

Anekant Education Society's
**TULJARAM CHATURCHAND COLLEGE
OF ARTS, SCIENCE & COMMERCE,
BARAMATI.
AUTONOMOUS INSTITUTE**



**SYLLABUS
THIRD YEAR B.Sc. ZOOLOGY
ACADEMIC YEAR 2021-2022
SEMESTER - V**

Scheme of Course Structure (CBCS)
Faculty of Science
Department of Zoology
Class: T.Y.B.Sc.
Evaluation Pattern: 40 (IA) + 60 (EA)
Total Credits: 48

Semester	Paper Code	Title of Paper	Credits
Semester V	ZOO 3101	ANIMAL SYSTEMATICS & DIVERSITY-V	3
	ZOO 3102	MAMMALIAN HISTOLOGY	3
	ZOO 3103	BIOCHEMISTRY	3
	ZOO 3104	ENVIRONMENTAL BIOLOGY & TOXICOLOGY	3
	ZOO 3105	PARASITOLOGY	3
	ZOO 3106	A] CELL BIOLOGY or B] GENERAL PATHOLOGY	3
	ZOO 3107	ZOOLOGY PRACTICAL-V (Related to ZOO 3101, 3102)	2
	ZOO 3108	ZOOLOGY PRACTICAL-VI (Related to ZOO 3103, 3104)	2
	ZOO 3109	ZOOLOGY PRACTICAL-VII (Related to ZOO 3105, 3106)	2
Semester VI	ZOO 3201	BIOLOGICAL TECHNIQUES	3
	ZOO 3202	MAMMALIAN PHYSIOLOGY & ENDOCRINOLOGY	3
	ZOO 3203	GENETICS & MOLECULAR BIOLOGY	3
	ZOO 3204	ORGANIC EVOLUTION	3
	ZOO 3205	GENERAL EMBRYOLOGY	3
	ZOO 3206	MEDICAL ENTOMOLOGY	3
	ZOO 3207	ZOOLOGY PRACTICAL-VIII (Related to ZOO 3201, 3202)	2
	ZOO 3208	ZOOLOGY PRACTICAL-IX (Related to ZOO 3203, 3204)	2
	ZOO 3209	ZOOLOGY PRACTICAL-X (Related to ZOO 3205, 3206)	2

IA* – Internal Assessment

EA* – External Assessment

Paper Code: ZOO 3101

Paper: I

Title of Paper: Animal Systematics and Diversity – V

Credits: 3

No. of Lectures: 48

A. Learning objectives:

- To learn basic classification and characteristics of Non- chordates.
- To learn about evolution and development of systems and animals.
- To make the students aware about conservation and sustainable use of Biodiversity.
- To emphasize on the habitat diversity of animals.

B. Learning outcomes:

- Imparts conceptual knowledge of Animals, their adaptations and associations in relation to their environment.
- Students understand the distinguishing characters and learn to identify the Non-chordate animals.
- Students acquire knowledge of economic importance of insects.
- Contributes the knowledge for conservation and sustainable use of Biodiversity

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	Study of <i>Pila globosa</i> with reference to the following:		14
	1.1	Systematic position, habit, habitat and external characters	
	1.2	Body wall & pallial complex	
	1.3	Functional anatomy: digestive, respiratory, circulatory, excretory, reproductive, nervous system & sense organs	
2	Study of the following groups with reference to:		08
	2.1	Porifera: Sponge's regeneration & reproduction	
	2.2	Coelenterata: polymorphism and importance of coral reefs	
	2.3	Annelida: Metamerism	
3	Study of <i>Calotes versicolor</i> with reference to the following:		16
	3.1	Systematic position, habit, habitat and External characters.	
	3.2	Functional Anatomy - Digestive, Circulatory, Excretory, Reproductive, Nervous system and Sense organs.	
4	Comparative study of following topics in vertebrates		06
	4.1	Heart: Structure of heart of <i>Scoliodon</i> , Frog, Calotes, Pigeon & Rat	
	4.2	Kidney: Evolution of Archinephros, Pronephros, Mesonephros, Metanephros	
	4.3	Brain: Morphological variation in the different regions of the brain of <i>Scoliodon</i> , Frog, Calotes, Pigeon and Rat/Rabbit	
5	Study of following groups with reference to:		04
	5.1	Pisces: Parental Care	
	5.2	Mammals: Dentition	

