



HYDERABAD (SIND)
NATIONAL COLLEGIATE BOARD

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

(Affiliated to the University of Mumbai)

University College Code : 217-JD Office : T14



Principal : Dr. Manju Lalwani Pathak

Ref No: CHM (A) AC/C/01/2025

Date: 18th June 2025

CIRCULAR

The immediate attention of all concerned is invited to this office Circular No. CHM (A) AC 05/2025 dated 19th May, 2025 regarding the Choice Based and Credit Based Syllabus (CBCS) for all subjects of F.Y.B.Sc. & T.Y.B.Sc. in Zoology SEM - I & SEM – V respectively.

It is hereby communicated that the recommendations of the syllabus made by the Ad-hoc Board of Studies in Zoology coordinated by the Dean, Faculty of Pure Sciences in the meeting of Academic Council held on 23rd May, 2025 vide item No. 5.5, have been accepted and subsequently passed.

In accordance, therewith, the syllabus as per the CBCS has been brought into force with effect from the academic year 2025 – 2026 and accordingly the same is attached for reference and is available on the College's website www.chmcollege.in

Ulhasnagar - 421 003

18th June, 2025

Dr. Manju Lalwani Pathak

Principal & Chairperson, Academic Council

Copy forwarded for information to:-

- 1) The Dean, Faculty of Humanities.
- 2) The Chairperson, Ad-hoc Board of Studies.
- 3) The Controller of Examination.
- 4) The Registrar



HSNC Board's
Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar
(Autonomous)
Affiliated to the University of Mumbai

Bachelor of Science
(Zoology)
(Aided)

Semester – V

Choice Based and Credit Based syllabus
with effect from the
Academic Year 2025-2026

PREAMBLE

The study of Zoology offers profound insights into the diversity, structure, function, and evolution of animal life. As a fundamental branch of biological sciences, it bridges basic biological concepts with applied sciences, contributing significantly to environmental conservation, biotechnology, health sciences, and agriculture.

This revised syllabus for Semesters V and VI of the B.Sc. Zoology programs have been thoughtfully designed to provide students with a comprehensive understanding of advanced zoological concepts, integrating both theoretical knowledge and practical skills. The curriculum encompasses diverse topics such as animal physiology, developmental biology, genetics, ecology, and biotechnological applications, reflecting the latest scientific developments and research trends.

The program aims to foster scientific temper, analytical thinking, and problem-solving abilities among learners. It emphasizes hands-on experience through well-structured practical components, enabling students to develop experimental and observational skills essential for a career in research, teaching, and allied professions.

The syllabus also encourages interdisciplinary learning, promoting awareness of the interconnections between zoology and other scientific disciplines. By nurturing curiosity and critical inquiry, this program prepares students to meet the challenges of modern biological sciences and contribute meaningfully to sustainable development and biodiversity conservation. Overall, this curriculum strives to create a strong foundation for students aspiring to excel in zoology and related fields, empowering them to become competent professionals and responsible global citizens.

PROGRAMME SPECIFIC OUTCOME (PSOs)

- PSO1:** They will acquire a deep understanding of the taxonomy and classification of invertebrates, haematology, immunology, cancer biology, toxicology, biostatistics, and human physiology. This multidisciplinary knowledge will help students apply concepts in both research and clinical contexts.
- PSO2:** They will be able to apply Principles of Taxonomy and Systematics Understand and utilize the principles and methods of animal classification, including a thorough study of representative invertebrates such as Sepia. This enables students to explore biodiversity with taxonomic clarity and precision.
- PSO3:** They will understand and Interpret Haematological and Immunological Processes.
- PSO4:** They will be able to comprehend the molecular and cellular basis of cancer, tissue histopathology, and toxicology.
- PSO5:** They will attain in-depth knowledge of human endocrine systems and physiological aspects of skin, tissues, bones, muscles, and neuroendocrinology preparing students for careers in health sciences, research, and applied physiology.

**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)**

Semester- V

**Title: Taxonomy - Invertebrates and Type Study
Paper I**

**With effect from the
Academic Year 2025-2026**

Title: Taxonomy - Invertebrates and Type Study

Course Code: CHM(A)USZO501

S. No.	Heading	Particulars
1	Description of the Course	The Course is designed to help learners grasp the fundamental principles of taxonomy, the various levels of biological organization, modern classification up to the class level, and the evolutionary significance of organizational features such as symmetry, coelom, and segmentation. Students will explore biological organization from the cellular level to the organ-system level, as well as understand the Linnaean hierarchy, binomial nomenclature, and six-kingdom classification. While students encounter the five-kingdom classification briefly in their higher secondary education, this syllabus offers a more detailed and reasoned study at the undergraduate level. It explains why particular animals are placed in specific divisions, phyla, or classes, and introduces learners to distinctive features of each phylum.
2	Vertical	-----
3	Type Teaching Method	Theory Lecture, Seminar, Group discussion, Presentation, simulations, field visits, AV mode etc.
4	Credit	2.5
5	Hours allotted	48 Hours
6	Marks allotted	100 Marks
7	Course Objectives:	1. To introduce fundamental concepts of biological organization, from unicellular to multicellular forms, symmetry, coelom, and metamerism to understand the complexity of animal body plans. 2. To provide detailed knowledge of classification, general characters, and representative examples of Protista and invertebrate phyla including Porifera to Echinodermata and minor phyla. 3. To develop an understanding of taxonomy and systematic position through comparative morphology and anatomical studies of various animal groups up to class level. 4. To offer in-depth exposure through a type study of Sepia (cuttlefish) focusing on its structure, systems (digestive to reproductive), habitat, behaviour, and economic importance.
8	Learning Outcomes:	Upon completion of the course, student will be able to LO 1 Identify and classify unicellular and multicellular organisms and explain the levels of biological organization and body symmetry in animals. LO 2 Distinguish different types of coeloms, metamerism, and their evolutionary significance in invertebrate phyla. LO 3 Describe the general characters, classification, and key examples of invertebrate phyla and Protista up to class level. LO 4 Comprehend of the anatomy and physiology of Sepia, including its systems and ecological/economic relevance through a detailed type study.

Syllabus

UNIT I: Principles of Taxonomy

Levels of Organization-I

- Unicellularity, colonization of cells, multicellularity, Levels of Organization: Acellular, Cellular, Tissue level, Organ level, and 'Organ-system' level
- Symmetry: Basic concept and types, Asymmetry (Amoeba), Radial symmetry (Starfish) and bilateral symmetry (Invertebrate – Planaria), and (Vertebrate – Man).

Levels of Organization-II

- Coelom: Basic concept and Types, Acoelomate (Platyhelminthes-Liver fluke), Pseudocoelomate (Nematoda- Roundworm), and Coelomate (Frog)
- Metamerism: Basic concept and Types: Pseudo metamerism (Tapeworm), True metamerism (Homonomous-Annelida – Nereis), (Heteronomous-Cephalization (Insecta-Dragonfly) and Cephalothorax (Crustacean-Lobster)
- Kingdom Protista (Animal-like Protists): Protozoa: General characters of Protozoa and Classification up to class level.
- Phylum Sarcomastigophora- Class Sarcodina (Amoeba); Class Mastigophora (Trypanosoma)
- Phylum Ciliophora- Class Ciliata (Opalina); Class Phyllopharyngea (Dysteria)
- Phylum Sporozoa- Class Aconoidasida (Plasmodium); Class Conoidasida (Toxoplasma)

UNIT II: Kingdom Animalia-I

- Phylum Porifera: General characters and classification up to class with distinguishing features and suitable examples: Class Calcarea (Leucosolenia- Branched sponge); Class Hexactinellida (Hyalonema- Glass-rope sponge), and Class Demospongia (Euspongia- Bath sponge)
- Phylum Cnidaria: General characters and Classification up to class with distinguishing features and examples of Class Hydrozoa (Hydra), Class Scyphozoa (Aurelia- jellyfish), and Class Anthozoa (Meandrina- Maze Coral)
- Phylum Platyhelminthes: General characters and Classification up to class with distinguishing features and examples of Class Turbellaria (Dugesia, Planaria); Class Trematoda (Schistosoma (Blood-fluke); Class Cestoda (Taenia-Tapeworm)
- Phylum Nematoda: General characters and Classification up to class with distinguishing features and examples of Class Aphasmida (Trichinella-Trichina worm); Class Phasmida (Ascaris-Roundworm)

