muscular contraction, disorders related to muscular contraction, cardiac cycle and urine formation.	
CO3	Apply the knowledge of physiology to interpret BMR, respiratory quotient and temperature changes in the body.	
CO4	Explain and analyse the causes, changes in the physiological parameters, respiratory quotient; outline the process of vision, hearing and sense of olfaction.	
CO5	Compare the methods of heat gain mechanism and heat loss mechanism, Bohr's effect and Haldane effect,	
CO6	Compile the physiological data related to digestive, respiratory, circulatory, excretory systems.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Digestion and Respiration: Digestion of carbohydrates, proteins, and fats. Absorption in small intestine: water, ions, and nutrients. Absorption in large intestine and formation of faeces, Mechanism of Ventilation, exchange of gases at lungs and tissue level, Mechanism of transport of gases: Transport of Oxygen, Transport of Carbon-dioxide, Respiratory Quotient and BMR.	10

II	Circulation and Excretion: Blood coagulation mechanism, blood pressure, Cardiac cycle: systole, diastole, cardiac output, and nodal tissues, Ornithine cycle: synthesis of urea, Physiology of Urine formation, Counter-Current Multiplier theory for urine concentration.	10
III	Nervous Co-ordination: Structure of Neuron, nerve impulse and its transmission, synaptic transmission, neurotransmitters, Vision, Hearing, and olfaction in man	07
IV	Muscles and Temperature regulation: Ultrastructure of skeletal muscles. Physiology of muscle contraction: sliding filament theory, physical and chemical changes in muscles, Normal body temperature, heat production, heat loss. Role of hypothalamus in temperature regulation	05
V	Reproduction: Reproductive cycles: physiological changes during oestrous cycle and menstrual cycle.	04

References:

1. Textbook of Medical Physiology, Guyton A.C. & Hall J. E., 2006, 11th Edition, Hercourt Asia Pvt. Ltd. / W.B. Saunders Company.
2. Principles of Anatomy and Physiology: G. J. Tortora and S.R. Grabowski, Harper Row Publishers
3. Human physiology, Vol. I & II, 1980, 12th Edn. Dr. C. C. Chatterjee, Medical applied agency, Kolkata.
4. Medical Physiology, 2006, Asis Das, Books and Allied Pvt. Ltd., Kolkata.
5. Endocrinology, 2005, Lohar P. S., M. J. P. Publishers, Chennai.
6. Animal Physiology (W. H. Freeman) Eckert R.
7. A Textbook of Animal Physiology - K. A. Goel and K. V. Shastri (Rastogi Pub.)
8. A Textbook of Practical Physiology - V. G. Ranade (P. V. G. Prakashan, Pune.)
9. Animal Physiology - A. Maria Kyttikan and N. Armugam (Saras Pub.)
10. Medical Laboratory Techniques - Ramni Sood, Jaypee Brothers Medical Pub. Pvt. Ltd., New Delhi.
11. Williams Text Book of Endocrinology - Tenth Edition, Saunders, 2003.
12. Endocrinology - Mac E. Hadley, Fifth Edition, Pears on Education, 2004.
13. Molecular Endocrinology - Bolander, F. F., Academic, San Diego, 1989.
14. Textbook of Endocrinology - Griffin J. E., S. R. Ojeda, Oxford, New York, 1988.
15. Basic and Clinical Endocrinology - Greenspan, F. S., 3rd ed., Appleton and Lange.

