

Principal : Dr. Manju Lalwani Pathak

Ref. No: CHM (A) AC/02/2026-27  
Date: 27<sup>th</sup> June, 2026

**CIRCULAR**

The immediate attention of all concerned is invited to this Office Circular No. CHM (A) AC 11/2026 dated 19<sup>th</sup> June, 2026 regarding Choice Based and Credit Based Syllabus (CBCS), of Smt. CHM College (Autonomous), under the guidelines of University of Mumbai, as per Academic Framework of NEP 2020, for all subjects of T.Y.B.Sc in Zoology SEM-V and SEM-VI.

This is in continuation with curriculum approved by Academic Council for all the subjects of F.Y.B.Sc in Zoology (SEM-I), S.Y.B.Sc in Zoology (SEM-III) and F.Y.B.Sc in Zoology (SEM-II) & S.Y.B.Sc in Zoology (SEM – IV) vide Circular Reference Numbers CHM (A) AC/C/01/2025 dated 18th June, 2025, CHM (A) AC/C/01A/2025 dated 21st July 2025 and CHM (A) AC/C/02/2025 dated 20th November, 2025 respectively.

It is hereby communicated that the recommendations of the curriculum designed 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 20<sup>th</sup> June, 2026 have been approved.

In accordance, therewith, the syllabus as per the CBCS, has been brought into force with effect from the Academic Year 2026-27 for T.Y.B.Sc in Zoology, in continuation with syllabus of F.Y.B.Sc in Zoology and S.Y.B.Sc in Zoology of 2025-2026 (updated), and accordingly the same is attached for reference and is available on the College's website [www.chmcollege.in](http://www.chmcollege.in)

Ulhasnagar – 421003  
27<sup>th</sup> June 2026



**Dr. Manju Lalwani Pathak**  
Principal & Chairperson, Academic Council

Copy forwarded for information to:

1. The Office of Chairperson, Academic Council
2. The Dean, Faculty of Pure Sciences
3. The Chairperson, Ad-hoc Board of Studies
4. The Controller of Examination
5. The Registrar



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

**Bachelor of Science**  
**(Zoology)**  
**(Aided Course)**

**Choice Based and Credit Based Syllabus**  
**with effect from the**  
**Academic Year 2026-2027**

## Faculty of Pure Sciences

### Programme Outcomes

**Upon completion of Bachelor of Science , learner will be able to :**

- PO1: Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the chosen discipline, their concepts, theories, methods, and its interdisciplinary applications
- PO2: Critical Thinking and Analytical Reasoning:** Analyse issues critically, apply logical reasoning, and develop appropriate solutions
- PO3: Problem Solving and Scientific Skills:** Apply scientific methods to investigate and solve real life problems.
- PO4: Research Competence:** Formulate research questions, design and conduct investigations, collect and interpret data, apply appropriate statistical methods and communicate research findings effectively.
- PO5: Digital literacy:** Effectively use ICT, digital resources, computational tools, bioinformatics, artificial intelligence applications, and statistical software for scientific learning, research, and decision-making.
- PO6: Communication Skills:** Communicate effectively through written reports, oral presentations, scientific publications, visual media, and interpersonal interactions with diverse audiences.
- PO7: Environmental Sustainability and Community Engagement:** Demonstrate empathy, appreciate cultural diversity, engage in community service, and promote environmental sustainability.
- PO8: Ethics and Professional Values:** Demonstrate integrity, ethical conduct, biosafety, academic honesty, respect for intellectual property, and professional responsibility in scientific practice and research.
- PO9: Leadership and Teamwork:** Work collaboratively in diverse teams, demonstrate leadership qualities, and contribute effectively to achieving common goals.
- PO10: Lifelong Education :** Engage in self-directed lifelong education for continuous personal and professional development.
- PO11: Employability and Entrepreneurship:** Apply scientific knowledge, creativity, and entrepreneurial skills for employment and entrepreneurship.

## Preamble

The B.Sc. Zoology Programme is designed to provide learners with a holistic understanding of the animal world, encompassing structural, functional, behavioural, ecological, and evolutionary perspectives. It emphasizes both conceptual and experiential learning to develop scientific aptitude, analytical thinking, and research orientation among students. Integrating modern biological sciences with skill-based and vocational components such as pet rearing and care, apiculture, aquarium management, aquaculture, dairy science nature educator, medical diagnostic, clinical research and fish value-added product development, the programme aligns with the experiential and outcome-based framework of NEP 2020. It aims to nurture graduates who are scientifically informed, ethically responsible, and vocationally empowered, capable of applying zoological knowledge to research, conservation, and entrepreneurship for societal and environmental betterment.

## Programme Specific Outcome (PSO)

**Upon completion of the Zoology Programme, learners will be able to:**

<b>PSO1</b>	Demonstrate comprehensive knowledge of animal diversity, biological organization, physiological processes, genetics, evolution, ecology, and applied zoology to explain the structure and function of living systems.
<b>PSO2</b>	Apply laboratory, field, molecular, computational, and diagnostic techniques to investigate biological systems, analyze data, and interpret scientific findings accurately.
<b>PSO3</b>	Design and conduct scientific investigations by integrating research methodology, scientific reasoning, statistical analysis, digital technologies, and ethical practices to address biological problems.
<b>PSO4</b>	Apply zoological principles to biodiversity conservation, wildlife management, environmental sustainability, animal health, aquaculture, and Indian Knowledge Systems for societal and ecological well-being.
<b>PSO5</b>	Demonstrate professional competence, effective communication, leadership, entrepreneurship, and lifelong learning for higher education, research, healthcare, biotechnology, environmental management, and allied life science careers.

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

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

Semester- I

**Choice Based and Credit Based syllabus  
as per NEP 2020 with effect from  
the Academic Year 2026-2027**

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

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

**Semester- I**

**Title: Life Processes and Animal Behaviour**

**Vertical - 1  
Major – 2 Credit**

**With effect from the  
Academic Year 2026-27**

**Course Title: Life Processes and Animal Behaviour**  
**(Course Code: CHMZOO11 Theory)**

S. No.	Heading	Particulars
1	<b>Description of the Course</b>	This course provides an integrated understanding of core physiological processes such as digestion, respiration, circulation, excretion, reproduction, and hormonal regulation across animal groups. It also introduces key concepts in animal behaviour, including communication, courtship, social interaction, and adaptive strategies like echolocation and camouflage. With a blend of theory, practicals, and field-based learning, the course builds foundational knowledge and skills relevant to careers in zoology, wildlife studies, and life sciences.
2	<b>Vertical</b>	Major
3	<b>Type</b>	Theory
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2 credits / 4 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To develop a foundational understanding of essential life processes and physiological systems across animal taxa.</p> <p><b>CO(A)2:</b> To introduce students to key behavioural adaptations and ethological concepts that explain survival, communication, and social interactions in animals.</p>
8	<b>Course Outcomes:</b>	<p>Upon completion of the course, learners:</p> <p><b>CO1:</b> Describe and compare the structure and function of major organ systems involved in digestion, respiration, circulation, excretion, and reproduction.</p> <p><b>CO2:</b> Identify, interpret, and analyze diverse animal behaviours and adaptive strategies in natural and experimental contexts.</p>