UNIT III: Kingdom Animalia-II

- Phylum Annelida: General characters and Classification up to class with distinguishing features and examples of Class Polychaeta (Nereis-Clamworm), Class Oligochaeta (Pheretima-Earthworm), and Class Hirudinea (Hirudinaria-Leech)
- Phylum Arthropoda: General characters and Classification up to class with distinguishing features. Study examples of:
 - Subphylum Chelicerata includes Class Arachnida (Hottentotta-Scorpion), Class Merostomata (Limulus-Horse-shoe crab), and Class Pycnogonida (Nymphon-Sea spider)
 - Subphylum Crustacea includes Class Malacostraca (Scylla-Crab), Class Maxillipoda (Balanus-Barnacle),
 - Subphylum Uniramia includes Class Chilopoda (Scolopendra-Centipede), Class Diplopoda (Xenobolus-Millipede), and Class Insecta (Attacus-Moth)
- Phylum Mollusca: General characters of the Phylum and Classification up to class with distinguishing features and examples of Class Aplacophora (Chaetoderma-Glisten worm solenogaster), Class Polyplacophora (Chiton-coat-of-mail shell),

	• Class Monoplacophora (Neopilina), Class Bivalvia (Donex-Wedge shell) Class Gastropoda (Nerita-Nerit), Class Pelecypoda (Solen-Razor clam) Class Scaphopoda e.g. Dentalium (Tusk shell) and Class Cephalopoda e.g. Nautilus (Pearly nautilus) • Phylum Echinodermata: General characters and Classification up to class with distinguishing features and examples of Class Asteroidea (Protoreaster-Starfish), Class Ophiuroidea (Ophiothrix-Brittle star), Class Echinoidea (Clypeaster-Sand dollar), Class Holothuroidea (Cucumaria- Sea cucumber), and Class Crinoidea (Antedon-Sea lily) • Minor phyla: General characters along with examples of Phylum Acanthocephala (Moniliformis), Phylum Onychophora (Peripatus-Velvet worm), Phylum Chaetognatha (Sagitta-Arrow worm), • Phylum Hemichordata: General characters and classification with distinguishing features and examples of Class Enteropneusta (Balanoglossus-Acorn worm), Class Pterobranchia (Rhabdopleura), and Class Planctosphaeroidea (Planctosphaera) UNIT IV: Type study: Sepia • General characters and classification, Habit and habitat, External characters, mantle cavity, locomotion, economic importance • Digestive system, Respiratory system, Circulatory system, Excretory system, Nervous system and Sense organs, Reproductive system																																	
10	Scheme of Examination and Assessment Pattern (Paper – 100 Marks) A. External Examination: Semester End External - 75 marks Time: 2.5 hour Format of Question Paper All the questions are compulsory. <table><tr><th>Question No.</th><th>Nature of questions</th><th>Marks</th></tr><tr><td>Q.1.</td><td>Multiple Choice 20 Questions (Attempt any 15 (1 mark each))</td><td>15</td></tr><tr><td>Q.2.</td><td>2.a. Total 2 questions of 8 marks from unit 1 (attempt any one) 2.b. Total 2 questions of 7 marks from unit 1 (attempt any one)</td><td>15</td></tr><tr><td>Q.3.</td><td>3.a. Total 2 questions of 8 marks from unit 2 (attempt any one) 3.b. Total 2 questions of 7 marks from unit 2 (attempt any one)</td><td>15</td></tr><tr><td>Q.4.</td><td>4.a. Total 2 questions of 8 marks from unit 3 (attempt any one) 4.b. Total 2 questions of 7 marks from unit 3 (attempt any one)</td><td>15</td></tr><tr><td>Q.5.</td><td>5. a. Total 2 questions of 8 marks from unit 4 (attempt any one) 5.b. Total 2 questions of 7 marks from unit 4 (attempt any one)</td><td>15</td></tr></table> Note: Equal Weightage is to be given to all the Units. Total 75 B. Internal Examination: Continuous Evaluation - 25 marks <table><tr><td>1.</td><td>Class test to be conducted as per the following pattern</td><td>20 Marks</td></tr><tr><td></td><td>a. Match the column/Fill in the blanks/Multiple Choice (1 mark each)</td><td></td></tr><tr><td></td><td>b. Answer in 1 or 2 lines (2 marks each)</td><td></td></tr><tr><td></td><td>c. Answer in brief (5 marks each)</td><td></td></tr><tr><td>2.</td><td>Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.</td><td>05 Marks</td></tr></table>	Question No.	Nature of questions	Marks	Q.1.	Multiple Choice 20 Questions (Attempt any 15 (1 mark each))	15	Q.2.	2.a. Total 2 questions of 8 marks from unit 1 (attempt any one) 2.b. Total 2 questions of 7 marks from unit 1 (attempt any one)	15	Q.3.	3.a. Total 2 questions of 8 marks from unit 2 (attempt any one) 3.b. Total 2 questions of 7 marks from unit 2 (attempt any one)	15	Q.4.	4.a. Total 2 questions of 8 marks from unit 3 (attempt any one) 4.b. Total 2 questions of 7 marks from unit 3 (attempt any one)	15	Q.5.	5. a. Total 2 questions of 8 marks from unit 4 (attempt any one) 5.b. Total 2 questions of 7 marks from unit 4 (attempt any one)	15	1.	Class test to be conducted as per the following pattern	20 Marks		a. Match the column/Fill in the blanks/Multiple Choice (1 mark each)			b. Answer in 1 or 2 lines (2 marks each)			c. Answer in brief (5 marks each)		2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05 Marks
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11 REFERENCES:

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2. A manual of Zoology - Part I, Invertebrate; Ayyar, M. Ekambar Anath
3. Invertebrate Zoology – Volumes of different Phyla; Hyman L.H.
4. Instant Notes in Animal Biology by Richard D. Jurd.
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7. Modern text book of Zoology – Invertebrates; Eleventh; Edition Professor R. L. Kotpal; Rastogi publication
8. Phylum Sarcomastigophora viz. Protozoology, by S. V. Nikam & S. T. Tanveer; ed. 2011, Pub. Oxford Book.
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11. Zoology for degree students, non-chordates-1 by V.K. Agarwal, 2017, S. Chand publications
12. Zoology for Degree Students-I, B.Sc. First Year, by V. K. Agarwal, Pub. S. Chand Co.
13. B. Sc. Zoology, Invertebrate Zoology by V.K. Aggarwal, 2017, S. Chand Publications
14. Invertebrate Zoology by Fatik Baran, 2012, PHI Learning
15. A Textbook of Invertebrates by N.C. Nair et al. 2010 Saras publications

**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)**

Semester- V

**Title: Practical based on Invertebrates and type Study
Practical I**

**With effect from the
Academic Year 2025-2026**

Title: Practical Based on Taxonomy - Invertebrates and Type Study

Course Code: CHM(A)USZOP05 (1)

1	Description of the Course	The Course is designed to help learners grasp the fundamental principles of taxonomy, the various levels of biological organization, modern classification up to the class level, and the evolutionary significance of organizational features such as symmetry, coelom, and segmentation. Students will explore biological organization from the cellular level to the organ-system level, as well as understand the Linnaean hierarchy, binomial nomenclature, and six-kingdom classification. While students encounter the five-kingdom classification briefly in their higher secondary education, this syllabus offers a more detailed and reasoned study at the undergraduate level. It explains why particular animals are placed in specific divisions, phyla, or classes, and introduces learners to distinctive features of each phylum.
2	Vertical	-----
3	Type	Practicum
4	Credit	1.5
5	Hours allotted	45 Hours
6	Marks allotted	50 Marks
7	Course Objectives: 1. To provide hands-on experience in the dissection and microscopic observation of anatomical structures, larval forms, and adaptations in invertebrates for better understanding of morphology and physiology. 2. To develop skills in specimen preparation and identification through temporary mountings, field visits, and observation of morphological features relevant to taxonomy and ecological adaptations.	
8	Learning Outcomes: Upon completion of the course student will be able to LO 1 Perform dissections and prepare temporary mounts to study key systems (digestive, reproductive, nervous) and structures (jaws, radula, spermatophore) of Sepia and other invertebrates. LO 2 Identify and describe larval forms, adaptive features, and morphological diversity among invertebrate phyla through both lab work and field observations.	