Title of the Course and Course Code	Molecular Biology ZOO3603	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe concept of chromatin, DNA packaging and its importance.	
CO2	Classify types of DNA and explain prokaryotic and eukaryotic DNA and plasmid's structure and function.	
CO3	Explain mechanism of DNA replication, transcription and translation in prokaryotes and eukaryotes.	
CO4	Categorize the types of DNA damage and explain DNA repair mechanisms.	
CO5	Explain and assess the processes of post transcriptional and post-translational modifications and their importance.	
CO6	Specify the processes of gene regulation and operon concepts.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	<p>Nucleic acids: Purine and Pyrimidine bases, nucleoside, nucleotide, types of DNA, double helical structure of DNA, Physico-chemical properties of DNA [T_m, Hypo- chromacity & Hyperchromacity], DNA as genetic material – evidence: transformation, transduction (specialised and generalised), conjugation (Hfr cells), molecular basis of recombination. Chromatin-Heterochromatin, Euchromatin, histones, nucleosome, super coiling of DNA (positive and negative).</p>	10
II	<p>Central Dogma of Molecular Biology: 1.Replication- Process and types of replication, (Semi-conservative replication, rolling circle type of replication) Replication in prokaryotes and eukaryotes Primosome and replisome. 2.Transcription: Synthesis of RNA, types of RNA, transcriptional unit, RNA polymerase, Transcription in prokaryotes and eukaryotes, post transcriptional modifications. 3.Translation: Genetic code, properties of genetic code, deciphering of genetic code. Structure of tRNA and role as an adaptor. Ribosome structure (prokaryotes and eukaryotes). Protein synthesis–Initiation, elongation, termination and post translational modification.</p>	14
III	<p>Operon Concept: Regulation of gene action, Lac operon, Trp operon</p>	06
IV	<p>DNA damage and repair – Types and mechanism of DNA damage and repair</p>	06

References:

1. Principles of Genetics, 1997, P. D. Snustad, M. L. Simmons J. B. Jenkins, John Wiley
2. Molecular Biology of the Cell, 2007, 5th Edn. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Taylor & Francis, UK.
3. Text Book of Cell and Molecular Biology, 2009, Second Edition, Ajoy Paul, Books and Allied (P) Ltd.
4. Cell and Molecular Biology, 2010, Third Edition, P. K. Gupta, Rastogi Publications.
5. Fundamentals of Molecular Biology, 2005, First Edition, Avinash and Kakoli Upadhyay, Himalaya Publishing House.
6. Molecular Biology Genes to Proteins, 2008, Third Edition, Burton Tropp. Jones and Bartlett.
7. Gene IX, X, XI, 1994, Lewin Oxford University Press, Oxford.
8. Molecular Biology of the gene, 1993, Watson J. Hopkins, Roberts, Steitz and Weiner, Benjamin Cummings.
9. Text book of Molecular biology, 1994, K. Shivrama Sastry, G. Padmanabhan & C. Subramanyan, Mc. Millan India.
10. Cell and molecular biology, 2010, 8th ed., De Robertis EDP and De Robertis EMF Jr. Lippincott Williams & Wilkins, Philadelphia
11. Principles of Biochemistry, 1993, 2nd ed., Lehninger A. L. Nelson D.L. & Cox M. M. CBH Publisher and distributors, Delhi.
12. Principles and techniques of Biochemistry and Molecular biology, 2009, seventh edition, Keith Wilson and John Walker, Cambridge University.

Title of the Course and Course Code	Organic Evolution ZOO3604	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Write about ancient and medieval beliefs of origin of life and discuss origin of eukaryotic cell.	
CO2	Differentiate and compile different evidences of organic evolution and explain how they help in studying origin of life.	
CO3	Illustrate aspects and patterns of animal distribution. Outline and describe the factors influencing animal distribution and discuss about barriers to dispersal.	
CO4	Differentiate and compare micro-evolutionary changes, speciation and adaptive radiation. Classify isolating mechanisms.	
CO5	Discuss, classify, and evaluate role of different kinds of adaptations in evolutionary pathway.	
CO6	Create/ prepare a world map of Zoogeographical distributions of different animals. Describe and compare the data of different realms	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Origin of life: Ancient and medieval beliefs, Origin of eukaryotic cell.	5
II	Evidences of organic evolution: Study of evidences from: Morphology and comparative anatomy, Embryology, Geographical distribution. Palaeontology, Connecting links.	9
III	Adaptations: Introduction, Kinds of adaptations, Divergent Evolution (Adaptive radiation)	4
IV	Isolation: Definition, Classifications of isolating mechanism, Types of isolating mechanism	4
V	The Origin of Species: Concept of species, Categories of species, Causative factors for speciation, Modes of speciation, Patterns of speciation Types of speciation.	5
VI	Animal Distribution and barriers to distribution: Aspects of animal distribution, Patterns of animal distribution. Factors influencing animal distribution, Barriers to dispersal. Means of dispersal.	5
VII	Zoogeographical distributions: Introduction, Types of zoogeographical distribution, Study of different regions.	4