## Syllabus

### Unit I: Life Processes (15 hrs)

#### Comparative Animal Physiology:

- Integument, types of integuments and epidermal Derivatives: - Scales (fish) and Glands (amphibians, reptiles and aves)
- Nutritional apparatus: - Amoeba, Cockroach, Ruminants, Human
- Respiratory apparatus - Earthworm, Fish, Frog, Bird, and Human
- Circulation Apparatus - Heart in Cockroach, Frog and Human
- Excretory Apparatus - Nephridia, Malpighian tubules and Human kidney
- Regulatory Apparatus - Neuron structure, Endocrine glands (Thyroid Gland, Adrenal and Pancreas)

#### Reproduction and Hormonal Regulation:

- Reproduction Overview - Asexual and sexual reproduction basics
- Gametogenesis & Fertilization - Spermatogenesis, Oogenesis, external and internal fertilization
- Modes of Reproduction - Oviparity, Viviparity, Ovoviviparity
- Estrous and menstrual cycles

### Unit II: Amazing world of animals and Ethology (15 hrs)

#### Wonders of the Wild

- Definition, Mechanism, Adaptation and Functions of Echolocation in bat and Bioluminescence in firefly
- Physiological Adaptations in Chameleon (Thermoregulation) and Eel (electricity)
- Definition, Mechanism, Adaptation and Functions of Camouflage in Indian Nightjar & Regeneration in Sea star
- Animal Intelligence - Crow
- Parental care in Darwin frog and Hornbill

#### Introduction to Ethology

- Ethology- Definition and Significance, Tinbergen's contribution
  - Types of Animal Behavior: Innate vs Learned, Social behavior, Imprinting
- Communication in Animals: Bee dance, Dolphin whistles, Chemical cues - Ant trail Pheromones
- Mating Behavior and Altruism: Courtship in birds; Kin selection in bees

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### Scheme of Examination and Assessment Pattern (Paper – 100 Marks)

#### A. Semester end External Examination-

30 marks

Time: 1:00 hour

#### Format of Question Paper

**Attempt all questions.**

S. No.	Evaluation type	Marks
Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15
Q. 2	Attempt any three questions out of six (5 marks each) based on Unit-2	15

**Note:** Equal Weightage is to be given to all the Units.

**Total 30**

<b>B. Internal Examination: Continuous Evaluation - 25 marks</b>		
1.	Assessment / Evaluation	Marks
	Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.	15
2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05
	Total	20

<b>11</b>	<p><b>Suggested Readings/References:</b></p> <ol style="list-style-type: none"> <li>1. Biological Science, 3rd Ed. (2005) D.J. Taylor, N. P. O. Green, G. W. Stout. Cambridge University press, Low priced edition. ISBN: 978- 0521684170</li> <li>2. Animal Behaviour: Psychobiology, Ethology and Evolution (1999). David McFarland. Pearson Publication. ISBN: 978-0582327320</li> <li>3. An introduction to animal behaviour, 6th edition – (2012) Aubrey Manning and M. S. Dawkins. Cambridge University press, ISBN: 978- 0521165143.</li> <li>4. National Geographic Vol. 193 (3) March 1998: Rise of life on Earth p. 54-81</li> <li>5. Scientific American Oct. 1994: Origin of life on Earth p. 53-61.</li> <li>6. Essentials of human genetics. 5th Ed. (2009) –M.L. Kothari, L.A. Mehta and S.S. Roychoudhary, University Press. SBN: 978-8173716478.</li> <li>7. Essentials of Ecology, 3rd edition (2011) G. Tyler and Miller Jr. Thompson Books. ISBN: 978-0538735377</li> <li>8. Biodiversity: An Introduction.(2004) 2nd Ed. Kevin J. Gaston &amp; John I. Spicer . Blackwell Publishing. ISBN: 1-4051-1857-1.</li> <li>9. Essentials of ecology and environmental sciences. 5th Ed. (2013) S. V. S. Rana. PHI publisher. ISBN: 978-8120347861</li> <li>10. Strickberger’s Evolution (2007) Monroe W. Strickberger, J. &amp; B. Publication. ISBN: 978-0763700669.</li> <li>11. National Parks of India. (2016) R.S. Bisht. Publication Division, Ministry of I &amp; B Govt. India. eBook.</li> <li>12. Indian National Parks. R. Pathak. ISBN: 978-8184200355.</li> <li>13. Indian Wild life Sanctuaries and National parks (2013). By Prakash Chandra. Cyber Tech Publications. ISBN: 978-9350531914.</li> <li>14. A course in electronic measurements and instrumentation. (2015) A K Sawhney Dhanpat Rai and Co. Pvt Ltd. ISBN: 978-8177001006</li> <li>15. Wilson And Walker's Principles And Techniques Of Biochemistry And Molecular Biology. 8th Ed. ISBN: 978-1316614761.</li> <li>16. An Introduction to Practical Biochemistry. (2017) David Plummer. 3rd Ed. McGraw Hill Education. ISBN: 978-0070994874.</li> <li>17. Bioinstrumentation. (2019) Bhawana Pandey and MH Fulekar. Dreamtech Press ISBN: 978-9389520286.</li> </ol>
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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

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

**Semester- I**

**Title: Practical based on Life Processes and Animal  
Behaviour**

**Vertical - 1  
Major – 2 Credit**

**With effect from the  
Academic Year 2026-27**

**Title: Practical Based on Life Processes and Animal Behaviour**  
**Course Code: CHMZOOI2 (Practical)**

S. No.	Heading	Particulars
1	<b>Description of the Course</b>	This practical course introduces learners to fundamental laboratory techniques, physiological experiments, and animal behaviour studies through hands-on activities, specimen observation, mounting, microscopy, and field visits. It develops skills in zoological experimentation, identification of animal adaptations and behaviours, physiological measurements, and ecological observations, enabling students to apply practical knowledge in understanding life processes and behavioural patterns in animals.
2	<b>Vertical</b>	Major
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To develop technical skills in observing, identifying, and experimentally demonstrating physiological and behavioural processes in animals.</p> <p><b>CO(A)2:</b> To provide hands-on training in laboratory techniques, specimen handling, mounting, dissection, and field-based animal behaviour study.</p>
8	<b>Course Outcomes:</b>	<p>Upon completion of the course, the learners will:</p> <p><b>CO1:</b> Perform basic zoological techniques including mounting, dissection, physiological measurements, and analysis of animal structures.</p> <p><b>CO2:</b> Observe and record animal behaviour, conduct field studies, and apply practical knowledge to real-world zoological contexts.</p>
9	<b>List of Practical</b>	
	<ol style="list-style-type: none"> <li>1. <b>Introduction to Basic Laboratory Safety Practices</b> – Precautions, Rules, and Safety Symbols</li> <li>2. <b>Study and Handling of the Compound Microscope</b> – Structure, Care, and Functional Components &amp; Focusing of permanent slide under 10X &amp; 45X</li> <li>3. <b>Temporary Mounting and Comparative Study of Fish Scales</b> – Placoid, Cycloid, and Ctenoid Types</li> <li>4. <b>Measurement of Human Lung Capacity</b> – Balloon Method and Observation of Light Reflex</li> <li>5. <b>Measurement of pH Using Natural Indicators</b> – pH of Milk, Lemon Juice, Aerated Drinks Using Red Cabbage Extract</li> <li>6. <b>Study and identification of:</b> Feather Types: Contour, Filoplume, Down and Bristles</li> <li>7. <b>Study and identification of:</b> Indian Non- Venomous &amp; Venomous Snakes and First aid for snake bite</li> <li>8. A. <b>Study of Animal Architects:</b> Nest Construction in Spider and Paper Wasp B. <b>Study of brood parasitism in Cuckoo bird</b></li> <li>9. <b>Study and identification of:</b></li> </ol>	