Reference Books

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. Invertebrate Zoology, 1992; S. N. Prasad, Vikas Publishing House, New Delhi.
4. Life of Invertebrates, 1992; S.N. Prasad, Vikas Publishing House, New Delhi.
5. Invertebrate Zoology, 1992 4th Edn., reprint, P.S. Dhama and J. K. Dhama, R. Chand and Co., New Delhi.
6. Modern text book of Zoology, Invertebrates 10th Edn., 2009, R.L. Kotpal, Rastogi publ., Meerut.
7. Invertebrates Structure and Function, 2nd Edn. 1979, E.J.W. 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 & 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 Kavita Juneja, 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.
15. Chordate Zoology, 1982, P. S. Dhama and J. K. Dhama, R. Chand and Co., New Delhi.
16. The life of Vertebrates, 3rd edn. 1993, J. Z. Young, Oxford University Press, USA.
17. The Phylum Chordata: Biology of Vertebrates and their Kin, 1987, H. H. Newman, Distributor Satish book enterprise, Agra.
18. A text book of Zoology, 1984, R. D. Vidyarthi, S. Chand and Co., New Delhi.
19. Comparative Anatomy of the Vertebrates, G. C. Kent, R. K Carr, 9th Edn., 2001, McGraw Hill, Boston, USA
20. Practical Zoology Invertebrates, 11th revised Edn., 2014, S. S. Lal, Rastogi publ., Meerut.
21. Vertebrate Practical Zoology, 11th revised Edition, 2014, S. S. Lal, Rastogi publ., Meerut.
22. Practical Zoology, 2004, Vijay Laxmi Sharma, Paragon International Publishers.
23. The anatomy of Garden Lizard, 1974, S.Y. Paranjape, Pune University Publication, Pune.
24. Chordate Zoology, 2009 reprint, E. L. Jordan, S. Chand and Co., New Delhi.
25. Text book of Zoology, Vertebrates, Vol. II, T.J. Parker and W.A. Haswell, edited by Marshall and Williams, CBS Publications, New Delhi.

Paper Code: ZOO 3102

Paper: II

Title of Paper: MAMMALIAN HISTOLOGY

Credits: 3

No. of Lectures: 48

Learning objectives:

- To familiarize the learners with the cellular architecture of the various organs in the body.
- To make the learners understand the need and importance of different types of tissues in the vital organs and their functions.
- To make learners understand the Ovarian Follicles, Corpus luteum, Corpus albicans & Structure of an Ovum.
- To familiarize the learners with the histology of endocrine glands.

Learning outcome:

- Learners will be able to understand the histology of mammals and its functions.
- Learners would appreciate the well planned organization of tissues and cells in the organ systems.
- Learner will be able to understand the Ovarian Follicles, Corpus luteum, Corpus albicans & Structure of an Ovum.
- Learners become aware about the Histological Structures of various Endocrine Organs, Cell types & Hormones Secreted by them, their functions in the Mammalian systems.
- Course helps to inculcate the research aptitude among the students.

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	Introduction		01
	1.1	Definition and scope of histology,	
	1.2	Application of histology in forensic science.	
2	Study of following tissues (location, structure, functions & histopathology):		08
	2.1	Epithelial: Simple, stratified & its types.	
	2.2	Connective: Proper, Areolar, Adipose, Ligament, Tendon, Cartilage.	
	2.3	Muscle: Striated, Smooth, Cardiac.	
	2.4	Nervous: Types of neurons, Medullated and non-medullated nerve fiber.	
3	Histological study of following organs:		31
	3.1	Skin (V.S.) (02)	
	3.2	Tooth (V.S.) (02)	
	3.3	Tongue (C.S.) with reference to mucosa papillae and taste buds (02)	
	3.4	Alimentary canal: Basic histological organization with reference to: Oesophagus (T.S.), stomach (T.S.), duodenum (T.S.) Ileum (T.S.) and rectum (T.S.) (08)	
	3.5	Glands associated with digestive system: (04) Salivary glands– C . S . of parotid, submandibular, sublingual liver and pancreas including both exocrine and endocrine components	
	3.6	Respiratory organs: Trachea (T.S.) & lung (C.S.) (02)	
	3.7	Blood vessels: Artery (T.S.), vein (T.S.) and capillaries (T.S.) (02)	
	3.8	Kidney (L.S.), Structure of nephron and juxtaglomerular complex (03)	
	3.9	Reproductive organs: (06) Testis (T.S.) with reference to Seminiferous Tubules and cells of Leydig Ovary (C.S.) - primary, secondary and Graafian follicle, corpus luteum and corpus albicans, Uterus and placenta.	
4	Histology of endocrine glands:		06
	4.1	Pituitary gland	
	4.2	Thyroid gland	
	4.3	Adrenal gland	
5	Introduction to Clinical Histopathology with special reference to cancer of: Colon, Lungs & Uterus		02

Reference Books

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. Bailey's Text book of Histology, 1971, 16th edn. Wilfred M. Copenhaver, Richard P. Bung & Mary Bartell Bunge, The William & Wilkins Company, Baltimore.
3. Histology, 1987, 9th Edn., Arthur W. Ham, David H. Cormack, J. B. Lippincott Co. Philadelphia.
4. Essential Histology, 2001, 2nd Edition, David H. Cormack, Lippincott Williams & Wilkins, Philadelphia.
5. A text book of Histology, 2014, 5thedn. Krishna Garg, Indira Bahl & Mohini Kaul CBS publication & Distributors, Delhi.
6. Histology, 1977, 4th Edn., R. O. Greep and L. Weiss, McGraw Hill Int. Book Co., New York.
7. Histology of Mammals, 1983, M. V. Athawale and A. N. Latey, Narendra Prakashan, Pune.
8. Hand book of Basic Microtechnique, 1964, 3rd Edn., Peter Gray, McGrawHill Book Co. New York.
9. Hand Book of Histopathological & Histochemical Techniques, 1983, 3rd Edition reprint, Butterworth & Co. (Publishers) Ltd, UK.
10. Hand Book of Histological and Histochemical Techniques, 1991, 1st Edn. S. K. David, CBS publisher & Distributors, Delhi.