References:

1. Organic Evolution, 1991 T. S. Gopalkrishnan, I. Sambashivarab Publ. House.
2. Evolution, 2010 P. K. Gupta, Rastogi Publ., Meerut.
3. Evolutionary Biology, 2010, Mohan P. Arora, Himalaya Pub. House, Delhi.
4. Evolution, 1968, E. O. Dodson, Reinhold Pub. Corp., New York.
5. American Museum of Natural History. The First Humans [Volume 1 of The Illustrated History of Humankind]. Harper Collins, 1993.
6. Andrews, Peter, and Christopher B. Stringer. Human Evolution: An Illustrated Guide. University Press, 1989.
7. Berger, Lee. "The Dawn of Humans: Redrawing Our Family Tree?" National Geographic 194 (August 1998): 90-99.
8. Cartmill, Matt. "Lucy in the Sand with Footnotes," Natural History (April 1981): 90-95.
9. The origin of species, 1959, Charles Darwin, New American Library, New York.
10. Diamond, Jared. The Third Chimpanzee: The Evolution and Future of the Human Animal. Harper Collins, 1992.
10. Edey, Maitland A. and Donald C. Johanson. Blueprints: Solving the Mystery of Evolution. Viking, 1990
11. Brunet, M., et al. 2002. A new hominid from the Upper Miocene of Chad, Central Africa. Nature 418:145-151.

ONLINE READINGS: -

1. Evolution: An International Journal of Organic Evolution | Nature
2. THE HISTORY OF ORGANIC EVOLUTION | Science (sciencemag.org)
3. Adaptation, speciation and extinction in the Anthropocene | Proceedings of the Royal Society B: Biological Sciences (royalsocietypublishing.org)
4. Divergent adaptation promotes reproductive isolation among experimental populations of the filamentous fungus *Neurospora* | BMC Ecology and Evolution | Full Text (biomedcentral.com)
5. (PDF) Adaptation and The Origin of Species (researchgate.net)
6. Climate adaptation and speciation: particular focus on reproductive barriers in *Ficedula* flycatchers - Qvarnström - 2016 - Evolutionary Applications - Wiley Online Library.

Animal Pathology		
Title of the Course and Course Code	Animal Pathology ZOO3605	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify the functions of the whole body organs and their mechanisms in diseased states.	
CO2	Explain various health conditions and their effects in diseased state. Discuss the pathophysiology of diseases.	
CO3	Define pathological conditions and apply their basic concepts to understand deformities and diseases in the human body.	
CO4	Differentiate between health and diseased state and discriminate the diseases and their pathogenesis.	
CO5	Review the pathological diseases and their processes in fishes, cattle and birds.	
CO6	Write about the mechanisms, mode of infection, pathogenesis and effects of communicable and non-communicable diseases on animals.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Common diseases of animals: Introduction of Pathology: scope and branches Diseases of animals, Diseases of fishes (Dropsy, Fin rot, Argularis, Anchor worm), Diseases of fowls. (Fowl pox, Newcastle disease, Avian influenza, Merks disease), Diseases of cattle's (Anthrax, Foot and mouth disease, Mastitis, Milk fever),	8
II	Human diseases: Communicable diseases in humans. Pathogen, aetiology, pathogenesis of - Hepatitis, Tuberculosis, AIDS, Zoonotic diseases: Bacterial disease – Leptospirosis, Fungal disease – Histoplasmosis, Viral disease – Rabies, Protozoan disease-Toxoplasmosis	10
III	Common pathological processes: Retrogressive changes: Cloudy swelling, Degeneration - fatty	8

	degeneration, mucoid degeneration and amyloid degeneration Necrosis: Nuclear and cytoplasm changes, Types of necrosis Gangrene: Definition and causes, Types of gangrene - dry, moist and gas gangrene	
IV	Pathological disturbances and disorders: Circulatory disturbances- Hyperaemia: active and passive (causes and effects) Ischaemia: causes and effects Haemorrhage: causes, effects and haemorrhagic effects Thrombosis: thrombus formation, its causes, and effects Embolism: Definition, sources, types, and effects Disorders of pigmentations: Causes and effects of pigmentation, melanises. Disorders of mineral metabolism: Mechanism of calcification, pathological calcification (dystrophic and metastatic) Causes and its effects. Gout aetiology and pathogenesis.	10