9	List of Practical	
	1. Dissection of <i>Sepia</i> to study its Digestive System, Reproductive System and Nervous System	
	2. Temporary mounting of Jaws, Radula, Statocyst, and Spermatophore in <i>Sepia</i>	
	3. Study of Binary fission, Conjugation in <i>Paramecium</i>	
	4. Temporary mounting of foraminiferan shells from sand sample	
	5. Study of spicules and the water vascular system in sponges.	
	6. Study of Polymorphic forms of coelenterates and Identification of corals (<i>Vellela</i> , <i>Rhizostoma</i> , <i>Corallium</i>)	
	7. Study of endoparasitic adaptation in Platyhelminthes and nemathelminths	
	8. Study of Ectoparasitic adaptation in Arthropoda.	
	9. Study of Crustacean larvae: <i>Nauplius</i> , <i>Zoea</i> , <i>Mysis</i> , <i>Megalopa</i> , <i>Phyllosoma</i> .	
	10. Temporary mounting of types of legs, mouth parts, and wings of cockroach	
	11. Study of foot & shell in Mollusca	
	12. Study of Echinoderm larvae: <i>Bipinnaria</i> , <i>Brachiolaria</i> , <i>Auricularia</i> , <i>Doliolaria</i> , <i>Echinopluteus</i> , <i>Ophiopluteus</i>	
	13. Study tour - Visit to fish market/ National Parks / Sanctuaries / and such other places to observe invertebrates. College may conduct more than one field visit for wide exposure, if feasible. However, at least one field visit should be such that it is affordable to every student	
	Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)	
	Duration: 5 hrs	Marks-50
	Sr. No.	Marks
	Q.1	Major experiment Dissection of sepia _____ system. (Digestive / Reproductive system / Nervous system)
	Q.2	Mounting of or Temporary slide preparation of: a. Jaws & Radula / Chromatophores / Spermatophores / Statocyst b. Foraminiferan Shells / legs, mouth parts and wings of cockroach
	Q.3	Identify and describe a. Spicules / Sponge Water Vascular System / Polymorphic form in coelenterate b. Endoparasitic adaptation / Ectoparasitic adaptation. c. Crustacean Larva d. Molluscan Foot / Shells e. Echinoderm Larva
	Q.4	Field Report Submission & Viva
	Q.5	Journal
		Total

**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)**

Semester- V

**Title: Basic and applied hematology and immunology
Paper II**

**With effect from the
Academic Year 2025-2026**

Title: Basic and applied hematology and immunology

Course Code: CHM(A)USZO502

S. No.	Heading	Particulars
1	Description of the Course	Course covers Basic and Applied Haematology and Immunology. It equips students with an understanding of human blood, clinical disorders, and diagnostic methods, emphasizing the importance of diagnostic tools for human health. The immunology component builds on haematology knowledge, covering antigen-antibody interactions and immunoassays. Teaching methods include traditional lectures supplemented with ICT tools, audiovisual simulations, practical sessions, and visits to institutions specializing in pathology and immunology. Teachers are encouraged to highlight career prospects in haematology and immunology
2	Vertical	-----
3	Type	Theory
	Teaching methods:	Lecture, Seminar, Group discussion, Presentation, simulations, field visits, AV mode etc.
4	Credit	2.5 Credits
5	Hours allotted	48 Hours
6	Marks allotted	100 Marks
7	Course Objectives: 1. To provide foundational knowledge of hematology, including blood components, formation of blood cells, haemoglobin, and common blood disorders. 2. To familiarize students with clinical biochemistry techniques for assessing blood-related parameters in diagnosing kidney, liver, and cardiac conditions. 3. To introduce students to the principles of immunology, including innate and adaptive immune responses, immune cells, and organs. 4. To develop an understanding of applied immunological techniques such as antigen-antibody interactions, immunoassays, and vaccine development and classification.	
8	Learning Outcomes: Upon completion of the course student will be able to LO 1 Describe the structure and function of blood components and explain the processes of hematopoiesis and related disorders. LO 2 Interpret common biochemical tests such as kidney and liver function tests, blood glucose monitoring, and enzyme markers for clinical diagnosis. LO 3 Understand the mechanisms of innate and adaptive immunity and identify the roles of immune cells and organs in disease defense. LO 4 Gain practical and theoretical knowledge of immunological applications, including immunoassays (e.g., ELISA), antigen-antibody reactions, and principles of vaccination.	

Syllabus

UNIT I: Basic hematology

- Introduction to hematology: Functions of blood, composition of blood, composition of plasma, difference between serum and plasma.
- Erythropoiesis, leucopoiesis and thrombopoiesis
- Erythrocytes: Structure and functions, Leucocytes: Types and functions, Thrombocytes: Structure, factors, and mechanism of clotting.
- Haemoglobin: Structure, formation, and degradation; variants of haemoglobin in adult and foetus
- Abnormalities of blood: Types of anemia (Aplastic anemia, sickle cell anemia, anemia due to iron deficiency, vitamin deficiency), Thalassemia, polycythemia, thrombocytopenia, thrombocytosis, leukopenia.

UNIT II: Clinical biochemistry of blood

- Biochemical examination of blood: Kidney function test: Serum creatinine, Blood Urea Nitrogen (BUN)
- Carbohydrate metabolism tests: Blood sugar, Glucose tolerance test, HbA1c Glycosylated-haemoglobin test.
- Plasma specific and non-plasma specific enzymes.
- Enzymes in myocardial infarction
- Enzymes in liver diseases and toxicity: AST, ALT
- Diagnostic importance of LDH

UNIT III: Basic Immunology

- Basic Concept of immunity
- Innate immunity - Definition, factors affecting innate immunity, Mechanisms of innate immunity - First line of defence - physical and chemical barriers; Second line of defence - phagocytosis, inflammatory responses, and fever
- Adaptive or Acquired immunity, Antibody mediated and cell mediated immunity; Active Acquired immunity - Natural and Artificial; Passive Acquired immunity - Natural and Artificial
- Cells of immune system - B cells, T cells and null cells, macrophages, dendritic cells, and mast cells
- Organs of immune system: Primary: Thymus and bone marrow and Secondary: Lymph nodes and spleen
- Antigens: Definition and properties; haptens
- Antibodies: Definition, basic structure, types/classes of antibodies

UNIT IV: Applied Immunology

- Antigen-Antibody interaction: General features of antigen-antibody interaction, Precipitation reaction - Definition, characteristics, and mechanism; Precipitation in gels (slide test); Radial immunodiffusion (Mancini method); Double immunodiffusion (Ouchterlony method)
- Agglutination reaction definition, characteristics, and mechanism. Haemagglutination (slide and micro-tray agglutination) Passive agglutination
- Immunoassay - ELISA
- Principles of vaccines - active and passive immunization, Routes of vaccine administration
- Classification of vaccines: Live attenuated, Whole-Killed or inactivated
- Sub-unit vaccines: Toxoids, Protein vaccines, Viral-like particles, DNA vaccines Adjuvants used for human vaccines: Virosomes and Liposomes, Saponins, Water-in-oil emulsions
- Vaccines against human pathogens: Polio, Hepatitis A and B, Tuberculosis (BCG)

10	Scheme of Examination and Assessment Pattern (Paper – 100 Marks)		
A. External Examination: Semester End External - 75 marks		Time: 2.5 hour	
Format of Question Paper			
Attempt all questions.			
Question No.	Evaluation type	Marks	
Q.1.	Multiple Choice 20 Questions (Attempt any 15 (1 mark each))	15	
Q.2.	2.a. Total 2 questions of 8 marks from unit 1 (attempt any one) 2.b. Total 2 questions of 7 marks from unit 1 (attempt any one)	15	
Q.3.	3.a. Total 2 questions of 8 marks from unit 2 (attempt any one) 3.b. Total 2 questions of 7 marks from unit 2 (attempt any one)	15	
Q.4.	4.a. Total 2 questions of 8 marks from unit 3 (attempt any one) 4.b. Total 2 questions of 7 marks from unit 3 (attempt any one)	15	
Q.5.	5. a. Total 2 questions of 8 marks from unit 4 (attempt any one) 5.b. Total 2 questions of 7 marks from unit 4 (attempt any one)	15	
Note: Equal Weightage is to be given to all the Units.			
B. Internal Examination: Continuous Evaluation - 25 marks			
1.	Class test to be conducted as per the following pattern	20 Marks	
	a. Match the column/Fill in the blanks/Multiple Choice (1 mark each)		
	b. Answer in 1 or 2 lines (2 marks each)		
	c. Answer in brief (5 marks each)		
2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05 Marks	
11	REFERENCES:		
	1. Human Physiology - Volume 1; C.C. Chatterjee.		
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	6. Short Textbook of Haematology; Shah B.S.; C.B.S. Publisher and Distributor.		
	7. Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd., Kolkata; 1999		
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	11. Essentials in Hematology and Clinical Pathology; Nayak, Ramadas.		
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**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)**

Semester- V

**Title: Practical based on basic and applied hematology and
immunology
Practical II**

**With effect from the
Academic Year 2025-2026**

Title: Practical based on basic and applied hematology and immunology
Course Code: CHM(A)USZOP05(2)