	<p><b>1. Imprinting Behavior</b> – Zebra Finch, Duckling and Penguin</p> <p><b>2. Ritualization and Altruism in Animals</b> – Dog, Peacock, Fiddler Crab, Meerkat, and Elephant</p> <p>10. <b>Study tour</b> - Visit to 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.  <b>Compulsory Submission of field visit report</b></p>																																																
10	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3" style="text-align: center;"><b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b></th> </tr> <tr> <th colspan="3" style="text-align: center;"><b>A. External Examination</b></th> </tr> <tr> <td style="text-align: center;"><b>30 marks</b></td> <td></td> <td style="text-align: right;"><b>Time: 2:00 hours</b></td> </tr> <tr> <th colspan="3" style="text-align: center;"><b>Format of Question Paper</b></th> </tr> <tr> <th style="text-align: center;">Sr. No.</th> <th style="text-align: center;">Experiment</th> <th style="text-align: center;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Q.1</td> <td><b>Major experiment</b></td> <td style="text-align: center;">07</td> </tr> <tr> <td style="text-align: center;">Q.2</td> <td><b>Minor experiment</b></td> <td style="text-align: center;">05</td> </tr> <tr> <td style="text-align: center;">Q.3</td> <td><b>Identify and describe</b></td> <td style="text-align: center;">08</td> </tr> <tr> <td style="text-align: center;">Q.4</td> <td><b>Field Report Submission &amp; Viva - Mandatory</b></td> <td style="text-align: center;">05</td> </tr> <tr> <td style="text-align: center;">Q.5</td> <td><b>Certified Journal - Mandatory</b></td> <td style="text-align: center;">05</td> </tr> <tr> <td></td> <td style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> <tr> <th colspan="3" style="text-align: center;"><b>B. Internal Examination: Continuous Evaluation - 20 marks</b></th> </tr> <tr> <td style="text-align: center;">1.</td> <td style="text-align: center;">Assessment / Evaluation</td> <th style="text-align: center;">Marks</th> </tr> <tr> <td></td> <td>Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.</td> <td style="text-align: center;">15</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Overall conduct as a responsible student,</td> <td style="text-align: center;">05</td> </tr> <tr> <td></td> <td style="text-align: center;">Total</td> <td style="text-align: center;">20</td> </tr> </tbody> </table>	<b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b>			<b>A. External Examination</b>			<b>30 marks</b>		<b>Time: 2:00 hours</b>	<b>Format of Question Paper</b>			Sr. No.	Experiment	Marks	Q.1	<b>Major experiment</b>	07	Q.2	<b>Minor experiment</b>	05	Q.3	<b>Identify and describe</b>	08	Q.4	<b>Field Report Submission &amp; Viva - Mandatory</b>	05	Q.5	<b>Certified Journal - Mandatory</b>	05		<b>Total</b>	<b>30</b>	<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>			1.	Assessment / Evaluation	Marks		Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.	15	2.	Overall conduct as a responsible student,	05		Total	20
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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Zoology)  
Semester- I**

**Title: Open Elective**

**Vertical - 3  
VSC – 2 Credit**

**With effect from the  
Academic Year 2026-27**



HSNC Board's

# Smt. Chandibai Himathmal Mansukhani College (Autonomous)



(Affiliated to the University of Mumbai)  
University College Code: 217 | JD Office: T14

## Faculty of Interdisciplinary

### Vertical 3: List of Open Elective Skill Based Courses for First Year: Semester - I

Sr. No.	Nomenclature of the Paper
1	Basic Computer Skills for Digital Age
2	Visual Design and Digital Tools : A Foundation For Animation
3	Basic Tools of AI for Economics and Education
4	Communicative English
5	Urbanization and Real Estate: Concepts and Contemporary Scenarios
6	Business of Travel and Tours
7	Managing Family Wealth Through Family Office
8	Web Designing Essentials: HTMLI and CSS Styling Techniques
9	Basics of Nutrition
10	Lessons of Reel Making
11	Performing Arts
12	Data Analysis with Excel
13	Political Communication and Media Skills
14	Stress Management-I
15	Social Media and Communication
16	Mushroom Cultivation: Training and Trading
17	Yoga and Fitness
18	Basic Perfumeries Course (Level-I)
19	Soft Skills for Corporate Readiness
20	Beautician : Strategic Business Planning
21	Current Trends of Fashion Design: Financial Perspective
22	Basics of Accounting-I
23	Digital Marketing
24	Online Trading in Stock Market
25	Event Management Course in Sindhi



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

**First Year B. Sc.  
(Zoology)  
Semester- I**

**Title: Pet Rearing and Care**

**Vertical - 4  
VSC – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Course Title: **Pet Rearing and Care**

**Course Code:** CHMZOO13

S. No.	Heading	Particulars
1	<b>Description of the Course</b>	This course provides hands-on knowledge and skills in identifying, managing, and caring for common pet animals such as dogs, cats, and small mammals. It covers aspects of breed recognition, behavior interpretation, grooming techniques, nutrition, first aid, vaccination, and preventive health care. The course also integrates ethical and responsible pet ownership, making learners career-ready for pet-related industries.
2	<b>Vertical</b>	VSC
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To familiarize learners with the characteristics, behavior, and health management of common pet animals.</p> <p><b>CO(A)2:</b> To develop practical skills in grooming, feeding, basic veterinary care, and understanding pet healthcare needs.</p>
8	<b>Course Outcomes:</b>	<p><b>Upon completion of the course, the learners should be able to:</b></p> <p><b>CO1:</b> Identify <b>different breeds</b> of dogs and cats and <b>interpret their behavior</b> through body language.</p> <p><b>CO2:</b> Demonstrate <b>competence in pet grooming, first aid, vaccination awareness</b>, and basic health monitoring techniques.</p>
9	<b>List of Practical</b>	<ol style="list-style-type: none"> <li>1. Identification of Exotic Dog Breeds Commonly Found in India <span style="float: right;"><b>(Any 5)</b></span> (<i>German Shepherd, Beagle, Bulldog, Great Dane, Chihuahua, Pug, Labrador, Golden Retriever, Shih Tzu, Siberian Husky</i>)</li> <li>2. Identification of Indian Dog Breeds <span style="float: right;"><b>(Any 5)</b></span> (<i>Indian Pariah dog, Rajapalayam, Gaddi, Rampur Hound, Mudhol Hound, Chippiparai, Kanni dog, Himalayan Sheepdog, Kaikadi, Jonangi</i>)</li> <li>3. Identification of Common Cat Breeds (<i>Persian cats, Bombay cats, Maine Coons, Turkish Van, Siamese cat, Ragdoll</i>)</li> <li>4. Interpretation of Pet Body Language: Dogs and Cats (<i>Using behavior charts; recognizing stress, fear, aggression, friendliness</i>)</li> <li>5. Observation of Stages of Estrous Cycle in Female Dogs and Cats through Behavioural and Physical Changes</li> <li>6. Measurement of Vital Signs in Pets: Temperature, Pulse, and Respiration Rate</li> </ol>