References:

1. A text book of Pathology, 2009, 15th Rev Edn., Dey N. C. and Dey T. K. Sinha Debashish, New central book agency, Kolkata.
2. General pathology and pathology of systems, 2008, 6th Edn., Bhende Y. M. and Deodhar S.G.; Popular Prakashan Ltd., India.
3. Robins Basic Pathology, 2012, 9th Edn., Vinay Kumar, Abul K. Abbas, Jon C. Aster, Saunders, Philadelphia.
4. Textbook of Pathology, 2014, 7th Edition, Harsh Mohan, Jaypee Brothers Medical Publishers (P) Ltd.
5. Essentials in Haematology & Clinical Pathology, 2012, 1st Edition, Ramadas Nayak, Sharada Rai, Astha Gupta.
6. Concise Book On Medical Laboratory Technology, 2005 reprint, 1st Edn., C. R. Maiti, New Central Book Agency (p) Ltd, Kolkata, India
7. Wiley: Diseases of poultry, 13th edition - David E. Swayne.
8. Pathological basis of veterinary diseases, 5th edition, Editor - James Zachary Mc Gavin.
9. Wiley: Fish diseases - diagnosis and treatment, Edward James, 2nd edition.

Title of the Course and Course Code	Human Genetics ZOO3606	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe concept of Mendel's law of Inheritance and importance.	
CO2	Classify types Chromosomes and explain human karyotype, explain flow karyotyping and FACS.	
CO3	Categorize Genetic diseases and explain mechanism of inheritance pattern.	
CO4	Explain Pedigree Studies and categorize stages of genetic Counselling	
CO5	Explain Dermatoglyphics and assess the processes of parental diagnosis.	
CO6	Specify the Genetics and Society (Eugenics, Euthenics, Euphenics, Human genome project, Gene Therapy, Stem Cells, Cord Blood Banking and Stem Cell Therapy. processes of gene regulation and operon concepts).	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	<p>Applications of Mendel's Laws to Human Inheritance: Pigmentation versus albinism, Mechanism of melanin synthesis, Inheritance of albinism in human, Lethal genes in human, Examples of dominant, recessive, semi-lethal genes in human, Human Chromosomes: Normal Human Karyotype: Paris Nomenclature, Flow karyotyping (Quantification of DNA of individual chromosomes) FACS - Fluorescence activated cell sorter, Genetic Diseases and Inheritance Pattern: Autosomal inheritance- Dominant (E.g. -Adult polycystic kidney, Achondroplasia, and Neurofibromatosis) Autosomal inheritance – Recessive, (E.g. - Sickle cell anaemia, Phenylketonuria), Sex linked inheritance - The Lyon Hypothesis (X- Chromosome inactivation, Recessive: (E.g. - Duchenne muscular dystrophy - DMD)X-linked; Dominant (E.g. - Goetz's syndrome, Oral Facial - Digital syndrome) Y-linked inheritance (Holandric gene - E.g. - Double Y Syndrome (XYY Syndrome)</p>	14

II	<p>Pedigree Studies and Genetic Counselling: Symbols used in pedigree studies, Pedigree analysis & construction, Pedigree analysis for the inheritance pattern of genetic diseases, Genetic Counselling, Stage 1: History and pedigree construction, Stage 2: Examination, Stage 3: Diagnosis, Stage 4: Counselling, Stage 5: Follow up, Oncogenetics: Properties of malignant cells, Types of Genes – Proto-Oncogenes, Oncogenes, Cellular Oncogenes, Tumor Suppressor Genes, Chromosomal abnormalities associated with the specific malignancies – Burkitt's Lymphoma, CML & Retinoblastoma</p>	12
III	<p>Dermatoglyphics: Introduction and classification, Flexion creases, Dermatoglyphics in clinical disorders, Clinical applications, its advantages, and limitations, Prenatal Diagnosis: Introduction and Definition, Various procedures used, such as Amniocentesis, Chorionic villus sampling, Ultrasonography and Fetoscopy. Genetics and Society: Eugenics: Positive and negative, Euthenics, Euphenics, Human genome project, Gene Therapy with reference to Haemophilia, Stem Cells - Definition types and sources. A brief account on Cord Blood Banking and Stem Cell Therapy.</p>	10