Paper Code: ZOO 3103

Paper: III

Title of Paper: BIOLOGICAL CHEMISTRY

Credits: 3

No. of Lectures: 48

Learning Objectives: -

- To understand the bonding interaction of biomolecules.
- To understand structures and functions of biomolecules.
- To understand the fundamental concepts of biocatalysts, and various classes of enzymes.
- To understand the basic concept of antigen and antibody.

Course Outcomes: -

- An understanding of fundamental biochemical principles.
- It helps to improve knowledge of biomolecules.
- Understand basic principle of acid and base.
- Understand basic principle of pH, Buffer, titration and biological buffer.
- An understand the structure/function of biomolecules.
- Understand basic principle of enzymes and enzyme kinetics.
- Biological and Clinical significance of biomolecules likes carbohydrates, amino acids, protein and lipids. It makes base for further research study.

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	Basic Biochemistry:		10
	1.1	Bond–Types: Ionic, covalent, non-covalent bonds (hydrogen, hydrophobic, electrostatic, Van der Waal forces) and their functions in biomolecules.	
	1.2	Structure of water molecule (liquid, ice and colloid)	
	1.3	Physico-chemical properties of water.	
	1.4	Concept of acid and base, pH, Sorenson's scale, derivation of Henderson–Hasselbalch equation and its applications.	
	1.5	Concept of Buffer-types of buffer, buffering capacity and buffers in biological system (Phosphate, bicarbonate)	
2	Carbohydrates:		08
	2.1	Definition and classification of carbohydrates	
	2.2	Isomerism in carbohydrates- Structural and stereoisomerism.	
	2.3	Stereochemical properties-enantiomers, anomers, epimerism, mutarotation, racemisation.	
	2.4	Biological significance of carbohydrates.	
3	Proteins:		08
	3.1	Essential and non-essential amino acids	
	3.2	Structure and classification of amino acids	
	3.3	Peptide bond, types of proteins, protein structures (primary, secondary, tertiary and quaternary structures with suitable example)	
	3.4	Bonds responsible for protein structures	
	3.5	Biological significance of proteins	
4	Enzymes:		10
	4.1	Classification and properties of enzymes.	
	4.2	Regulatory and non-regulatory enzymes.	
	4.3	Enzyme kinetics, MM equation and its importance and LB plot	
	4.4	Reversible and irreversible enzyme inhibition	
	4.5	Factors influencing enzyme activity (pH, temperature, substrate concentration, enzyme concentration)	
	4.6	Introduction of isoenzymes, allosteric enzymes, immobilized enzymes and ribozymes	
5	Lipids:		06
	5.1	Introduction, classification and chemistry	
	5.2	Clinical significance (obesity, atherosclerosis, myocardial infarction)	
	5.3	Biological significance of lipids	

6	Nucleic Acids:		06
	6.1	Introduction, definition, nitrogenous bases, pentose sugars, Nucleosides, Nucleotides.	
	6.2	DNA: Watson & Crick's model, Comparative study of forms of DNA: A, B, Z; Chargaff's rule.	
6.3	RNA: Types & structure- mRNA, rRNA, tRNA, snRNA, snoRNA, miRNA, siRNA, piRNA (PiWi-interacting RNA).		

Reference books

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. Zubly G. Wm, C.Brown Communications USA
3. Harpers 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 publisher sand 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. Fundamentals of Biochemistry, Jain, J.L., Jain, S. and Jain, N., S. Chand and Company Ltd. (2005).
10. Roitt I., Brostoff J., Male D., Immunology, Mosby Elsevier (2004).
11. Khan F.H. The Elements of Immunology, Pearson Education (2009)
12. Owen J. A., Punt J., Strandfod S.A, Jones P.P., Kuby- Immunology W.H. Freeman & Company (2013).

Paper Code: ZOO 3104

Paper: IV

Title of Paper: ENVIRONMENTAL BIOLOGY AND TOXICOLOGY

Credits: 3

No. of Lectures: 48

Learning objectives:

- To study the ecosystem and the importance of abiotic and biotic factors.
- To learn various kinds of pollution, their consequences and preventive measures.
- To study the natural resource and their conservation.
- To study the wildlife, threats to wildlife and its management.
- To understand the toxicants, toxicity and health hazards.

Learning Outcomes:

- Students understand the basic concepts in environmental biology.
- Students understand the components of ecosystems and their interactions.
- Students understand the types of ecosystems, reasons of their degradation, ways of their conservation.
- Students understand the types of pollution, their reasons and thereby control measures.
- Students acquire the knowledge of environmental monitoring, role of various bioindicators, etc.
- Students understand the basic concepts in toxicology like LC_{50} , LD_{50} .