7. Assembly and Demonstration of a Basic Pet First Aid Kit and Management of Emergency Situations (Wound Care, Seizures, Choking, Poisoning)
8. Identification of Common External and Internal Parasites in Pets and Study of Their Treatment and Prevention (Fleas, Ticks, Ear *Mites*, *Sarcoptic Mites*, Tapeworm, *Rabies*, Ringworm)
9. Demonstration of Basic Handling and Restraint Techniques for Dogs & Cats
10. Study and Demonstration of Grooming Techniques: Brushing, Bathing, Nail Trimming, Ear Cleaning, Hair Trimming, Teeth Brushing, Proper Feeding Techniques for Puppies, Kittens, and Adult Pets
11. Estimation of Moisture Content in Dry Pet Food Samples.
12. Preparation and Study of Vaccination Schedules, Deworming Timelines, and Health Cards for Dogs and Cats and Study of Pet Insurance, Adoption Procedures, and Responsible Pet Ownership

Visit to an Animal Rescue Centre/Animal Care Centre, Animal Training Centre, Veterinary Hospital, or Pet Grooming Centre and Submission of a Structured Field Report

#### **Experiential Assignments and Submissions**

1. Pet Photography
2. Creation of DIY Pet Toys Using Safe Household Materials
3. Preparation of Herbal Pet Grooming Products (e.g., Neem-Based Shampoo)
4. Formation of Homemade balanced food.
5. Behavioral Observation Assignment: Recording and Analyzing Pet Behavior over One Week (Students maintain a daily diary on feeding, playing, sleeping patterns of a pet.)
6. Micro-Project: Designing an Ideal Pet Housing/Enrichment Plan (Dog kennel, Cat climber, Rabbit hutch, Bird aviary.)

10

<b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b>		
<b>A. External Examination</b>		
<b>30 marks</b>		<b>Time: 2:00 hours</b>
<b>Format of Question Paper</b>		
S. No.	Experiment	Marks
Q.1	<b>Major experiment</b>	08
Q.2	<b>Minor experiment</b>	04
Q.3	<b>Identify and describe</b>	06
Q.4	<b>Submission of Assignment / Field Report (Compulsory)</b>	07
Q.5	<b>Certified Journal (Compulsory)</b>	05
<b>Total</b>		<b>30</b>
<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>		
1.	Assessment / Evaluation	<b>Marks</b>
	Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.	15
2.	Overall conduct as a responsible student	05
Total		20

**11 Suggested Readings/References:**

1. Graham, J M (1992) The hive and the honey bee. Dadant and Sons, Hamilton, Illinois.
2. Mishra R.C. (1995) Honey bees and their management in India. ICAR Publication, New Delhi.
3. Singh, S. (1971) Beekeeping in India, ICAR publication.
3. The Biology of the Honey Bee: Mark L. Winston First Harvard Univ. Press 281 pages. ISBN: 0-674-07409 1987
4. The Anatomy of the Honey Bee: R.E. Snodgrass Forgotten Books 214 plus pages. ISBN: 1000193433 1910
5. The Hive and The Honey Bee version Editor: Joe Graham Dadant 943 plus pages. ISBN: 978-0-915698-16-5 2015
6. Honey Bee Biology & Beekeeping Authors: Dewey M Caron & Lawrence John Connor 2013 Wicwas Press 364 pages ISBN: 978-1-878075-29-1
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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Zoology)  
Semester- I**

**Title: Aquarium management**

**Vertical - 4  
VSC – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Course Title: Aquarium Management

**Course Code:** CHMZOO14

S. No.	Heading	Particulars
1	<b>Description of the Course</b>	This course introduces learners to the fundamentals of setting up, maintaining, and managing freshwater aquariums. It covers aspects such as water quality monitoring, species selection, tank design, feeding regimes, and disease management. The course is designed to impart practical skills and entrepreneurial insights for careers in ornamental fish culture, pet trade, and hobby aquaria.
2	<b>Vertical</b>	SEC
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objective:</b>	<p><b>CO(A)1:</b> To develop entrepreneurial skill in aquarium management and enhance professional skill with proper scientific knowledge.</p> <p><b>CO(A)2:</b> To acquaint learners to practical skills of aquarium management.</p>
8	<b>Course Outcome:</b>	<p>Upon successful completion of this course, students will be able to:</p> <p><b>CO1.</b> Work as aquarium maintenance professional, generate source of employment.</p> <p><b>CO2.</b> Construct and set aquarium for ornamental fishes and disease management of ornamental fish.</p>
9	<b>Syllabus</b>	<ol style="list-style-type: none"> <li>1. Types of aquariums: Freshwater (warm water, cold water), nano, marine, reef tank.</li> <li>2. Accessories/equipment used in aquarium: Filters (mechanical, biological, chemical), Aerator, Heater, Thermometer, Lights, protein skimmer.</li> <li>3. Identification of freshwater ornamental fishes: Guppy, Molly (<i>Poecilia</i> spp.), Goldfish (<i>Carassius auratus auratus</i>), Oscars (<i>Astronotus ocellatus</i>), Asian arowana (<i>Scleropages formosus</i>), Siamese fighting fish (<i>Betta splendens</i>), Zebra fish (<i>Danio rerio</i>), Reticulated loach (<i>Botia lohachata</i>), Dwarf gourami (<i>Trichogaster lalius</i>), Denison barb (<i>Sahyadria denisonii</i>), and Rosy Barb (<i>Puntius conchonius</i>)</li> <li>4. Identification of marine ornamental fishes: Yellowtail damselfish (<i>Chrysiptera parasema</i>), Royal Gramma (<i>Gramma loreto</i>), Powder Blue Tang (<i>Acanthurus leucosternon</i>), Ocellaris Clown Fish (<i>Amphiprion ocellaris</i>), Blue Devil (<i>Paraplesiops meleagris</i>), and Butterfly fish (<i>Chaetodon</i> spp).</li> <li>5. Study of Aquarium plants: Vallisneria, Hydrilla, Azolla, Pistia, Sagittaria, Amazon Sword, <i>Limnophila</i>, <i>Limnophila aquatica</i>, <i>Ceratophyllum</i>, <i>Chara</i>.</li> <li>6. Live fish feed: Infusoria, Rotifers, <i>Artemia</i>, Cladocerans, Tubifex worms, <i>Chironomid</i> Larvae (Blood worm)</li> <li>7. Preparation of formulated fish feed</li> <li>8. Symptoms and treatment of fish diseases             <ol style="list-style-type: none"> <li>a. Parasitic: Whit spot diseases, costiasis, whirling disease, <i>Trichodiniasis</i></li> </ol> </li> </ol>