References:

1. Essentials of Human Genetics by S. M. Bhatnagar et al (1999), IV edition, Orient Longman.
2. Human Genetics: Concepts and Applications by Lewis R. (2001), McGraw Hill, Boston.
3. Basic Human Genetics by E. J. Manage and A. P. Manage, (1997, Indian Reprint), Rastogi Publications, Meerut.
4. Molecular Basis of Inherited Diseases, (6 th Edition - 1989) by Scriver, C. R. A. L. Beudit, W. S. Sty and D. Valle, McGraw Hill, New York).
5. Human Genetics by S. D. Gangane, (2 nd edition - Reprint 2001), B. L. Churchill Livingstone Pvt. Ltd., New Delhi.
6. Genetics in Medicine by M. W. Thompson et al., 5 th Edition, W. B. Saunders Company, London.
7. The New Human Genetics by Gerald J. Stine, WCB Publications.
8. Genetics by Steakburger, 3rd edition, Publisher -Prentice Hall India Learning Private Limited
9. Human Genetics by Winchester-4th Edition, Publisher-Longman

Title of the Course and Course Code	Poultry Science ZOO3608	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe endocrine glands and physiological functions of hormones synthesized and secreted by them.	
CO2	Explain hormonal regulations of different hormones.	
CO3	Illustrate feedback mechanism of hormones secreted by Pituitary gland, other endocrine glands and neuroendocrine system.	
CO4	Classify different classes of hormones and their mechanism of action.	
CO5	Review different Assisted Reproductive technologies.	
CO6	Write a report on hormonal dysfunctions and disorders.	

Unit. No.	Title of and Unit Contents	No. of Lectures
I	Introduction to Endocrinology Brief History and Scope of Endocrinology, Endocrine glands and hormones: Hypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Thymus, Pancreas, Adrenal, Ovaries and Testes	3
II	Classification of different fowls and study of different breeds	6
III	Breeding of poultry. Natural mating, Artificial insemination	6
IV	Formation, structure, and nutritive value of eggs. Abnormal types of eggs	5
V	Hatching of eggs. Brooding and rearing	4
VI	Different systems of fowl farming.	4
VII	Study of poultry equipment's and poultry feeding.	4
VIII	Study of infectious and non-infectious diseases (two each)	4

References:

1. Mead, G. C. & Wells, R. G. 1999. Poultry meat science. Wallingford, UK, CAB International Publishing.
 2. Scientific poultry production Book · January 2006, Edition III, ISBN - 81-8189-1473, Publisher: International Book Distributing Co., Sreenivasaiah P.
 3. Text Book of Poultry Science by Sreenivasaiah P. V. (2008).
- ONLINE READINGS:** - 1. Danish Poultry Network - www.poultry.kvl.dk
2. Poultry Information Network - www.wattnet.com
 3. International4. Egg Commission - www.internationalegg.com
 4. Egg - Nutrition Centre - www.enc-online.org
 5. American Egg Board - www.aeb.org

Title of the Course and Course Code	Biostatistics ZOO3609	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe statistical data representation and interpretation methods	
CO2	Explain collection, presentation of statistical data and various methods of presenting data	
CO3	Illustrate descriptive statistical methods like Mean, Median and Mode, measures of dispersion and Probability	
CO4	Classify various statistical methods and interpretation	
CO5	Review Concepts used in Testing of Hypothesis	
CO6	Application of statistical methods and prepare a report on given statistical data and its analysis	

Unit. No.	Title of and Unit Contents	No. of Lectures
I	<p>Introductory Biostatistics, Data Representation, and Interpretation</p> <p>Importance of Statistics in Biology, Samples and Population</p> <p>A. Types of data, Random sampling (SRSWR and SRSWOR), Attributes and Variables, Collection and presentation of data, tabulation, Diagrammatic representation (Simple bar diagram, sub-divided bar diagram and pie diagram). Graphical representation (Histogram and frequency polygon)</p>	8
II	<p>Descriptive Statistics and Probability</p> <p>A. Measures of central tendency–Mean, median, mode.</p> <p>B. Measures of dispersion–Range, Standard deviation, and Variance</p> <p>C. Concept of Probability – classical definition, discrete and continuous random variable, concept of density and mass function.</p>	10
III	<p>Testing of Hypothesis</p> <p>A. The concepts of null hypothesis, alternative hypothesis, significance level, type I and type II errors, p-value, one tailed and two tailed tests, degrees of freedom.</p> <p>B. Equality of two population means - t-test, paired t-test.</p> <p>C. χ^2(chi square) test –test for goodness of fit, independence of attributes (2X2 contingency table)</p>	10