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	Environmental Biology		02
	1.1	Introduction- Definition, basic concepts and scope	
2	The Ecosystem		08
	2.1	Definition, abiotic and biotic components and their interrelationship	
	2.2	Energy flow in ecosystem and flow models	
	2.3	Major Ecosystems: (a) natural ecosystem: e.g., fresh water, forest (b) artificial ecosystem: e.g., cropland	
	2.4	Food chain in ecosystem and food web	
	2.5	Ecological pyramids	
3	Environmental Pollution:		10
	3.1	3.1 Definition and types of pollution	
	3.2	Pollutants, types of pollutants (metallic, gaseous, acids, alkalis, biocides)	
	3.3	Air pollution: Definition, sources of air pollution and their effects	
	3.4	Air pollution and its relevance with the following 3.4.1 Acid rain 3.4.2 Greenhouse effect 3.4.3 Ozone layer depletion	
	3.5	Water pollution: definition, sources of water pollution and their effects on ecosystem. 3.5.1 Community waste with reference to following: I. Sewage II. Industrial wastes III. Agricultural wastes	
	3.6	Land / Soil pollution: definition, sources of land / soil pollution and their effects	
3.7	Noise pollution: definition, sources of noise pollution and their effects and control measures		
4	Environment and Development		05
	4.1	Bioindicators and environmental monitoring	
	4.2	Environmental challenges in India: land degradation, Population explosion, urbanization & industrialization.	
5	Population ecology		02
	5.1	Demographics of populations	
	5.2	Population growth models	
	5.3	Regulation of population size	
6	Natural Resources and Conservation:		04
	6.1	Renewable and non-renewable resources	
	6.2	Soil conservation	
	6.3	Forest conservation	
	6.4	Energy sources: conventional and non-conventional	
7	Introduction to Carbon credit		02
	7.1	Emission allowances	
	7.2	Kyoto's flexible mechanisms	
	7.3	Emission market	

8	Wildlife Management:		05
	8.1	Definition, causes of wildlife depletion	
	8.2	Importance of wildlife management in India	
	8.3	Endangered species, vulnerable species, rare species and threatened species	
	8.4	Wild life conservation	
9	Toxicants and Toxicity:		06
	9.1	Definition of toxicology, scope and branches	
	9.2	Types of toxicants	
	9.3	Factors influencing toxicity (pH, temperature, reproductive status, age, physiological state)	
	9.4	Dose, LD ₅₀ , LC ₅₀	
10	Toxicants of Public Health and Hazards:		04
	10.1	Pesticides, heavy metals, fertilizers, food additives and radioactive substances	
	10.2	Toxin free farming, biofertilizers and bio-pesticides	

Reference Books

1. Ecology and environment, 2014, 12th revised Edition, P. D. Sharma, Rastogi Publ. Meerat.
2. Environmental Biology, 1996, P. S. Verma and V. K. Agrawal, S. Chand and Co. New Delhi.
3. Ecology, 2007, 1st Edn. Mohan P. Arora, Himalaya Publ. House, Delhi.
4. Fundamentals of ecology, 2009, 3rd Edn., M. C. Dash, Tata Mcgraw Hill, New Delhi.
5. Elements of ecology, 1967, George L. Clarke, John Wiley and Sons, New York.
6. Ecology of Natural resources, 1985, Francois Ramade, W. J. Duffin, John Wiley and Sons, New York.
7. Concepts of Ecology, 1996, E.J. Kormondy, Prentice Hall of India. New Delhi
8. Modern concept of Ecology, 1995, 8thEdn. H. D. Kumar, Vikas Publishing House, New Delhi

Paper Code: ZOO 3105

Paper: V

Title of Paper: PARASITOLOGY

Credits: 3

No. of Lectures: 48

Learning Objectives:

- To provide the students the knowledge of evolutionary, biological, epidemiological and ecological aspects of parasites with special reference to human host.
- To enable the learners to understand the pathogenesis, clinical presentations & complications of parasitic & zoonotic diseases.
- To enable the learners to reach the diagnosis and know the general outline of treatment & prophylaxis of parasitic infections.
- To provide the learners adequate knowledge about endemic, epidemic & pandemic concepts of parasites.

Learning Outcomes:

- Student gets the knowledge about various branches of Parasitology and the scope of subject in the career.
- Students become aware about various types of parasites and hosts and thereby try to remain free from parasites.
- Student understands the host-parasite relationship so that it can implement the strategies to control the parasite infection.
- Becomes aware about endoparasites. With this knowledge, it spreads the awareness in society about infection chances, preventive measures and treatment.
- Increases awareness about infections and control measures of ectoparasites like head louse, tick, mite, mosquitoes.
- Acquires in depth knowledge about zoonotic diseases like bird flu, rabies and toxoplasmosis. This knowledge helps it to spread the awareness about preventive measures and treatments of these diseases.
- Updates the knowledge about epidemic disease like typhoid, cholera and small pox. This knowledge helps it to spread the awareness about preventive measures and treatments of these diseases.