	<p>b. Bacterial: Bacterial gill rot, Dropsy, Ulcer disease, <i>Furunculosis</i>, <i>Vibriosis</i>, <i>Columnaris</i>, and Fish T.B.</p> <p>c. Fungal- <i>Saprolegniasis</i>, <i>Brachiomycois</i>, <i>Ichthyophonosis</i>.</p> <p>9. Water quality analysis of aquarium water:</p> <p>a. Estimation of pH</p> <p>b. Estimation of ammonia</p> <p>c. Estimation of hardness</p> <p>d. Estimation of salinity</p> <p>e. Determination of dissolved oxygen of water.</p> <p>10. Assignment on setting of freshwater and / or marine aquarium</p> <p>11. Report Submission: Visit to aquarium fish keeping entrepreneur</p> <p>12. Submission of feasibility report or budget for setting up an aquarium fish farm.</p>																														
<b>10</b>	<p align="center"><b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b></p> <p><b>A. External Examination</b>  <b>30 marks</b> <span style="float: right;"><b>Time: 3:00 hours</b></span></p> <p align="center"><b>Format of Question Paper</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S. No.</th> <th style="width: 70%;">Experiment</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q.1</td> <td><b>Major experiment</b></td> <td align="center">08</td> </tr> <tr> <td>Q.2</td> <td><b>Identify and describe</b></td> <td align="center">10</td> </tr> <tr> <td>Q.3</td> <td><b>Field Report and Viva (based on Field visit)</b></td> <td align="center">07</td> </tr> <tr> <td>Q.4</td> <td><b>Certified Journal</b></td> <td align="center">05</td> </tr> <tr> <td></td> <td align="right"><b>Total</b></td> <td align="center"><b>30</b></td> </tr> </tbody> </table> <p><b>B. Internal Examination: Continuous Evaluation - 20 marks</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">1.</th> <th style="width: 70%;">Assessment / Evaluation</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td></td> <td>Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.</td> <td align="center">15</td> </tr> <tr> <td>2.</td> <td>Overall conduct as a responsible student,</td> <td align="center">05</td> </tr> <tr> <td></td> <td><b>Total</b></td> <td align="center"><b>20</b></td> </tr> </tbody> </table>	S. No.	Experiment	Marks	Q.1	<b>Major experiment</b>	08	Q.2	<b>Identify and describe</b>	10	Q.3	<b>Field Report and Viva (based on Field visit)</b>	07	Q.4	<b>Certified Journal</b>	05		<b>Total</b>	<b>30</b>	1.	Assessment / Evaluation	Marks		Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.	15	2.	Overall conduct as a responsible student,	05		<b>Total</b>	<b>20</b>
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<b>11</b>	<p><b>Suggested Readings/References:</b></p> <ol style="list-style-type: none"> <li>1. K K Balachandran (2002) - Post Harvest Technology of Fish and Fish Products, Daya Publications.</li> <li>2. G M Hall - Text Book of Fish Processing Technology. ICAR. (Ed). 1992.</li> <li>3. K Gopakumar - Textbook of fish processing technology</li> <li>4. Ninawe and Rathnakumar (2008) - Fish Processing Technology and Product Development, Narendra Publishing House.</li> <li>5. Wheaton and Lawson (1985) Processing Aquatic Food Products, John Wiley &amp; Sons.</li> <li>6. Prasanna Chandra (2020). Fundamentals of Financial Management, 7th Edition, McGraw Hill.</li> <li>7. Aitken A (1982). Fish handling &amp; Processing: 2 nd edition, Ministry of Agriculture, Fisheries &amp; Food, Torry Research Station; Edinburgh.</li> </ol>																														



HSNC Board's

# Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

(Affiliated to the University of Mumbai)

University College Code: 217 | JD Office: T14



Estd. Year  
1965

## Faculty of Interdisciplinary

### Vertical 3: List of Open Elective Skill Based Courses for First Year: Semester - I

Sr. No.	Nomenclature of the Paper
1	Basic Computer Skills for Digital Age
2	Visual Design and Digital Tools : A Foundation For Animation
3	Basic Tools of AI for Economics and Education
4	Communicative English
5	Urbanization and Real Estate: Concepts and Contemporary Scenarios
6	Business of Travel and Tours
7	Managing Family Wealth Through Family Office
8	Web Designing Essentials: HTMLI and CSS Styling Techniques
9	Basics of Nutrition
10	Lessons of Reel Making
11	Performing Arts
12	Data Analysis with Excel
13	Political Communication and Media Skills
14	Stress Management-I
15	Social Media and Communication
16	Mushroom Cultivation: Training and Trading
17	Yoga and Fitness
18	Basic Perfumeries Course (Level-I)
19	Soft Skills for Corporate Readiness
20	Beautician : Strategic Business Planning
21	Current Trends of Fashion Design: Financial Perspective
22	Basics of Accounting-I
23	Digital Marketing
24	Online Trading in Stock Market
25	Event Management Course in Sindhi



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

**First Year B.Sc.**

**Semester- I**

**Vertical – 5**

**Ability Enhancement Course (English)  
2 Credits**

**with effect from  
Academic Year 2026-2027**

**Title: Introduction to Communication Skills in English**

**Course Code: CHMBSCAECI**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>Effective communication is the cornerstone of academic and professional success. This course introduces learners to foundational skills in English communication, with a focus on both oral and written competencies essential in academic, social, and workplace contexts. It aims to equip learners with the ability to read critically, write precisely, speak confidently, and listen actively. Emphasis is placed on building clarity, coherence, and conciseness in communication, along with an understanding of audience, purpose, and tone.</p> <p>The course integrates grammar reinforcement, vocabulary building, reading comprehension, and practice-oriented modules such as email etiquette, group discussion, and formal writing. Through dynamic classroom interactions and practical assessments, learners will gain confidence in using English effectively and purposefully.</p>
2	<b>Vertical 4</b>	Ability Enhancement Course
3	<b>Type</b> Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>  <ol style="list-style-type: none"><li>1. To introduce learners to the fundamentals of effective communication and its components.</li><li>2. To enhance learners' reading comprehension through exposure to multiple genres and contexts.</li><li>3. To develop grammatical accuracy and lexical resourcefulness for academic and professional communication.</li><li>4. To strengthen verbal and non-verbal presentation skills and promote interactive speaking abilities.</li></ol>	

	5. To build competence in real-world writing tasks such as email drafting, bio-data preparation, and descriptive writing.
<b>8</b>	<b>Learning Outcomes:</b> Student will be able to LO-1: Understand and apply key principles of effective communication in varied contexts. LO-2: Comprehend and analyze written texts using appropriate reading strategies. LO-3: Recognize and correct common grammatical and lexical errors. LO-4: Engage in clear, confident, and context-appropriate spoken interactions. LO-5: Produce structured, coherent, and grammatically correct written content for academic and workplace use.