1	Description of the Course	The hands-on practical course in Immunology and haematology provides students with essential laboratory skills to study cell structure, and function. The practical course in immunology provides students with hands-on experience in analyzing the chemical processes essential to life. Through laboratory experiments, students will explore immune parameters, blood parameters, enzymatic reactions, metabolic pathways, and molecular interactions.
2	Vertical	-----
3	Type	Practical
4	Credit	1.5
5	Hours allotted	45 Hours
6	Marks allotted	50 Marks
7	Course objective: 1. To train students in haematological and biochemical techniques for the enumeration, analysis, and diagnosis of blood parameters and disorders. 2. To develop hands-on skills in immunological techniques and organ identification relevant to immune system function and clinical diagnostics.	
8	Learning outcome: Upon completion of the course, student will be able to LO 1 Perform and interpret basic haematological tests, such as RBC/WBC counts, differential count, hemoglobin estimation, bleeding/clotting time, and blood grouping. LO 2 Demonstrate practical understanding of immunological methods (e.g., Ouchterlony test) and identify immune organs and major hematological disorders like sickle cell anaemia and thalassemia.	
9	List of Practical 1. Measurement of cell-size using oculometer and stage micrometer 2. Study of permeability of cell through plasma membrane (osmosis in blood cells). 3. Study of prokaryotic cells (bacteria) by Crystal violet staining technique 4. Study of eukaryotic cells (WBCs) from blood smear by Leishman's stain 5. Preparation of titration curve for strong acid and strong base with the help of pH meter. 6. Qualitative analysis of carbohydrates (Fehling's test, Iodine test, Anthrone test). 7. Qualitative tests for proteins (Ninhydrin test, Biuret test, Millon's test). 8. Qualitative tests for lipids (Solubility test, Sudan III test, Oil Red O test). 9. Detection of Vitamin C from various suitable fruits. 10. Effect of substrate concentration on Acid phosphatase enzyme activity. 11. Study of Osazone formation using suitable reducing sugar.	

16	Scheme of Examination and Assessment Pattern (Paper – 50 Marks)		
	Duration 5 hrs		Marks-50
	S. No.	Experiment	Marks
	Q.1.	Major Experiment Enumeration of Erythrocytes - Total Count. OR Enumeration of Leucocytes - Total Count. OR Differential count of Leucocytes.	15
	Q.2.	Minor experiment Estimation of total serum/ plasma proteins by Folin's method. OR Estimation of serum/ plasma total triglycerides by Phosphovanillin method OR Estimation of haemoglobin by Sahli's acid haematin method.	10
	Q.3.	Minor experiment Determination of bleeding and clotting time. OR Determination of blood groups OR Screening of anemic and non-anemic by CuSO ₄ method OR Immunodiffusion by Ouchterlony method	06
	Q.4.	Identification a. Organ of Immune system (e.g. Spleen, thymus) b. Organ of Immune system (e.g. Bone marrow/lymph node) c. Blood disorders (Sickle cell anemia, ITP (Immune thrombocytopenic purpura), Thalassemia)	09
	Q.5	Viva voce	05
	Q.6.	Journal	05

**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)**

Semester- V

**Title: Cancer biology, Histopathology, Toxicology, Biostatistics
Paper III**

**With effect from the
Academic Year 2025-2026**

Title: Cancer biology, Histopathology, Toxicology, Biostatistics

Course Code: CHM(A)USZO503

Sr. No.	Heading	Particulars
1	Description of the Course	Course covers Mammalian Histology, Basic Toxicology, General Pathology, and Biostatistics. Students are expected to appreciate the central role histology plays in diagnostics. The microtomy skills developed in the laboratory will enable students to work proficiently in histological analysis. Emphasis is placed on the pharmaceutical aspects of toxicology, with an introduction to regulatory toxicology to provide insight into practical challenges and standards in toxicity testing. Teachers should highlight the importance of both histology and toxicology in pathological studies, using ICT tools to enhance learning. The use of biostatistics for interpreting and validating experimental data is stressed, with students being introduced to relevant biostatistical software
2	Vertical	-----
3	Type Teaching methods	Theory Lecture/ Seminar/ Group discussion/ Presentation/ simulations/ field visits/ AV mode etc.
4	Credit	2.5 Credits
5	Hours allotted	48 Hours
6	Marks allotted	100 Marks
7	Course Objectives: 1. To provide an understanding of the cellular and genetic basis of cancer, mechanisms of metastasis, and therapeutic approaches to cancer treatment. 2. To develop foundational knowledge in histology and pathology, including tissue structure, cellular injury mechanisms, and types of degeneration and necrosis. 3. To introduce the principles and scope of toxicology, emphasizing the sources, types, effects, and organ-specific toxicity of common toxins. 4. To equip students with the tools of biostatistics for data collection, analysis, interpretation, and application in biological and medical research.	
8	Learning Outcomes: Upon completion of the course student will be able to LO 1 Explain the molecular mechanisms of cancer development, including the role of oncogenes, tumor suppressor genes, and diagnostic markers. LO 2 Identify and describe normal and pathological tissue structures through histological knowledge and understand mechanisms of cellular damage. LO 3 Evaluate toxicological effects on different organ systems, interpret dose-response relationships, and classify various toxins. LO 4 Demonstrate proficiency in statistical tools, including data presentation, measures of central tendency, hypothesis testing, and correlation analysis relevant to biological research.	

UNIT I: Cancer Biology

- Introduction to cancer, Characteristics/properties of cancerous cells:
- Cell cycle checkpoints and cancer.
- Concept of protooncogenes and oncogenes: Activation of protooncogenes to oncogenes (Point mutation, Gene amplification, Chromosomal translocation, local DNA arrangement, Insertional mutagenesis by viruses).
- Genes involved in tumorigenesis (Tumor suppressor genes: Caretaker and gatekeeper genes, role of cdk). Retinoblastoma (Two hit hypothesis and Loss of heterozygosity).
- Metastasis: Introduction, Interaction of invading cancer with ECM (Extracellular Matrix).
- Oncogenic markers: Clinical uses of tumor markers, types of tumor markers, commonly used tumor markers: HCG, Alpha Fetoprotein (AFP). Diagnosis using flow cytometry (leukemia, lymphoma).
- Therapeutics interventions: Traditional Treatments (Chemotherapy and Radiotherapy), Newer therapies (chemoimmunotherapy and radioimmunotherapy).

UNIT II: Histology and general pathology

- Introduction to Histology: principle and procedure
- Vertical section (V.S.) of mammalian skin: Layers and cells of epidermis and dermis; sweat glands, sebaceous glands, and skin receptors.
- Transverse section (T.S.) of mammalian stomach, small intestine, large intestine, Liver, and pancreas.
- General Pathology: Introduction and scope
- Cell injury: Mechanisms of cell injury: ischemic, hypoxic, free radical mediated and chemical.
- Retrogressive changes: Definition, cloudy swelling, degeneration: fatty, mucoid, and amyloid (causes and effects)
- Necrosis: Definition and causes; nuclear and cytoplasmic changes; types: coagulative, liquefactive, caseous, fat and fibroid.

UNIT III: Toxicology

- Introduction to toxicology, definition, scope, relationship to other sciences, history of toxicology.
- Sources of toxic compounds; food additives, Drugs of abuse, therapeutic drugs, Naturally occurring toxins: mycotoxins, microbial toxins, plant toxins (caffeine & nicotine), animal toxins (honey bee sting, venom of snake).
- Dose response relationship: Measurement of dose response relationship, dose response curves, LC_{50} and LD_{50} , acute and chronic toxicity; margin and safety & therapeutic index; threshold dose and no observed effect level (NOEL); TDH, TDL.
- Target organ toxicity – hepatotoxicity; nephrotoxicity, neurotoxicity.