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	Introduction:		03
	1.1	Scope and branches of Parasitology, Symbiosis & its types: commensalisms, mutualism and parasitism.	
	1.2	Concept of: Parasite, Host, Vector (Vector types).	
2	Parasitism & Types of parasites:		04
	2.1	Properties of Parasite, Advantages & Hazards of parasitism.	
	2.2	Classification of parasites according to different criteria.	
3	Types of hosts:		03
	3.1	Classification according to different criteria, Intermediate and Definitive, paratenic, reservoir host.	
4	Host-Parasite relationship:		04
	4.1	Host specificity- definition & types.	
	4.2	Adaptations of Parasites, Effects of parasites on host.	
5	Study of the Protozoan parasites Habit, habitat, Life cycle, Mode of Infection, pathogenicity and control measures of –		09
	5.1	<i>Plasmodium vivax</i>	
	5.2	<i>Entamoeba histolytica</i>	
	5.3	<i>Trypanosoma spp</i>	
6	Study of the following helminth parasites Habit, habitat, Life cycle, Mode of Infection, pathogenicity and control measures of-		09
	6.1	<i>Ascaris lumbricoides</i>	
	6.2	<i>Taenia solium</i>	
	6.3	<i>Wuchereria bancrofti</i>	
7	Study of following Arthropod parasites: Morphology, life cycle, pathogenicity and control measures of:		09
	7.1	Head louse	
	7.2	Tick	
	7.3	Mite (<i>Sarcoptes scabiei</i>)	
8	Concept of Zoonosis and study of following zoonotic diseases:		03
	8.1	Viral, Bacterial, Fungal & Parasitic zoonoses. (01 example from each).	
9	Concept of epidemic diseases: Pathogen, Mode of infection, Symptoms, Treatment & Prophylaxis of		04
	9.1	Typhoid	
	9.2	Cholera	
	9.3	Plague	
	9.4	Corona (COVID-19)	

Reference Books

1. Comparative Protozoology: Ecology, Parasitology, Life history, 1988, Anderson, O.R. Springer Verlag, Berlin.
2. Parasites and parasitism, Cameron, 1958, T. W. M. Methuen, London
3. An Introduction to Parasitology, 1961, Chandler, A.C.& C. P. Read, Wiley, New York
4. Parasitology and Helminthology in relation to Clinical Medicine, 1980, Edn.12
Chatterjee, K.D., Chatterjee Medical publishers, Calcutta.
5. The biology of animal parasites, 1964, Cheng T.C., Saunders, Philadelphia.
6. Symbiosis, 1970, Cheng T.C., Pegasus, New York.
7. Parasitology -The biology of animal parasites, 1971, Noble E.R. & G. A. Noble, Lea and Febiger, Philadelphia U.S.A.
8. Modern Text-book of Parasitology, A. N. Latey.
9. Foundations of Parasitology, Larry Roberts & John Janovy, McGraw-Hill, New York.
10. Microbiology, Lansing M. Prescott, McGraw-Hill Companies, New York.
11. Essential Microbiology, Stuart Hogg, John Willey & Sons, Ltd.

Paper Code: ZOO 3106

Paper: VI

Title of Paper: CELL BIOLOGY

Credits: 3

No. of Lectures: 48

Learning Objectives: -

- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
- To understand the different kinds of cell membrane model & transport system.
- To understand how cellular organelles are used to generate and utilize energy in cells.
- To understand the basic application of stem cell therapies.
- To understand the concept of Immunology.

Learning Outcomes: -

- Students understand the distinguishing characters of Pro & Eukaryotic Cells.
- Students will Understand the basic structure & functions of Cell & organelles.
- Students will Understand the basic process of cell division & distinguish between its types.
- Students will Understand the basic techniques of cell identification & separation of cellular contents.
- Students will Understand Animal cell culture and its applications in the medicine.
- Students will understand Antigen – Antibody & Cell mediated Immune responses.
- Students acquire skills helpful for the advance studies.

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	Introduction to Cell biology:		01
	1.1	Definition and scope	
	1.2	Prokaryotic and eukaryotic cell: size, shape & structure	
2	Plasma membrane:		06
	2.1	Models: Lipid membrane concept, Sand-witch model, Unit membrane concept and Fluid Mosaic Model.	
	2.2	Membrane transport: Passive and Active Exocytosis and Endocytosis (Phagocytosis and Pinocytosis)	
3	Study of following cell organelles with respect to structure and functions in brief		04
	3.1	Endoplasmic reticulum	
	3.2	Golgi complex	
	3.3	Lysosomes	
	3.4	Mitochondria	
4	Nucleus:		05
	4.1	Ultrastructure of nuclear membrane and pore complex	
	4.2	Nucleolus: general organization, chemical composition and functions	
	4.3	Nuclear sap / nuclear matrix	
	4.4	Nucleocytoplasmic interactions	
5	Cytoskeleton:		03
	5.1	Microfilaments: location, ultrastructure, biochemical composition and functions	
	5.2	Intermediate Filament: location, ultrastructure, biochemical composition and functions	
	5.3	Microtubules: location, ultrastructure, biochemical composition and functions	
6	Cell cycle and cell division:		06
	6.1	Various phases of cell cycle, mitosis, meiosis & role of centriole in the cell division, Check points of cell cycle	
7	Cellular ageing and cell death:		04
	7.1	Concept of ageing theories:	
	7.2	Intracellular changes: free radicals	
	7.3	Extra cellular changes	
	7.4	Cell death:	
	7.5	Apoptosis: definition & significance	
	7.6	Necrosis: definition and examples	
8	Animal Cell Culture Techniques & Applications		07
	8.1	Animal cell culture: Introduction, principle and applications.	
	8.2	Stem Cells: Introduction to stem cells i) Potency of stem cells: Totipotency, Pluripotency, Multipotency, Unipotency ii) Sources of stem cells-Embryo, Fetal, Adult, Bone marrow iii) Stem cell therapy	