	Hands on: <ol style="list-style-type: none"> 1. Diagrammatic and graphical representation of data in R. 2. Descriptive Statistics using R 3. t-tests using R 4. χ^2 (Chi square) tests using R 	8
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References:

1. Goon, Gupta and Dasgupta Fundamentals of Statistics, World Press Kolkata
2. Gupta S. P. Statistical methods, Sultan Chand & Sons Publisher, New Delhi
3. Irfan Ali Khan and Atiya Khanum, Fundamentals of Biostatistics. 3rd Ed. Ukaaz, Publications, Hyderabad
4. Gupta S.P. Statistical methods, Sultanchand & Sons Publisher, New Delhi
5. Irfan Ali Khan and Atiya Khanum, Fundamentals of Biostatistics. 3rd Ed. Ukaaz, Publications, Hyderabad
6. Bernard Rosner Fundamentals of Biostatistics, 5th Ed. Duxbury Thomson
7. Irfan Ali Khan and Atiya Khanum, Fundamentals of Biostatistics. 3rd Ed. Ukaaz, Publications, Hyderabad
8. Gupta S.P. Statistical methods, Sultan Chand & Sons Publisher, New Delhi
9. Norman T.J. Bailey Statistical methods in biology, 3rd Ed. Cambridge University Press

Title of the Course and Course Code	Public Health and Hygiene ZOO3510	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify air, water, and soil pollutants.	
CO2	Explain various health influencing factors and effects of alcohol, tobacco, and drugs on personal and community health.	
CO3	Apply the concepts gained during the study of personal social and Industrial health during the study of epidemiology.	
CO4	Discriminate between the communicable and non-communicable diseases and their impact on health.	
CO5	Review the techniques for home and large-scale water purification.	
CO6	Arrange different food adulterants and their impact on human health.	

Unit. No.	Title of and Unit Contents	No. of Lectures
I	Introduction and scope of public health Health: Definition, factors affecting health (inborn, environmental), Personal and community health, Effects of alcohol, tobacco and drugs, WHO and its programs Food: Deficiency diseases, types of food adulterants, effects of food adulterants on health.	10
II	Air: Composition of air, effects of air pollutants on health, Water and water supplies: Quality of water for human consumption methods of water purification. Soil: Diseases spread by contaminated soil.	10
III	Diseases: Communicable diseases: causative organisms, signs and symptoms, modes of transmission, prevention and control measures of: corona virus disease, tuberculosis. Non-Communicable diseases: rheumatic heart disease, coronary heart disease and diabetes.	10
IV	Epidemiology-Causes of epidemics Social and Industrial hygiene: Provisions for disabled and mental hygiene	06

References:

1. A text book of preventive and social medicine 2011, 21st Edn., Park. K., Banarsidas Bhanot Publishers, Jabalpur, India
2. Preventive and social medicine in India, 2013, 4th Edn., B. K. Mahajan, M. C. Gupta, Jaypee Brothers Medical Publishers, New Delhi, India
3. Medical Zoology and Medical Technology. R.C. Sobti, Shobanlal and Co., Jalandhar
4. Review in community medicine, 2006, 2nd Edn., V. V. R. Seshu Babu, Paras Medical Books Pvt. Ltd., Hyderabad

Title of the Course and Course Code	Zoology Practical – IV (Life and Diversity of Animals - VI and Physiology - Life Sustaining Process) ZOO3611	Number of Credits : 2
Course Outcomes (COs)		
On completion of the course, the students will be able to:		
CO1	Identify and label organs of digestive system, reproductive system, arterial, venous system of <i>Calotes</i> and neotenic forms of Axolotl larva.	
CO2	Explain external characters of Branchiostoma, sectional view of buccal cavity, pharynx, intestine and tail.	
CO3	Demonstrate estimation of haemoglobin and preparation of the haemin crystals from haemoglobin	
CO4	Compare the structure and functions of heart and brain of shark, frog, calotes, pigeon and rat.	
CO5	Test the urine for physical and chemical properties.	
CO6	Compile the information obtained from the visit to biodiversity spot and write a report on diversity of life in that area.	