UNIT IV: Biostatistics

- Scope of biostatistics – Definition and advantages.
- Sampling techniques: Simple random sampling- lottery method, with and without replacement, use of table of random numbers; stratified random sampling.
- Classification of data- Primary, secondary, qualitative (concept of attributes), quantitative

	(concept of variate- discrete and continuous). • Presentation of data: tabulation-simple tables (one way and two way), complex tables, frequency distribution tables, diagrammatic presentation-frequency polygon, frequency curves, bar diagram, (simple, multiple, segmented), pie diagrams. • Measure of central tendency and dispersion: Mode, median, mean, variance, standard deviation. • Testing of hypothesis • Normal distribution: Properties of normal distribution, Z- transformation, p-value. • Parametric test of significance- Two tailed Z test and t-test, chi-square test and its applications. • Correlation: Correlation coefficient and testing significance of correlation coefficient																																			
10	Scheme of Examination and Assessment Pattern (Paper – 100 Marks) A. External Examination: Semester End External - 75 marks Time: 2.5 hour Format of Question Paper Attempt all questions. <table><tr><th>Question. No.</th><th>Evaluation type</th><th>Marks</th></tr><tr><td>Q.1.</td><td>Multiple Choice 20 Questions (Attempt any 15 (1 mark each)</td><td>15</td></tr><tr><td>Q.2.</td><td>2.a. Total 2 questions of 8 marks from unit 1 (attempt any one) 2.b. Total 2 questions of 7 marks from unit 1 (attempt any one)</td><td>15</td></tr><tr><td>Q.3.</td><td>3.a. Total 2 questions of 8 marks from unit 2 (attempt any one) 3.b. Total 2 questions of 7 marks from unit 2 (attempt any one)</td><td>15</td></tr><tr><td>Q.4.</td><td>4.a. Total 2 questions of 8 marks from unit 3 (attempt any one) 4.b. Total 2 questions of 7 marks from unit 3 (attempt any one)</td><td>15</td></tr><tr><td>Q.5.</td><td>5. a. Total 2 questions of 8 marks from unit 4 (attempt any one) 5.b. Total 2 questions of 7 marks from unit 4 (attempt any one)</td><td>15</td></tr></table> Note: Equal Weightage is to be given to all the Units. B. Internal Examination: Continuous Evaluation - 25 marks <table><tr><td>1.</td><td>Class test to be conducted as per the following pattern</td><td>20 Marks</td></tr><tr><td></td><td>a. Match the column/Fill in the blanks/Multiple Choice (1 mark each)</td><td></td></tr><tr><td></td><td>b. Answer in 1 or 2 lines (2 marks each)</td><td></td></tr><tr><td></td><td>c. Answer in brief (5 marks each)</td><td></td></tr><tr><td>2.</td><td>Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.</td><td>05 Marks</td></tr></table>			Question. No.	Evaluation type	Marks	Q.1.	Multiple Choice 20 Questions (Attempt any 15 (1 mark each)	15	Q.2.	2.a. Total 2 questions of 8 marks from unit 1 (attempt any one) 2.b. Total 2 questions of 7 marks from unit 1 (attempt any one)	15	Q.3.	3.a. Total 2 questions of 8 marks from unit 2 (attempt any one) 3.b. Total 2 questions of 7 marks from unit 2 (attempt any one)	15	Q.4.	4.a. Total 2 questions of 8 marks from unit 3 (attempt any one) 4.b. Total 2 questions of 7 marks from unit 3 (attempt any one)	15	Q.5.	5. a. Total 2 questions of 8 marks from unit 4 (attempt any one) 5.b. Total 2 questions of 7 marks from unit 4 (attempt any one)	15	1.	Class test to be conducted as per the following pattern	20 Marks		a. Match the column/Fill in the blanks/Multiple Choice (1 mark each)			b. Answer in 1 or 2 lines (2 marks each)			c. Answer in brief (5 marks each)		2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05 Marks
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11	REFERENCES 1. Textbook of Histology; Deshmukh Shivaji; Dominant Pub. 2. Colour Textbook of Histology; Gartner, Leslie P.; Saunders. 3. A Textbook of Histology; Mathur Ramesh; Anmol Pub. 4. A Textbook of Histology; Khanna D.R.; Sonali Pub. 5. Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd., Kolkata; 1999. 6. Textbook of medical biochemistry; M.N. Chatterjee, Rana Shinde																																			

7. Practical clinical biochemistry: Methods and interpretations: Ranjna Chawla
8. Casarett and Doulls Toxicology - The basic science of poisons; Edited by Curtis Klaassen; McGraw-Hill; 2001.
9. Toxicological testing handbook - Principles, applications, and data interpretation; David Jacobson-Kram and Kit Keller; CRC Press; 2006.
10. Principles and methods of toxicology; A. Wallace Hayes; CRC Press; 2007.
11. Toxicology - principles and methods; M.A. Subramanian; MJP Publishers, Chennai; 2004.
12. Fundamentals of Toxicology; Kamleshwar Pandey and JP Shukla; New Central book agency Ltd., Kolkata; 2011.
13. Elements of Toxicology; Kamleshwar Pandey and JP Shukla; Wisdom Press, New Delhi; 2010.
14. Principles and Applications of Toxicology; Lahir Y.K.; Seekay Publications; 2013.

**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)**

Semester- V

**Title: Practical based on cancer biology, histopathology,
toxicology, biostatistics
Practical III**

**With effect from the
Academic Year 2025-2026**

Title: Practical based on Cancer biology, Histopathology, Toxicology, Biostatistics
Course Code: CHM(A)USZOP05 (3)

1	Description of the Course	This practical focuses on developing technical skills and understanding key concepts in cancer biology, histopathology, toxicology, and biostatistics. Students will perform histopathological staining and microscopic examination of tumor tissues to identify abnormalities in cellular architecture. They will carry out toxicology assays to assess the effects of various compounds on cell viability and growth, thereby evaluating their potential as therapeutic agents. Additionally, biostatistical methods will be used to analyze data, interpret results, and draw meaningful conclusions. These practical aims to enable students to connect theory with practice, fostering a comprehensive understanding of disease mechanisms, diagnostic techniques, and the statistical tools essential for scientific research.
2	Vertical	---
3	Type	Practicum
4	Credit	1.5
5	Hours allotted	45 Hours
6	Marks allotted	50 Marks
7	Course Objective: 1. To provide hands-on training in histological and biochemical techniques for the study and diagnosis of mammalian tissues, diseases, and toxicological impacts. 2. To develop analytical and statistical skills in interpreting biological data using biostatistical tools and toxicity assays, along with real-world exposure through institutional visits.	
8	Learning Outcome: Upon completion of the course student will be able to LO 1 Students will be able to identify and analyze histological sections and pathological conditions (e.g., necrosis, psoriasis, vitiligo), and measure biomarkers like lactate and liver enzymes. LO 2 Students will gain the ability to apply statistical tools such as Z-test, t-test, chi-square, and data visualization techniques, and interpret the impact of toxicants using LC50 and probit analysis on model organisms like <i>Daphnia</i> .	

9	List of Practical 1. Study of mammalian tissues: V.S. of Tooth, T.S. of Stomach, T.S. of small intestine, T.S. of Liver, T.S. of pancreas 2. Estimation of lactate concentration in biological samples using a colorimetric method based on lactate oxidase and peroxidase reactions. 3. Identification of diseases or conditions (from slides or pictures): Vitiligo, Psoriasis, Necrosis. 4. From the given data, make frequency distribution table/frequency polygon/histogram/bar diagram/pie diagram 5. From the given data, derive mean and standard deviation 6. Problems based on Z-test 7. Problems based on t-test 8. Problems based on Chi-square test 9. Determination of LC₅₀ for a suitable pollutant (any one salt of a heavy metal dissolved in water) on <i>Daphnia</i>, Probit analysis. 10. Effect of heavy metal/salt on the heart rate of <i>Daphnia</i> 11. Effect of CCl₄ on the level of enzyme activity in liver or serum acid and aspartate and alanine amino transferase. 12. Visit to cancer research institute/hospital/ pathology lab and prepare report on it. 13. Study of Tumorigenesis and metastasis using Teaching aids																								
10	Scheme of Examination and Assessment Pattern (Paper – 50 Marks) Duration: 5hrs Marks-50 <table><tr><th>Sr. No.</th><th>Experiment</th><th>Marks</th></tr><tr><td>Q.1.</td><td>Major Experiment Effect of CCl₄ on the level of enzyme activity in liver aspartate amino transferase/alanine amino transferase OR Estimation of lactate concentration in biological samples using a colorimetric method based on lactate oxidase and peroxidase reactions.</td><td>12</td></tr><tr><td>Q.2.</td><td>Minor experiments Determination of LC₅₀ for a suitable pollutant (any one salt of a heavy metal dissolved in water) on <i>Daphnia</i>, Probit analysis. OR Effect of heavy metal/salt on the heart rate of <i>Daphnia</i></td><td>08</td></tr><tr><td>Q.3.</td><td>Identifications (3×3=9) a. Mammalian Tissue (e.g. V.S. of Tooth/ T.S. of Stomach/ T.S. of small intestine/ T.S. of Liver/ T.S. of pancreas) b. Mammalian Tissue (e.g. V.S. of Tooth/ T.S. of Stomach/ T.S. of small intestine/ T.S. of Liver/ T.S. of pancreas) c. Clinical Disorder (e.g. Vitiligo, Necrosis, Psoriasis)</td><td>09</td></tr><tr><td>Q.4.</td><td>Problems based on Biostatistics (any one problem)</td><td>06</td></tr><tr><td>Q.5.</td><td>Submission of report of field visit to pathology lab/cancer hospital/cancer research institute</td><td>05</td></tr><tr><td>Q.6.</td><td>Viva Voce</td><td>05</td></tr><tr><td>Q.7.</td><td>Certified Journal</td><td>05</td></tr></table>	Sr. No.	Experiment	Marks	Q.1.	Major Experiment Effect of CCl ₄ on the level of enzyme activity in liver aspartate amino transferase/alanine amino transferase OR Estimation of lactate concentration in biological samples using a colorimetric method based on lactate oxidase and peroxidase reactions.	12	Q.2.	Minor experiments Determination of LC ₅₀ for a suitable pollutant (any one salt of a heavy metal dissolved in water) on <i>Daphnia</i> , Probit analysis. OR Effect of heavy metal/salt on the heart rate of <i>Daphnia</i>	08	Q.3.	Identifications (3×3=9) a. Mammalian Tissue (e.g. V.S. of Tooth/ T.S. of Stomach/ T.S. of small intestine/ T.S. of Liver/ T.S. of pancreas) b. Mammalian Tissue (e.g. V.S. of Tooth/ T.S. of Stomach/ T.S. of small intestine/ T.S. of Liver/ T.S. of pancreas) c. Clinical Disorder (e.g. Vitiligo, Necrosis, Psoriasis)	09	Q.4.	Problems based on Biostatistics (any one problem)	06	Q.5.	Submission of report of field visit to pathology lab/cancer hospital/cancer research institute	05	Q.6.	Viva Voce	05	Q.7.	Certified Journal	05
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**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)
Semester- V**