9	Introduction to Immunology		12
	9.1	Historical Perspectives	
	9.2	Types of immunity: Innate, Acquired	
	9.3	Study of antigen	
	9.4	Study of Antibodies & their types.	
9.5	Vaccination regime in India		

Reference Books

1. Cell and molecular biology, 2010, 8th Edn., De Robertis EDP and De Robertis EMF Jr., Lippincott Williams & Wilkins, Philadelphia
2. Molecular Cell biology, 2013, 1st Edn., C. B. Powar, Himalaya Publi. House.
3. Cell and molecular biology, 1968, Dupraw E. J., Academic Press, New York.
4. Molecular Cell biology, 1986, Avers C.J. Addison Wesley Pub. Co., New York & London.
5. Cell and Molecular biology, 2013, 7th Edn., Gerald Karp, John Wiley and Sons, USA.
6. Cell biology, 1993, David E. Sadava, Johnes and Bartlett Publi., London.
7. Cell Structure and Function, 1991, 3rd Edn, A.G. Loewy & Siekevitz, Saunder college Publi., Philadelphia
8. Becker's World of the Cell, 2012, 8th Edition, Jeff Hardin, Gregory Paul Bertoni, Lewis J. Kleinsmith, Benjamin Cummings, UK
9. The Cell: A molecular approach, 2013, 6th Edn., Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, USA
10. Molecular Biology of the Cell, 2007, 5th Edn., Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Taylor & Francis, UK
11. Morgan, S.I. Animal Cell culture 1993 Bio. Scientific Publishers Ltd Oxford.
12. Freshney, R.I. Culture of Animal Cells: A manual of Basic Technique, 1994, John Wiley Sons Inc. Pub. USA.
13. Immunology, Kubly, by Kindt, Goldsby, Osborne, Sixth Edition.
14. Immunobiology, The Immune system in Health and Disease, Seventh Edition by Janeway, Travers et al, Garland Publishing, 2008.

Paper Code: ZOO 3106

Paper: VI

Title of Paper: B) GENERAL PATHOLOGY

Credits: 3

No. of Lectures: 48

Learning Objectives:

1. To enable the student to understand the basic nature of disease processes from the standpoint of causation, epidemiology, natural history, and the structural and functional abnormalities that result.
2. To enable the student to classify diseases of various body systems and how they manifest clinically and histo-pathologically.
3. To enable the student to devise likely diagnoses from clinical scenarios by recognizing key manifestations of congenital, hemodynamic, inflammatory, infectious, metabolic, environmental, and neoplastic diseases.
4. To enable the student to apply knowledge of pathology's role in the diagnosis, staging, and management of disease.
5. To enable the student to utilize high quality peer-reviewed literature to maintain currency in the management of pathologic conditions.

Learning Outcomes:

1. Students will be able to identify the fundamental causes and mechanisms of disease, and the associated alterations in the structure and function of cells, tissues, organs and systems.
2. Students will describe basic mechanisms of cellular pathology, including cell injury, necrosis, and cellular adaptations.
3. Students will be able to describe the etiology and classification of inflammatory responses, and the mechanisms involved in healing and repair.
4. Students will be able to devise likely diagnoses from clinical scenarios by recognizing key manifestations of congenital, hemodynamic, inflammatory, infectious, metabolic, environmental, and neoplastic diseases.
5. Students will be able to apply knowledge of pathology's role in the diagnosis, staging, and management of disease.
6. Students will be able to utilize high quality peer-reviewed literature to maintain currency in the management of pathologic conditions.

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	Introduction:		04
	1.1	Definition, scope and basic branches	
	1.2	Applied pathology- biopsy and surgery	
	1.3	Autopsy- post mortem changes	
2	Clinical pathology		04
	2.1	Definition and scope	
	2.2	Gastric analysis	
	2.3	Urine examination	
	2.4	Importance of CSF examination	
	2.5	Liver function test	
3	Diseases:		04
	3.1	Definition and causes	
	3.2	Infectious diseases: aetiology and infectious agents	
4	Retrogressive changes		04
	4.1	Definition, cloudy (changes) swelling, degeneration, fatty degeneration, mucoid degeneration and amyloid degeneration	
5	Necrosis		03
	5.1	Definition and causes	
	5.2	Nuclear and cytoplasmic changes	
	5.3	Types of necrosis	
6	Gangrene		03
	6.1	Definition and causes	
	6.2	Types: dry, moist and gas gangrene	
7	Circulatory disturbances		08
	7.1	Hyperemia: active and passive (causes and effects)	
	7.2	Ischaemia: causes and effects	
	7.3	Hemorrhage: causes, effects and hemorrhagic effects	
	7.4	Thrombosis: thrombus formation, its causes & effects	
	7.5	Embolism: Definition, sources, types and effects	
8	Inflammation		05
	8.1	Definition and causes, cardinals of inflammation (signs), vascular phenomenon and cellular response	
	8.2	Acute and chronic inflammation	
9	Repair		04
	9.1	Process of Repair	
	9.2	Types: by regeneration, by connective tissue proliferation	
	9.3	Healing: primary and secondary	
10	Neoplasia		04
	10.1	Definition, causes & types of tumours- benign & malignant	
	10.2	Leukemia: acute and chronic.	
11	Disorders of pigmentations		02
	11.1	Brief idea about normal process of pigmentation, melanosis and jaundice	

12	Disorders of mineral metabolism		03
	12.1	Mechanism of calcification, pathological calcification (dystrophic and metastatic) causes and its effects. Gout aetiology and pathogenesis	

Reference Books

1. A text book of Pathology, 2009, 15th Rev Edn., Dey N. C. and Dey T. K. Sinha Debashish, New central book agency, Kolkota.
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 Hematology & 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.