D* = Demonstration, E = Experimental [Credits - 2]

Practical No.	Title and Contents
1.	Study of external characters and digestive system of <i>Calotes</i> .* (D)
2.	Study of arterial and venous system of <i>Calotes</i> .* (D)
3.	Study of male and female reproductive systems of <i>Calotes</i> .* (D)
4.	Comparative study of Heart: Shark, Frog, <i>Calotes</i> , Pigeon and Rat. (D)
5.	Comparative study of Brain: Shark, Frog, <i>Calotes</i> , Pigeon and Rat. (D)
6.	Study of accessory respiratory organs in fishes: <i>Anabas</i> , <i>Labeo</i> , <i>Clarias</i> . (D)
7.	Study of neotenic forms (Axolotl larva). (D)
8.	Visit to local Biodiversity spot and report writing. (E)
9.	Estimation of muscle glycogen. (E)
10.	Estimation of haemoglobin using Sahli's haemoglobinometer. (E)
11.	Preparation of haemin crystals. (E)
12.	Urine Analysis: Physical and chemical: Colour appearance, odour, urea, Ph. (E)
13	Any other practical suggested by concerned teacher based on syllabus

Notes:

1. No live animals will be used for practical as per ethical guidelines.
2. wherever preserved specimen's stock is exhausted, virtual demonstrations are planned.

3. Any ten practicals to be conducted.
4. *-with the help of images / charts.

Title of the Course and Course Code	Zoology Practical– V (Molecular Biology and Organic Evolution) ZOO3612	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Determination of polytene chromosome from suitable material. Carry out DNA and RNA estimation by Methyl Green Pyronin staining in living cell.	
CO2	Classify types of DNA and preparation of DNA paper model.	
CO3	Evaluate and estimate DNA by Diphenylamine method. Prepare temporary preparation of Barr body by temporary mounting method.	
CO4	Explain and describe evidences from evolution. Determine different zoogeographical realms. Compile and illustrate distribution of animals to respective zoogeographical realms on the world map.	
CO5	Tabulate and compare morphological similarities and differences between man and ape.	
CO6	Identify and describe different types of fossils. Discriminate between different structural adaptations Compare and discuss adaptations with examples.	

Practical No.	Title and Contents
1.	Temporary preparation of Polytene Chromosome from suitable material. (E)
2.	Estimation of DNA by Diphenylamine method. (E)
3.	Detection of DNA and RNA by Methyl Green Pyronin staining. (E)
4.	Preparation of DNA paper model. (E)
5.	Study of types of DNA. (D)
6.	Temporary mounting of Barr body. (E)
7.	Study of continuous and discontinuous type of distribution with two examples, with the help of specimens / charts / photos. (D)
8.	Study of morphological similarities and differences between man and ape. (D)
9.	Study of types of fossils with the help of specimens / charts / photos. (D)
10.	Study of structural adaptations: (D) Terrestrial adaptations, Aquatic adaptations, Aerial adaptation.
11.	Study of evidences of evolution - embryological, paleontological, connecting- links, comparative anatomy. (D)
13.	To record Zoogeographical distribution of animals to respective zoogeographical realms on the world. (E)
14.	Prepare and submit a study report on adaptations of any three species present in Pune district. (P)

Title of the Course and Course Code	Zoology Practical– VI (Animal pathology and General Endocrinology) ZOO3613	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Determination of bone marrow cells and endocrine disorders based on clinical features	
CO2	Classify animal pathogens and animal diseases, neuroendocrine structures in invertebrates	
CO3	Evaluate and estimate normal and abnormal constituents in urine and its interpretation in terms of clinical significance.	
CO4	Explain and describe estrous cycle in mammal (rat)	
CO5	Tabulate and compare human contraceptive devices	
CO6	Identify and describe different corticoids by using suitable separation methods.	