## Syllabus

### UNIT I: Foundations of English Communication

#### A) Core Concepts of Communication

- Principles of Effective Communication: The 7 Cs
- Verbal and Non-verbal Communication with Examples
- Cross-cultural Communication in the Globalized World
- Technology in Communication: Email, Messaging, Video Conferencing
- Listening for Detail and Intent: Barriers to Listening and Strategies

#### B) Reading Comprehension

- Understanding the Main Idea and Supporting Details
  - Interpreting Tone, Purpose, and Bias
  - Using Context Clues for Vocabulary Building
  - Reading Visual Texts: Graphs, Charts, and Infographics
- Sample readings will include excerpts from news articles, reports, editorials, and educational essays (200–250 words).*

#### C) Grammar and Vocabulary

- Subject-Verb Agreement
- Sentence Structures
- Punctuation and Capitalization
- Commonly Confused Words
- Editing and Proofreading Practice

*A remedial and functional approach will be followed with contextual exercises.*

### UNIT II: Applied Communication Skills

#### A) Speaking and Listening Skills

- Introducing Oneself in Academic/Professional Settings
- Participating in Group Discussions and Expressing Opinions
- Delivering a Short Speech (2–3 minutes) on Familiar Topics
- Understanding and Responding to Instructions
- Listening Comprehension Practice through Audio/Video Clips

#### B) Functional Writing Skills

- Formal Email Writing with Subject and Tone Sensitivity
- Descriptive Paragraph Writing (People, Places, Processes)
- Bio-data and Resume Writing
- Drafting Job Applications (Solicited and Unsolicited)
- Writing a Statement of Purpose

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Question No	Nature of Questions	Marks
Q. 1	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 1</b> <b>OR</b> <b>Essay-Type Question</b> (Attempt any 1 out of 2)- <b>Unit 1</b>	15
Q. 2	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 2</b> <b>OR</b> <b>Essay-Type Question</b> (Attempt any 1 out of 2)- <b>Unit 2</b>	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Students are required to draft a job application letter along with a resume using the following AI assistance: Canva Resume Builder, Resume.oi, Zety, Novopresume, Rezi etc <b>OR</b> Draft an SoP with the help of the following AI assistance: Quillbot, Yocket, Writesonic, Jasper AI	15
2.		05
	<b>Total</b>	<b>20</b>

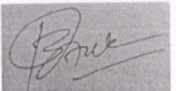
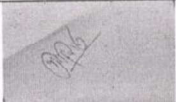
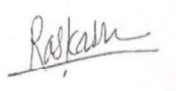
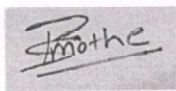
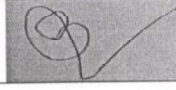
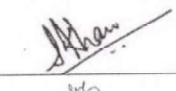
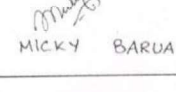

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**REFERENCES:**

1. Adler, Ronald B., et al. *Understanding Human Communication*. 15th ed., Oxford UP, 2021.
2. Bailey, Stephen. *Academic Writing: A Handbook for International Students*. 5th ed., Routledge, 2018.
3. Barrass, Robert. *Students Must Write: A Guide to Better Writing in Coursework and Examinations*. Routledge, 2005.
4. Brown, Gillian, and George Yule. *Teaching the Spoken Language: An Approach Based on the Analysis of Conversational English*. Cambridge UP, 1983.
5. Carnegie, Dale. *The Quick and Easy Way to Effective Speaking*. Pocket Books, 2006.
6. Chaney, Lillian, and Jeanette Martin. *Intercultural Business Communication*. 6th ed., Pearson, 2014.
7. Cullen, Pauline, et al. *English Grammar in Use Supplementary Exercises*. Cambridge UP, 2019.
8. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.

9. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication: Process and Product*. 9th ed., Pearson, 2021.
10. Hewings, Martin. *Advanced Grammar in Use: A Self-study Reference and Practice Book for Advanced Learners of English*. 3rd ed., Cambridge UP, 2013.
11. Jones, Leo. *Functions of English: Communication Practice in English*. Cambridge UP, 1981.
12. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
13. Lynch, Tony. *Listening in Language Learning*. Longman, 1988.
14. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
15. Nordquist, Richard. *The Essentials of English Grammar*. McGraw-Hill Education, 2016.
16. Quirk, Randolph, et al. *A Comprehensive Grammar of the English Language*. Longman, 1985.
17. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
18. Straus, Jane, et al. *The Blue Book of Grammar and Punctuation*. 12th ed., Jossey-Bass, 2021.
19. Wallace, Catherine. *Reading*. Oxford UP, 1992.
20. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

### Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University)	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	 MICKY BARUA
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr.) Kailas Aute



Name & Signature of the Dean: Prof. (Dr.) Nitin Arekar



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

**First Year**

**Semester- I**

**Title: Indian Knowledge System**

**Vertical - 5  
IKS Subject - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Indian Knowledge System****Course Code:CHMIKSI**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course introduces students to the Indian Knowledge System (IKS), emphasizing its historical depth, cultural relevance, and interdisciplinary value. Rooted in the context of Indian civilization, it explores the holistic development of knowledge from ancient to pre-modern times, including contributions in medicine, mathematics, logic, linguistics, governance, arts, and sciences. By revisiting the traditional education systems and intellectual heritage of India, the course encourages learners to connect ancient insights with contemporary disciplines. It aims to enhance awareness, foster appreciation of indigenous wisdom, and reveal the interconnectedness of various streams of knowledge, aligning with the goals of the NEP 2020.
2	<b>Vertical 5</b>	IKS
3	<b>Type</b>	Theory+ Practicum (Teaching Methods: Lecture/ Discussion/ Presentation etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"><li>1. To sensitize the students about context in which they are embedded i.e. Indian culture and civilization including its Knowledge System and Tradition.</li><li>2. To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system.</li><li>3. To help to study the enriched scientific Indian heritage.</li><li>4. To introduce the contribution from Ancient Indian system &amp; tradition to modern science &amp; Technology</li></ol>
8	<b>Learning Outcomes:</b> Students will be able to	LO1: Understand and appreciate the rich Indian Knowledge Tradition LO2: Understand the contribution of Indians in various fields LO3: Experience increase subject-awareness and self-esteem LO4: Develop a comprehensive understanding of how all knowledge is ultimately intertwined

9

**Syllabus****UNIT I: Introduction**

- Introduction to IKS (What is knowledge System, Characteristic Features of Indian Knowledge System)
- Why IKS? (Macaulay's Education Policy and its impact, Need of revisiting Ancient Indian Traditions)
- Scope of IKS (The Universality of IKS (from Micro to Macro), development form Earliest times to 18th Century CE)
- Tradition of IKS (Ancient Indian Education System: Home, Gurukul, Pathashala, Universities and ancient educational centres)
- Relevant sites in the vicinity of the Institute (Water Management System at Kanheri, Temple Management of Ambarnath, etc.)

**UNIT II:**

- Medicine (Ayurveda)
- Alchemy
- Mathematics
- Logic
- Art of Governance (Arthashastra)

**UNIT III: (Select Any FIVE out of the following)**

- Aesthetics
- Town Planning
- Strategic Studies
- Krishi Shastra
- Vyakaran & Lexicography
- Natyashastra
- Ancient Sports
- Astronomy
- Yoga and Wellbeing
- Linguistics
- Chitrasutra
- Architecture
- Taxation
- Banking
- Trade and Commerce

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hours**

Format of Question Paper

Question No	Nature of Questions	Marks
Q1	Attempt any TWO Questions out of FIVE.	06
Q2	Attempt any THREE Questions out of FIVE	12
Q3	Attempt any THREE Questions out of FIFTEEN	12
<b>Total</b>		<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

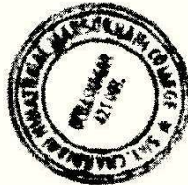
	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test during the lectures (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles).	10
2.	Participation in Workshop/ Conference/Seminar/ Case Study/Field Visit/ Certificate Course/Project presentation /viva .	10
		<b>Total 20</b>