**Title: Human Physiology and Endocrinology
Paper IV**

**With effect from the
Academic Year 2025-2026**

Title: Human Physiology and Endocrinology

Course Code: CHM(A)USZO504

S. No.	Heading	Particulars
1	Description of the Course	This course emphasizes the significance of various epidermal and dermal derivatives, the human skeleton, including its structure, types, and functions, and different types of long limb muscles, their arrangement, and their roles in body movement. It also covers the developmental processes involved in chick embryo formation
2	Vertical	-----
3	Type Teaching method	Theory Lecture/ Seminar/ Group discussion/ Presentation/ simulations/ field visits/ AV mode etc.
4	Credit	2.5 Credits
5	Hours allotted	48 Hours
6	Marks allotted	100 Marks
7	Course Objectives: 1. To impart foundational knowledge of endocrine glands, hormones, their receptors, and regulatory mechanisms including signal transduction and feedback loops. 2. To study the histological structure and physiological functions of human tissues, skin, bones, muscles, and the nervous system. 3. To understand the physiology and molecular mechanisms of neuroendocrine integration, particularly the hypothalamic-pituitary axis and its role in homeostasis. 4. To explore the clinical aspects of endocrine disorders, hormone therapies, and the impact of endocrine disruptors on human health.	
8	Learning outcomes: Upon completion of the course learner will be able to LO 1 Explain the structure, functions, and hormonal outputs of major endocrine glands, and interpret hormonal mechanisms and feedback systems. LO 2 Identify and describe the structural organization and function of human skin, tissues, bones, and muscle types with physiological relevance. LO 3 Understand the neurophysiological processes such as synaptic transmission, action potential, neuromuscular junctions, and reflexes. LO 4 Correlate neuroendocrine signalling (e.g., HPA axis, GnRH pulsatility) with physiological functions such as stress, reproduction, energy homeostasis, and biological rhythms.	
9	Syllabus UNIT I: Endocrinology • Overview of endocrine glands and their structural features, Classification of hormones effects, and regulation- basic concepts and methods • Receptors and Types- Membrane receptors, nuclear receptors, receptor regulation and signal transduction, second messengers, hormone action and termination • Endocrinology of Pituitary, Adrenal, Pancreas, Thyroid, Parathyroid, and human gonads Hormones and functions • Endocrine disorders, Endocrine Disruptors, Human Exposure, Hormone therapies, Clinical Implications. UNIT II: Human Physiology: Skin and Tissues • Basic structure of integument: Epidermis and dermis, Skin derivatives: Hair, Feathers, Nails, and Glands, functions of skin, diseases of skin, diet, and lifestyle for healthy skin • Structure, location, classification, and functions of epithelial tissue, connective tissue,	

	muscular tissue, and nervous tissue UNIT III: Human Physiology: Bones and Muscles • Structure and types of bones and cartilages, types of bone ossification, bone growth, and resorption • Histology of different types of muscle; Ultrastructure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation, and tetanus UNIT IV: Human Physiology: Neuroendocrinology • Structure of neuron, resting membrane potential, Origin of action potential, and its propagation across the myelinated and unmyelinated nerve fibers • Types of synapses, Synaptic transmission, and Neuromuscular junction; Reflex action and its types - reflex arc • Foundations of Neuroendocrinology: Hypothalamic-pituitary axis: Regulation of anterior/posterior pituitary hormones (e.g., ACTH, oxytocin). • Hormone classification: Mechanisms of peptide, steroid, and thyroid hormone action; second messenger systems • Signal transduction: Membrane vs. nuclear receptors; receptor regulation and termination pathways • Key Regulatory Systems: Stress response: HPA axis dynamics; glucocorticoid effects on metabolism and immunity. • Energy homeostasis: Neuroendocrine control of appetite, leptin/ghrelin signaling, and glucose metabolism. • Reproductive endocrinology: Gonadotropin-releasing hormone (GnRH) pulsatility; sex steroid feedback loops. • Biological rhythms: Suprachiasmatic nucleus in circadian regulation																														
10	Scheme of Examination and Assessment Pattern (Paper – 100 Marks) A. External Examination: Semester End External - 75 marks Time: 2.5 hour Format of Question Paper Attempt all questions. <table><tr><th>Question No.</th><th>Evaluation type</th><th>Marks</th></tr><tr><td>Q.1.</td><td>Multiple Choice 20 Questions (Attempt any 15 (1 mark each))</td><td>15</td></tr><tr><td>Q.2.</td><td>2.a. Total 2 questions of 8 marks from unit 1 (attempt any one) 2.b. Total 2 questions of 7 marks from unit 1 (attempt any one)</td><td>15</td></tr><tr><td>Q.3.</td><td>3.a. Total 2 questions of 8 marks from unit 2 (attempt any one) 3.b. Total 2 questions of 7 marks from unit 2 (attempt any one)</td><td>15</td></tr><tr><td>Q.4.</td><td>4.a. Total 2 questions of 8 marks from unit 3 (attempt any one) 4.b. Total 2 questions of 7 marks from unit 3 (attempt any one)</td><td>15</td></tr><tr><td>Q.5.</td><td>5. a. Total 2 questions of 8 marks from unit 4 (attempt any one) 5.b. Total 2 questions of 7 marks from unit 4 (attempt any one)</td><td>15</td></tr></table> Note: Equal Weightage is to be given to all the Units. B. Internal Examination: Continuous Evaluation - 25 marks <table><tr><td>1.</td><td>Class test to be conducted as per the following pattern</td><td>20 Marks</td></tr><tr><td></td><td>a. Match the column/Fill in the blanks/Multiple Choice (1 mark each)</td><td></td></tr><tr><td></td><td>b. Answer in 1 or 2 lines (2 marks each)</td><td></td></tr><tr><td></td><td>c. Answer in brief (5 marks each)</td><td></td></tr></table>	Question No.	Evaluation type	Marks	Q.1.	Multiple Choice 20 Questions (Attempt any 15 (1 mark each))	15	Q.2.	2.a. Total 2 questions of 8 marks from unit 1 (attempt any one) 2.b. Total 2 questions of 7 marks from unit 1 (attempt any one)	15	Q.3.	3.a. Total 2 questions of 8 marks from unit 2 (attempt any one) 3.b. Total 2 questions of 7 marks from unit 2 (attempt any one)	15	Q.4.	4.a. Total 2 questions of 8 marks from unit 3 (attempt any one) 4.b. Total 2 questions of 7 marks from unit 3 (attempt any one)	15	Q.5.	5. a. Total 2 questions of 8 marks from unit 4 (attempt any one) 5.b. Total 2 questions of 7 marks from unit 4 (attempt any one)	15	1.	Class test to be conducted as per the following pattern	20 Marks		a. Match the column/Fill in the blanks/Multiple Choice (1 mark each)			b. Answer in 1 or 2 lines (2 marks each)			c. Answer in brief (5 marks each)	
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	c. Answer in brief (5 marks each)																														