Sr.No	Title of Experiment
1	Study of following pathogens:(D) <i>Mycobacterium tuberculae, Pneumococcus Plasmodium.</i> and <i>Entamoeba.</i>
2	Study of following diseases: Dropsy, Fin rot, Avian influenza, Fowl pox, Anthrax and Mastitis. (D)
3	Study of following pathological slides / specimens: Fatty degeneration (Fatty liver), Cloudy degeneration / Swelling, Dying cell – necrosis, Lung lobar pneumonia, Lung tuberculosis.(D)
4	Study of following pathological slides / specimens: Nutmeg liver, Organized thrombus, Breast Cancer, Spleen infarct and Liver cirrhosis (D)
5	Detection of the normal and abnormal constituents of urine (E)
6	Study of urine sediment (E)
7	Study of Invertebrate Neuroendocrine Structures (D)
8	Study of Estrous cycle in rat by observation of slides. (D)
9	Study and Demonstration of contraceptive devices (D)
10	Isolation and Observation of Bone marrow Cells (E)
11	Study of endocrine disorders:(D) Hypothyroidism and Hyperthyroidism, Gigantism, Acromegaly, Dwarfism and Cushing's syndrome
12	Observation of permanent slides, Comparative morphology of Ovary and Comparative morphology of Testes (D)
13	Paper chromatographic separation of corticoids (E)

Title of the Course and Course Code	Zoology Practical –VI ZOO3613	Number of Credits : 2
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe Karyotypes, structure of egg of fowl.	
CO2	Explain different systems of fowl and different syndromes in humans	
CO3	Illustrate Dermatoglyphics, staining methods for Barr Bodies	
CO4	Classify different stages of development of fowl with the help of permanent slides.	
CO5	Review of pedigree, development of chick embryo.	
CO6	Prepare blood Smear of Drumsticks in Neutro, print of fingertips and palm, model of poultry house	

Practical No.	Title of the practical
1.	Study of Karyotypes I: Normal Karyotyping in Humans Male (46, XY), Female, (46, XX). (D)
2.	Study of Karyotypes II: Abnormal Karyotypes, Down Syndrome (Autosomal), Turner Syndrome (Sex chromosomal), Klinefelter Syndrome (Sex chromosomal). (D)
3.	Buccal Smear Study and staining methods for Barr Bodies. (E)
4.	Blood Smear Study of Drumsticks in Neutrophils. (E)
5.	Pedigree Analysis: Symbols used in autosomal recessive disorder, autosomal, dominant disorder, Sex chromosomal (X & Y linked). (D)
6.	Dermatoglyphics 1: Recording of print of fingertips and palm. Classify ridges on the, fingertips arch, loop and whorl. (E)
7.	Dermatoglyphics 2: Recording of palm print - area demark as hypothenar, thenar and inter-digital areas, record presence or absence of Simian Crease, Ridge Counting and , atd angle calculation. (E)
8.	Study of chick embryo whole mounts with reference to staging method in chick development (By Hamburger & Hamilton, given the book by Belinsky): 18 h (primitive streak), 21h, 24h, 33h, 48h, 72h & 96h of incubation. (D)
9.	Study of permanent histological slides of chick embryo: Primitive streak (T. S), 24h (T. S. through neural tube) and 33H (T. S. Through heart). (D)
10.	Study of permanent histological slides of chick embryo: 48h (T. S. through pharynx and T. S. through extra embryonic membrane), 72h embryo (T.S.) (D)

11.	To study various equipment's used in poultry (fowl). (D)
12.	To Study the Circulatory system of Poultry(fowl). (D)
13.	Temporary preparation of chick embryo(E)
14.	To Study the Digestive system of Poultry (fowl). (D)
15.	To Study the Reproductive (Male and Female) system of Poultry(fowl). (D)
16.	To Study Formation of egg. (D)
17.	To Study Structure of egg. (D)
18.	To study and prepare a report on different breeds of poultry. (Student Activity)(P)
19.	Preparation and submission of model of any one type of poultry house. (Student Activity) (P)
20.	Field visit to a poultry house and submission of report. (P)

- 1 No live animals will be used for practical as per ethical guidelines.
2. Any ten practicals are to be conducted.
3. * - with the help of images / charts.
4. Any other practical suggested by the faculty member could be conducted
5. D-demonstration, E-experimental, P-project