**REFERENCES:**

1. Concise history of science in India- D.M. Bose, S.N Sen, B.V. Subbarayappa.
2. Positive sciences of the Ancient Hindus- Brajendranatha seal, Motilal Banrasidas, Delhi 1958
3. History of Chemistry in Ancient India & Medieval India, P.Ray- Indian Chemicals Society, Calcutta 1956.
4. Charaka Samhita- a scientific synopsis, P. Ray & H.N Gupta National Institute of Sciences of India New Delhi 1965.
5. MacDonnell A.A- History of Sanskrit literature
6. Winternitz M- History of Indian Literature Vol. I, II
7. Dasgupta S.N & De S.K- History of Sanskrit literature Vol' I'
8. Ramkrishna Mission- cultural heritage of India Vol' I, II
9. Majumdar R. C & Pushalkar A.D- History & culture of the Indian people, Vol. I, II & III.
10. Keith A B- History of Sanskrit literature'

**Name & Signature of the Dean & Adhoc BoS Chairperson(Interdisciplinary):**

( Dr. Nihar Arekar )



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

**First Year**

**Semester- I**

**Title: Cocurricular Course I**

**Vertical - 6  
Cocurricular Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Cocurricular Course - I**

**Course Code: CHMCCI6**


Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year.</p> <p>Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting.</p> <p>This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.</p>
2	<b>Vertical 6</b>	Cocurricular Course (Mandatory)
3	<b>Type Teaching Methods</b>	Non Theory Participation, Report Writing, Presentation etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities.</li> <li>2. To enhance personal and interpersonal skills through real-life experiences and teamwork.</li> <li>3. To foster a sense of responsibility, leadership, and community engagement among students.</li> <li>4. To develop self-confidence and emotional well-being through creative expression and collaboration.</li> <li>5. To integrate classroom learning with experiential learning for holistic growth.</li> </ol>
8	<b>Learning Outcomes:</b>	<p>By the end of the course, students will be able to:</p> <p><b>LO1:</b> Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences.</p> <p><b>LO2:</b> Demonstrate improved communication, leadership, and teamwork skills.</p> <p><b>LO3:</b> Exhibit increased awareness of social responsibility and civic engagement.</p> <p><b>LO4:</b> Build confidence through creative, cultural, and intellectual expressions.</p> <p><b>LO5:</b> Maintain a portfolio or activity log to track participation and personal development.</p>

9	<b>Syllabus</b>															
	<b>Unit I - Suggested Areas of Participation in the activities:</b> <ul style="list-style-type: none"> <li>• <b>Cultural Events:</b> Drama, dance, music, literary events, debates, etc.</li> <li>• <b>Social Outreach:</b> Blood donation, awareness campaigns, cleanliness drives.</li> <li>• <b>Clubs &amp; Societies:</b> Photography, quiz, environment club, shram club, etc.</li> <li>• <b>Sports &amp; Fitness:</b> College tournaments, yoga, marathons, fitness challenges.</li> <li>• <b>Institutional Events:</b> Foundation Day, Annual Day, College Festivals, Intercollegiate events.</li> <li>• <b>National Festivals:</b> Independence Day, Republic Day etc.</li> </ul> <b>Unit II - Program Specific Topics</b> <ul style="list-style-type: none"> <li>• <b>Workshops/Seminars:</b> Report Writing, Personality Development, Soft Skills, Leadership Talks.</li> <li>• <b>Speak, Show, Shine:</b> Presentation / Poster Presentation / Viva and Learning Experience</li> </ul> <b>Mode of Evaluation:</b> <ul style="list-style-type: none"> <li>• <b>Faculty Coordinator:</b> To guide and evaluate student progress.</li> <li>• <b>Participation Proof:</b> Certificates, photos, attendance records.</li> <li>• <b>Reflective Journal:</b> Minimum 2-3 pages summarizing experiences, learning, and growth.</li> <li>• <b>Final Viva/Presentation:</b> 5-minute talk on poster presentation and on overall learning.</li> </ul>															
10	<b>Scheme of Examination and Assessment Pattern</b> <b>Based on 3 approved Activities</b> <b>Semester End External - 30 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Activity No</th> <th style="width: 65%;">Nature of Activities</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Title of Approved Activity - 1</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Title of Approved Activity - 2</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Title of Approved Activity - 3</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table>	Activity No	Nature of Activities	Marks	1.	Title of Approved Activity - 1	10	2.	Title of Approved Activity - 2	10	3.	Title of Approved Activity - 3	10	<b>Total</b>		<b>30</b>
Activity No	Nature of Activities	Marks														
1.	Title of Approved Activity - 1	10														
2.	Title of Approved Activity - 2	10														
3.	Title of Approved Activity - 3	10														
<b>Total</b>		<b>30</b>														
	<b>Internal Examination: Continuous Evaluation – 20 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 85%;">Assessment / Evaluation</th> <th style="width: 10%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Reflective journal</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Presentation/ poster presentation/viva</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>		Assessment / Evaluation	Marks	1.	Reflective journal	10	2.	Presentation/ poster presentation/viva	10	<b>Total</b>		<b>20</b>			
	Assessment / Evaluation	Marks														
1.	Reflective journal	10														
2.	Presentation/ poster presentation/viva	10														
<b>Total</b>		<b>20</b>														

**Suggested Readings:**

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

  
 Dr. Manju Lalwani Pathak



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

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

Semester- II

**with effect from the  
Academic Year 2026-2027**

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

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

Semester- II

**Title: Instrumentation and Biodiversity**

**Vertical - 1  
Major – 2 Credit**

**with effect from the  
Academic Year 2026-2027**

**Course Title: Instrumentation and Biodiversity**  
(Course Code: CHMZOOIII1 )

S. No.	Heading	Particulars
1	<b>Description of the Course</b>	This course integrates the study of modern biological instrumentation with the exploration of biodiversity. It introduces key analytical tools used in biological research and provides an understanding of the diversity, classification, and conservation of life forms. Together, these units develop both technical competence and ecological insight essential for modern biological sciences.
2	<b>Vertical</b>	Major
3	<b>Type</b>	Theory
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	500 Marks
7	<b>Course Objectives:</b> <b>CO(A)1:</b> To enable learners to understand the principles, functioning, and applications of essential biological instruments used in analysis and research. <b>CO(A)2:</b> To develop an appreciation of biodiversity through the study of classification, conservation, and ecological significance of life forms.	
8	<b>Course Outcomes:</b> Upon completion of the course, learners will be able to: <b>CO1:</b> Analyze and interpret biological data obtained through modern instruments with scientific accuracy. <b>CO2:</b> Evaluate and apply biodiversity concepts in understanding ecological balance and conservation strategies.	
9	<b>Syllabus</b> <b>Unit I: Instrumentation (15 hrs)</b> <b>Basic Laboratory Instrumentation:</b> <ul style="list-style-type: none"> <li>● Spectroscopy &amp; Colorimetry - Principle and applications</li> <li>● Centrifuge - Principle and applications</li> <li>● Electrophoresis (AGE &amp; PAGE) - Principle and applications</li> <li>● Chromatography (Partition and Adsorption) - Principle and applications</li> <li>● LUX meter - Principle and applications</li> </ul> <b>Advanced Analytical and Molecular Instruments and tools:</b> <ul style="list-style-type: none"> <li>● Polymerase Chain Reaction Machine (PCR) - Principle and applications</li> <li>● DNA Fingerprinting - Principle and applications</li> <li>● ELISA Reader - Principle and applications</li> </ul>	