	2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05 Marks
11	REFERENCES 1. Integumentary system and its derivatives; Samuel D. Hodge 2. Atlas of Human Anatomy – Vol I; R.D. Sinelnikov; Mr. Publishers Moscow 3. A Guide to Osteology (for medical students); Prakash Kendra, Lucknow 4. Textbook of Comparative Anatomy and Physiology; Tortora 5. Human Osteology – Tim D White 6. Textbook of Human Osteology – Singh Inderbir 7. Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi; 1978 8. Human Anatomy – John W. Hole, Jr., Karen A. Koos, Publisher: W. C. Brown Publisher, USA. 9. Principles of Anatomy and Physiology – Gerard T. Tortora and Sandra Reynolds Grabowski. Publisher: Harper Collins College Publishers (7th Edition). 10. Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd., Kolkata; 1999. 11. Gardner, D. G., & Shoback, D. (2018). Greenspan's basic & clinical endocrinology (10th ed.). McGraw-Hill Education. 12. Melmed, S., Polonsky, K. S., Larsen, P. R., & Kronenberg, H. M. (2016). William's textbook of endocrinology (13th ed.). Elsevier. 13. Bhansali, A., & Gogate, Y. (Eds.). (2019). Clinical rounds in endocrinology (Vol. 1). Jaypee Brothers Medical Publishers. 14. Larsen, P. R., Kronenberg, H. M., Melmed, S., & Polonsky, K. S. (2015). The endocrine system (7th ed.). Elsevier. 15. Meikle, A. W. (2017). Endocrine replacement therapy in clinical practice. Springer.		

**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)**

Semester- V

**Title: Practical based on human physiology and endocrinology
Practical IV**

**With effect from the
Academic Year 2025-2026**

Title: Practical based on Human Physiology and Endocrinology
Course Code: CHM(A)USZOP05 (4)

1	Description of the Course	This practical course is designed to provide hands-on experience and technical skills in endocrinology and physiology. Students will learn to prepare and mount nervous and endocrine tissue for microscopic examination, identify abnormalities, and appreciate the cellular mechanisms underlying disease progression. They will perform physiological assays to gauge the effects of various compounds on muscle, linking their findings to therapeutic applications. Overall, it aims to hands on training on practical of endocrinology, physiology and neurosciences.
2	Vertical	-----
3	Type	Practical
4	Credit	1.5
5	Hours allotted	45 Hours
6	Marks allotted	50 Marks
7	Course objectives: 1. To provide hands-on experience in identifying the structure and function of various endocrine glands, tissues, muscles, bones, and neurons using microscopy and staining techniques. 2. To investigate the physiological roles of hormones, muscle activity, and tissue responses under different conditions and understand the impact of lifestyle on human health.	
8	Learning outcomes: Upon completion of the course learner will be able to LO 1 Identify, differentiate, and explain the microscopic features of endocrine glands, tissues, muscles, and nerves, and correlate them with their physiological functions. LO 2 Demonstrate practical understanding of hormone function, muscle fatigue, and health-related physiological responses, including the influence of exercise and lifestyle on well-being.	
9	List of Practical 1. Estimation of Blood Glucose Levels to Study Pancreatic Hormone Function 2. Microscopic Examination of Endocrine Glands and Hormone-Secreting Cells 3. Demonstration of Hormone-Receptor Interaction and Signal Transduction Pathways 4. Observe and identify the histological structure of the pituitary, thyroid, adrenal, pancreas, and gonads using prepared slides. 5. Mounting and Staining of Shark Nerve to visualize Myelinated Axons under Microscope. 6. Study the types of bones and cartilages in the axial and appendicular skeleton 7. Study the major muscles in human forelimbs and hind limbs. 8. To study the VS of human skin and identify various epidermal and dermal layers in it. 9. To learn about various diseases of the skin and its derivatives (hair, nails) 10. Observing the Microscopic Structure of Different Muscle Types 11. Investigating the Effect of Exercise on Muscle Fatigue 12. Temporary mounting of different types of tissues (Epithelial, Connective, Muscular) and observing under the microscope. 13. To learn about different parts of the human brain and their functions. 14. Temporary mounting of neurons using chicken brain and understanding various parts of it. 15. Understand the role of lifestyle on overall health benefits regarding muscle, bone, and mental health.	

16	Scheme of Examination and Assessment Pattern (Paper – 50 Marks)		
	Duration: 5 Hrs		Marks-50
	S.No.	Experiment	Marks
	Q.1.	Identify spots to 'e' as per instructions (5 identifications x 3)	15
	Q.2.	Major Experiment	10
	Q.3.	Minor Experiment	08
	Q.4.	Minor Experiment	07
	Q.5	Viva-voce	05
	Q.6.	Certified Journal	05
		Total	50

**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)**

Semester- V

**Title: Environmental Science (Applied Component)
Paper V**

**With effect from the
Academic Year 2025-2026**

Title of the Course: Environmental Science (Applied Component)
Course code: CHM(A)USACEVS501

Sr. No.	Heading	Particulars
1	Description of the Course:	This course offers a comprehensive understanding of environmental science, its challenges, and solutions. It covers key aspects of pollution, climate change, renewable energy, and analytical methods used in environmental monitoring. Students will learn about sources and impacts of air, water, soil, and noise pollution, alongside climate change vulnerability, policy responses, and alternative energy technologies. The syllabus emphasizes practical applications, including sampling, data interpretation, and laboratory techniques for analyzing environmental samples. This multidisciplinary approach prepares students to contribute to sustainable environmental management and policy formulation in a rapidly changing world.
2	Vertical	-----
3	Type Teaching method	Theory Lecture/ Seminar/ Group discussion/ Presentation/ simulations/ field visits/ AV mode etc.
4	Credit:	2 Credits
5	Hours Allotted:	48 Hours
6	Marks Allotted:	100 Marks
7	Course Objectives:	1. To provide a comprehensive understanding of environmental components, processes, and their interdependences. 2. To enable students to identify and analyze sources of environmental pollution and climate change and appreciate their impacts on human health and natural resources. 3. To familiarize students with alternative energy resources and green technologies as sustainable solutions for growing energy demands. 4. To equip students with analytical methods and techniques for assessing environmental parameters and interpreting data to aid in decision-making.
8	Learning Outcomes:	Upon completion of the course, student will be able to LO 1 Explain the fundamentals of environmental science, climate change, and their impacts on human settlements and agriculture. LO 2 Identify major sources of air, water, soil, and noise pollution and propose appropriate control and mitigation measures. LO 3 Apply knowledge of alternative energy, waste management, and green technologies to solve real-world environmental problems. LO 4 Perform analytical procedures to measure, separate, and interpret environmental parameters, demonstrating competency in technical skills and data presentation.

Syllabus

Unit I: Introduction to Environment and Pollution

- Definition, scope, and principles of environmental science.
- Components of environment: biotic and abiotic; Atmosphere, hydrosphere, lithosphere, biosphere.
- Interdependence of ecosystems and impacts of human activities.
- Environmental degradation and its implications.
- Air Pollution: Sources (e.g., industrial emissions, vehicular exhaust), effects (e.g., health impacts, acid rain).
- Water Pollution: Sources (e.g., agricultural runoff, industrial waste), effects (e.g., eutrophication, contamination).
- Soil Pollution: Types of soil pollutants: Heavy metals, pesticides, industrial waste
- Noise Pollution: Causes (e.g., urbanization), effects on health and environment.
- Solid Waste Management: Types (municipal, biomedical, e-waste), disposal methods.

Unit II: Climate Change

- Fundamentals of Climate Change: Introduction to climate change, global warming, and its effects,
- Greenhouse substances: Sources & effects.
- Geospatial technology-Remote Sensing & GIS.
- Role of IPCC in climate change monitoring: Kyoto Protocol, Montreal Protocol, Earth Summit & UN Convention on Climate Change.
- Impacts of Climate Change: Effects on natural systems: Biodiversity loss, ecosystem shifts, ocean acidification
- Impacts on human systems: Agriculture, health, urban infrastructure
- Vulnerability assessments: Equity, ethics, and responsibility in climate impacts.
- Impacts on human settlements: floods, droughts, cyclones, and hurricanes

Unit III: Alternate Energy Resources

- Types, sources, and advantages of alternative sources like Solar energy, Wind energy, Tidal energy, and nuclear energy
- Principles of energy conversion in renewable systems.
- Design and efficiency of solar panels, wind turbines, and tidal energy systems.
- Case studies on large-scale renewable energy projects (e.g., offshore wind farms, solar parks).
- Types of Petro crops, Cultivation of Petro crops, Major Petro crops
- Biodiesel: Process of synthesis and advantages
- Energy from Biomass: mechanism and significance
- Energy from solid waste: Mechanism and significance.