Paper Code: ZOO 3107

Zoology Practical: V

Credits: 02

No. of Practicals: Any 10

Evaluation Pattern: 40 (Internal Assessment) + 60 (External Assessment)

Subject Code: ZOO-3107

Subject Title: ZOOLOGY PRACTICAL-V

Learning objectives

1. To learn the external characters, digestive and Nervous system of *Pila* & *Calotes*
2. To learn the scales, pecten and hyoid apparatus of *Calotes*.
3. To understand the Gemmules in sponges.
4. To understand the comparative study in vertebrates.
5. To make the students understand identification different types of tissues.
6. To make the students understand the method of temporary slide preparation of striated muscle fiber, stratified epithelial cells and medullated nerve fiber.
7. To introduce the students to different cells of human blood and their importance.

Learning outcomes

1. Outline the systematic position of *Pila* & *Calotes*.
2. The student will be able to label the organs and systems of *Pila* and *Calotes*.
3. The student will be able to understand asexual reproduction in sponges through gemmules.
4. Illustrate the morphological peculiarities of Heart, Kidney and Brain of vertebrates
5. Students are able to distinguish the permanent histological slides of different types of tissues.
6. 2. Students make a temporary slide preparation of striated muscle fiber, stratified epithelial cells and medullated nerve fiber.
7. 3. Students acquire the skill of making the blood smear and identifying different types of lymphocytes such as neutrophils, eosinophil, basophil and monocytes.

(Related to ZOO 3101, 3102)

Title of the Proposed Practical		Status
1	Study of external characters and digestive system of <i>Pila</i>	D
2	A. Study of Nervous system of <i>Pila</i> B. Temporary mounting of radula, osphradium & statocyst of <i>Pila</i>	D
3	Study of external characters and digestive system of <i>Calotes</i>	D
4	Study of nervous system of <i>Calotes</i>	D
5	A. Temporary mounting of scales, pecten and hyoid apparatus of <i>Calotes</i> B. Study of Gemmules in sponges	D
6	Comparative study of Scales in fishes: Placoid, Cycloid, and Ctenoid Heart: <i>Scoliodon</i> , Frog, <i>Calotes</i> , Pigeon and Rat Brain: <i>Scoliodon</i> , Frog, <i>Calotes</i> , Pigeon and Rat	D
7	Study tour to visit costal locality / Bio-diversity area / Hilly area / ponds/lakes / tanks / zoo / museum / science center- prepare tour report and submit at the time of examination	
8	Study of the different types of tissues with the help of permanent slides	D
9	Temporary mounting of tissues: A. Medullated Nerve fibre B. Striated muscle fibre C. Stratified epithelial cells	E
10	Study of permanent histological slides of skin, tooth, tongue, stomach, duodenum, ileum,liver, pancreas and any one salivary gland	D
11	Study of permanent histological slides of trachea, lung, kidney, testis, ovary, thyroid and adrenal gland.	D
12	Study of human blood smear to observe different cells	E

Paper Code: ZOO-3108

Zoology Practical: VI

Credits: 02

No. of Practical: Any 10

Learning Objectives:

- To study the methods of collection, preservation and identification of planktons from freshwater
- To understand the importance and methods of water quality analysis
- To understand the importance and methods of soil analysis
- To study the methodologies of dissolved O₂ estimation from water samples.
- To study the methodologies of dissolved CO₂ estimation from water samples.
- To learn calculation of LC₅₀ and LD₅₀ from the data.
- To understand the working principle of pH meter using various solutions.
- To understand the effect of pH, temperature on enzyme activity.
- To know about how to prepare standard solutions while performing experiments.
- To detect carbohydrate, protein with suitable test.
- To estimate protein with Lowry's method.
- To study the separation of biomolecules with specific technique.

Learning outcomes:

- Students understand the methods of field collection, preservation and identification of planktons
- Students learn various water quality parameters, their measurement using analysis kit and importance.
- Student learn methods of estimating LC₅₀ and LD₅₀.
- It helps to student to understand about acidic, basic and neutral nature of chemicals.
- It helps to know about how the enzyme activity is dependent on different factors.
- Understand about application of different techniques in biomolecules separation.
- Understand about conversion and preparation of standard solutions.
- It helps to understand methods for estimation of protein, carbohydrates.