Unit IV: Applications of Analytical methods

- Sampling methods: Principles and applications
- Analysis: Classical Methods (Volumetric and Gravimetric); Modern Methods (Colorimetry, Spectrophotometry, Spectroscopy, Nephelometry, Turbidometry, Atomic Absorption Spectroscopy, Fluorescence Spectrometry, X-Ray Absorption Spectroscopy, X-Ray Diffraction.
- Separation Methods: Extraction Techniques (Distillation, Solvent Extraction and Column Chromatography), Chromatography (Gas Chromatography (GSC, GLC) HPLC and Electrophoresis.

Interpretation and presentation- Introduction to the application of statistical tools and software.

10	Scheme of Examination and Assessment Pattern		
	A. Internal Assessment – (25 marks)		
	1.	Class test to be conducted as per the following pattern	20 Marks
		d. Match the column/Fill in the blanks/Multiple Choice 20 Questions (1 mark each)	
		e. Answer in 1 or 2 lines (Concept-based 10 questions) (2 marks each)	
		f. Answer in brief (Attempt any 4 out of the 6) (5 marks each)	
	2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05 Marks
	B. External Examination ((Semester end theory assessment - (75 marks)		
	S. No.	Evaluation type	Marks
	Q.1.	Multiple Choice 20 Questions (Attempt any 15 (1 mark each)	15
	Q.2.	2.a. Total 2 questions of 8 marks from unit 1 (attempt any one) 2.b. Total 2 questions of 7 marks from unit 1 (attempt any one)	15
	Q.3.	3.a. Total 2 questions of 8 marks from unit 2 (attempt any one) 3.b. Total 2 questions of 7 marks from unit 2 (attempt any one)	15
	Q.4.	4.a. Total 2 questions of 8 marks from unit 3 (attempt any one) 4.b. Total 2 questions of 7 marks from unit 3 (attempt any one)	15
	Q.5.	5. a. Total 2 questions of 8 marks from unit 4 (attempt any one) 5.b. Total 2 questions of 7 marks from unit 4 (attempt any one)	15
	Duration - The examination shall be of two and a half hours' duration		

REFERENCE

1. A Text Book in Environmental Science, V. Subramanian, Narosa Publishing House. 2002.
2. An Advanced Textbook on Biodiversity, K.V. Krishnamurthy, Oxford & IBH Publishing Co. Pvt. Ltd. 2009.
3. Atmosphere, Weather & Climate, R.G. Barry & R.I. Charley, ELBS 1982.
4. Bioresource Ecology, T. N. Anatha Krishnan, Oxford & IBM Publishing Company, New Delhi 1982.
5. Ecological Methods of Field & Laboratory Investigations, P. Michael, Tata Mc Graw Hill.
6. Ecology & Quality of our Environment, Charles H. Southwind, D. Van Nostrand Co. N.Y. 1976.
7. Ecotourism, Eco restoration & Development, Solomon Raju, New Central book agency, 2007.
8. Environmental, Chemical & Biological Analysis, H.V. Jadhav & S.N. Jogdand, Himalaya Publishing House.
9. Environmental Impact Assessment Methodologies, Anjaneyulu Y., B.S Publication, Hyderabad. 2002.
10. Environmental Management. Environmental Engineering Series; Vijay Kulkarni & T. V. Ramchandra, Publ. Commonwealth of Learning, Indian Institute of Science (IISC), Bangalore. 2011.
11. Environmental Pollution & Health Hazards in India, R. Kumar, Abhish Publ. House, New Delhi 1987.
12. Environmental Pollution & Management, Pramod Singh, Chugh Publ. Allahabad 1985.
13. Environmental Science Ahluwalia V.K. & Malhotra Sunita: Ane Books India 2006.
14. Environmental Science, J. Turk, A. Turk & K. Arms, Saunders College Publishing 1983.
15. Environmental Science, S.C. Santra, New Central Book Agency (P) Ltd. 2001.

**Smt. Chandibai Himathmal Mansukhani College
(Autonomous)**

**Third Year B. Sc.
(Zoology)**

Semester- V

**Title: Practical based on Environmental Science
(Applied Component)
Practical - V**

**With effect from the
Academic Year 2025-2026**

Title: Practical Based on Environmental Science (Applied Component)
Course code: CHM(A)USACEVP05

S. No.	Heading	Particulars
1	Description of the Course:	This course offers a comprehensive, hands-on exploration of environmental science, focusing on soil, air, water, microbial activity, and legislation. Students will learn to measure physical and chemical soil properties, identify heavy metal pollutants, and apply methods to analyze population density and indicator species in nature. Techniques for bioremediation, biodegradable plastics, and microbial isolation will foster a deep understanding of sustainable practices. Field visits, data collection, and a project report will enable students to connect theory with real-world scenarios, strengthening their ability to contribute to environmental protection and restoration in their future endeavors.
2	Vertical	-----
3	Type:	Practicum
4	Credit:	2 Credits
5	Hours Allotted:	60 Hours
6	Marks Allotted:	100 Marks
7	Course Objectives:	1. To enable students to develop practical skills in assessing soil, air, and water quality and to identify microbial and plant contributors to bioremediation. 2. To familiarize students with environmental legislation, organizations, and strategies for conserving biodiversity and managing environmental degradation through field studies and laboratory practices.
8	Learning Outcomes: Upon completion of the course, student will be able to	LO 1 Perform analytical and field techniques to monitor environmental parameters, identify heavy metal contamination, microbial activity, and indicator species, thereby strengthening their technical competency. LO 2 Apply their understanding to design and execute a project related to environmental degradation or restoration, demonstrating a holistic approach toward conserving natural resources.
9	List of Experiment	1. Study of physical properties of soil: Temperature, moisture, & texture of soil. 2. Study of chemical properties of soil: pH, Organic matter, and Calcium carbonate. 3. Detection of heavy metal cations: Zinc, Cadmium, Lead from soil sample. 4. Population study analysis by Quadrant method & Line transect method. 5. Observation & study of indicator species. 6. Study of air & noise pollution monitoring device, geospatial instrument. 7. Study of any four biodiversity hotspots, bio reserves of India. 8. Study the role of environmental organisations and agencies (CITES, EPA, IUCN & MAB) 9. Study of environmental laws of India (any 5) 10. Study of microbes & plants used in bioremediation. 11. Study of biodegradable plastic products, bio pesticides brands. 12. Isolate and identify soil microbes (bacteria/fungi) using serial dilution and culture

	techniques. 13. Analyze decomposition rates of bioplastic vs. conventional plastic under controlled conditions. 14. Visit to any industry/laboratory/plant/national park and submission of report. 15. Prepare a Project on any environmental degradation or restoration topic, present it and submit a report.		
10.	Scheme of Practical Examination and Assessment Pattern		
	Skeleton paper of Applied Component		
	Duration: 4 hrs		Maximum Marks: 100
	S.No.	Experiment	Marks
	Q.1.	Identify spots 'a' to 'e' as per instructions (5 identifications x 4)	20
	Q.2.	Major Experiment	15
	Q.3.	Minor Experiment (a)	08
	Q.4.	Minor Experiment (b)	07
	Q.5.	Conduct a Survey on a relevant environmental restoration topic or issue (such as waste disposal, air quality, water pollution, or community awareness) and submit your findings in form of a project and present in a class discussion.	20
	Q.6.	Perform anyone of the following: Create a Model, Chart Paper, or Banner illustrating a case study related to an environmental issue. OR Visit a Location of Ecological Interest (such as a park, wetland, sanctuary, or reserve) and prepare a report describing its flora and fauna.	10
	Q.7.	Certified Journal	10
	Q.8.	Viva-voce	10
		Total	100

Department of Zoology:

S. No	Name of the Faculty	Designation and College	Signature
1.	Dr. Shashibhal Pandey	HOD & Associate Professor Smt. CHM College, Ulhasnagar	
2.	Dr. Sandeep Garg	Associate Professor Smt. CHM College, Ulhasnagar	
3.	Dr. Meena Poonja	Assistant Professor Smt. CHM College, Ulhasnagar	

Name & Signature of the Ad Hoc BoS Chairperson: Dr. Shashibhal Pandey



Name & Signature of the Dean: Dr. Neena Anand