(Related to ZOO 3103, 3104)

Title of the Proposed Practical		Status
1	Study of fresh water plankton (field collection, preservation and gross identification).	E
2	A visit to water body to study physicochemical properties of water. (TDS, Temperature, pH, turbidity, hardness, acidity & alkalinity) using analysis kit.	E
3	Study of physico-chemical properties of soil sample (using analysis kit)	E
4	Estimation of dissolved oxygen in water by Winkler's method.	E
5	Estimation of dissolved CO ₂ in water.	E
6	Hypothetical problem to determine LC ₅₀ and LD ₅₀ .	E
7	Study of principle and working of pH meter and measuring pH of three samples.	D
8	To study the effect of pH, temperature and inhibition on salivary amylase.	E
9	Detection of carbohydrates (monosaccharides, disaccharides and polysaccharides) with the help of suitable tests.	E
10	Study of preparation of standard acid and alkali and its standardization.	E
11	Estimation of proteins from suitable biological sample by Lowry's method.	E
12	Separation of amino acids / sugars / lipids by thin layer chromatography (TLC).	E

Paper Code: ZOO-3109

Zoology Practical: VII

Credits: 02

No. of Practicals: Any 10

Learning Objectives: -

- To Learn the detection of mitochondria with help of Janus Green B Stain.
- To study the of permanent slides of different stages of mitosis & meiosis.
- To Learn the temporary preparation of different mitotic stages from onion root tip cells.
- To Learn the effect of Colchicine on mitosis.
- To study the of temporary preparation of different meiotic stages from grasshopper testis / Tradescantia/ Onion floral bud.
- To study the viability of cell by using Trypan Blue dye.
- To study Splenectomy in rat.
- To understand the morphology and life cycle of *Plasmodium vivax* and *Entamoeba histolytica*, *Ascaris lumbricoides* and *Taenia solium*.
- To describe the morphology and pathogenicity of arthropods of human & animal health importance.
- To identify vector - host - pathogen relationships in arthropod-borne diseases.
- To expose the endoparasites from the host.
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Learning Outcomes: -

- Students will learn how to detect mitochondria by using 'Janus Green B' Stain.
- Students will learn & identify the different stages of mitosis & meiosis by using readymade permanent slides.
- Students will learn how perform the temporary preparation of mitotic stages in onion root tip cells.
- Students will learn the role of Colchicine on mitosis (cell cycle).
- Students will learn the temporary preparation of different meiotic stages from grasshopper testis / Tradescantia/ Onion floral bud.
- Students will learn how perform the viability of cell by using Trypan Blue dye.
- Students will learn Splenectomy & its significance.
- Students learn the morphology & life cycle of protozoan & helminth parasites.
- Students become aware about the spreading of diseases by different arthropods.
- Students can identify the different vectors responsible for spreading of diseases.
- Students will learn the dissection, collection and mounting of endoparasites.

(Related to ZOO 3105, 3106)

Title of the Proposed Practical		Status
1	Study of Life cycle of <i>Plasmodium vivax</i> and <i>Entamoeba histolytica</i> (whole mounts of life stages), <i>Ascaris lumbricoides</i> and <i>Taenia solium</i> (whole mounts of life stages).	D
2	Study of morphology & pathogenicity of Head louse, Tick, & Mite.	D
3	Study of vectors by whole mountings of —mosquito, rat flea, house fly and bed bug.	E
4	To study rectal parasites of cockroach OR Intestinal Parasites of Hen / Fish.	E
5	Study of detection of mitochondria by Janus Green B.	E
6	Study of permanent slides of mitosis & meiosis.	D
7	To study the effect of Colchicine on mitosis.	E
8	Study of temporary preparation of different meiotic stages from grasshopper testes / Tradescantia/ Onion floral bud.	E
9	Cell Viability Test (Trypan Blue)	D
10	Study of antigen-antibody interaction by Ouchterlony Method.	D

OR (Optional for Practical no. 5 to 10 from Cell Biology)

ZOO-3106 B] General Pathology

Practicals:

5. Study of pathogenic agents and pathological conditions with the help of suitable microscopic slides **D**
 - a) *Mycobacterium tuberculosis*
 - b) *Mycobacterium leprae*
 - c) *Vibrio cholerae*
 - d) *Anthrax bacilli*
 - e) *Pneumococci* sp.
 - f) *Trypanosoma* sp.
6. Study of pathological conditions with the help of suitable microscopic slides **D**
 - a) Normal and diseased cell (Lung)
 - b) Fatty degeneration (Liver)
 - c) Cloudy degeneration/Swelling (Kidney)
 - d) Dying cell –necrosis (Liver)
 - e) Lung lobar pneumonia
 - f) Ovarian cyst
 - g) Thyroid goitre
7. Study of following pathological slides or specimens **D**
 - a) Carcinoma in situ eg. Human cervix
 - b) Malignant cell
 - c) Organized thrombus
 - d) Ovary fibroid tumour/carcinoma
 - e) Carcinoma of colon-cauliflower growth
 - f) Carcinoma of stomach
 - g) Liver cirrhosis

h) Breast fibrocystic disease

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| 8. To detect the normal and abnormal constituents of urine | E |
| 9. Study of Gastric juice analysis by Toffler's reagent (alcoholic solution of dimethylaminoazobenzol methyl orange indicator). | E |
| 10. Visit to medical college/hospital/pathological laboratory | |

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