	<p><b>Unit II: Biodiversity (15 hrs)</b></p> <p><b>Basic concepts of Biodiversity</b></p> <ul style="list-style-type: none"> <li>• Definition, Types of Biodiversity, Significance of Biodiversity</li> <li>• Value of Biodiversity - Consumptive value, Productive value and Social value</li> <li>• Threats to Biodiversity - Habitat loss and Illegal Trading of Wildlife</li> <li>• Wildlife conservation Methods - In-situ conservation and Ex-situ conservation</li> </ul> <p><b>Animal Population and Animal Dispersion</b></p> <ul style="list-style-type: none"> <li>• Population dynamics - Density, Natality, Mortality and Fecundity</li> <li>• Survivorship Curves - Sigmoid and Exponential curves</li> <li>• Age pyramids</li> <li>• Distribution of Animals - Uniform, Random and Aggregated distribution</li> </ul> <p>Animal Interactions - Commensalism, Mutualism, Competition and Predation</p>																								
10	<p align="center"><b>Scheme of Examination and Assessment Pattern (Paper – 100 Marks)</b></p> <p><b>A. Semester end External Examination-</b></p> <p align="center"><b>30 marks</b> <span style="float: right;"><b>Time: 1:00 hour</b></span></p> <p align="center"><b>Format of Question Paper</b></p> <p><b>Attempt all questions.</b></p> <table border="1"> <thead> <tr> <th>S. No.</th> <th>Evaluation type</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td></td> <td>Attempt any three questions out of six (5 marks each) based on Unit-1</td> <td>15</td> </tr> <tr> <td></td> <td>Attempt any three questions out of six (5 marks each) based on Unit-2</td> <td>15</td> </tr> <tr> <td></td> <td><b>Total</b></td> <td><b>30</b></td> </tr> </tbody> </table> <p><b>Note:</b> Equal Weightage is to be given to all the Units.</p> <p><b>B. Internal Examination: Continuous Evaluation - 25 marks</b></p> <table border="1"> <thead> <tr> <th>No</th> <th>Assessment / Evaluation</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.</td> <td>15</td> </tr> <tr> <td>2.</td> <td>Overall conduct as a responsible student,</td> <td>05</td> </tr> <tr> <td></td> <td><b>Total</b></td> <td><b>20</b></td> </tr> </tbody> </table>	S. No.	Evaluation type	Marks		Attempt any three questions out of six (5 marks each) based on Unit-1	15		Attempt any three questions out of six (5 marks each) based on Unit-2	15		<b>Total</b>	<b>30</b>	No	Assessment / Evaluation	Marks	1.	Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.	15	2.	Overall conduct as a responsible student,	05		<b>Total</b>	<b>20</b>
S. No.	Evaluation type	Marks																							
	Attempt any three questions out of six (5 marks each) based on Unit-1	15																							
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1.	Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.	15																							
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11	<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Biological Science, 3rd Ed. (2005) D.J. Taylor, N. P. O. Green, G. W. Stout. Cambridge University press, Low priced edition. ISBN: 978- 0521684170</li> <li>2. Animal Behaviour: Psychobiology, Ethology and Evolution (1999). David McFarland. Pearson Publication. ISBN: 978-0582327320</li> <li>3. An introduction to animal behaviour, 6th edition – (2012) Aubrey Manning and M. S. Dawkins. Cambridge University press, ISBN: 978- 0521165143.</li> <li>4. National Geographic Vol. 193 (3) March 1998: Rise of life on Earth p. 54-81</li> <li>5. Scientific American Oct. 1994: Origin of life on Earth p. 53-61.</li> <li>6. Essentials of human genetics. 5th Ed. (2009) –M.L. Kothari, L.A. Mehta and S.S.</li> </ol>																								

Roychoudhary, University Press. SBN: 978-8173716478.

7. Essentials of Ecology, 3rd edition (2011) G. Tyler and Miller Jr. Thompson Books. ISBN: 978-0538735377
8. Biodiversity: An Introduction.(2004) 2nd Ed. Kevin J. Gaston & John I. Spicer . Blackwell Publishing. ISBN: 1-4051-1857-1.
9. Essentials of ecology and environmental sciences. 5th Ed. (2013) S. V. S. Rana. PHI publisher. ISBN: 978-8120347861
10. Strickberger's Evolution (2007) Monroe W. Strickberger, J. & B. Publication. ISBN: 978-0763700669.
11. National Parks of India. (2016) R.S. Bisht. Publication Division, Ministry of I & B Govt. India. eBook.
12. Indian National Parks. R. Pathak. ISBN: 978-8184200355.
13. Indian Wild life Sanctuaries and National parks (2013). By Prakash Chandra. Cyber Tech Publications. ISBN: 978-9350531914.
14. A course in electronic measurements and instrumentation. (2015) A K Sawhney Dhanpat Rai and Co. Pvt Ltd. ISBN: 978-8177001006
15. Wilson And Walker's Principles And Techniques Of Biochemistry And Molecular Biology. 8th Ed. ISBN: 978-1316614761.
16. An Introduction to Practical Biochemistry. (2017) David Plummer. 3rd Ed. McGraw Hill Education. ISBN: 978-0070994874.
17. Bioinstrumentation. (2019) Bhawana Pandey and MH Fulekar. Dreamtech Press ISBN: 978-9389520286.

## Title: Practical Based on Instrumentation and Biodiversity

**Course Code:** CHMZOOI2

S. No.	Heading	Particulars
1	<b>Description of the Course</b>	This course provides hands-on training in analytical and ecological techniques, integrating the use of biological instruments with field-based biodiversity studies. Learners gain practical skills in chromatography, colorimetry, DNA analysis, and population assessment, fostering scientific accuracy, analytical thinking, and ecological awareness essential for research and conservation.
2	<b>Vertical</b>	Major
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To provide hands-on experience in the use of analytical and molecular biology techniques such as chromatography, colorimetry, and DNA fingerprinting, and to understand their applications in research, diagnostics, and forensic sciences.</p> <p><b>CO(A)2:</b> To enable learners to explore and quantify biodiversity through ecological sampling techniques, understand species distribution patterns, and evaluate conservation priorities using scientific methods.</p> <p><b>CO(A)3:</b> To develop observational and analytical skills through field studies, identification of endangered and critically endangered species, and interpretation of animal interactions within ecosystems.</p>
8	<b>Course Outcomes:</b> Upon completion of the course, the learners will:	<p><b>CO1</b> Perform biochemical and molecular experiments such as separation of amino acids and dyes through chromatography, estimation of DNA using colorimetric principles, and interpretation of DNA fingerprinting results in criminological contexts.</p> <p><b>CO2</b> Demonstrate the ability to apply ecological sampling methods such as the capture–recapture technique and quadrat or transect analysis to estimate population density, analyze species richness, and assess local biodiversity patterns.</p> <p><b>CO3</b> Identify and classify endangered and critically endangered species of India, interpret animal interaction types, locate important national parks and sanctuaries, and compile detailed field visit reports reflecting their understanding of conservation biology and wildlife management.</p>
9		<p style="text-align: center;"><b>List of Practicals</b></p> <ol style="list-style-type: none"><li>1. Separation of amino acids from mixture by Paper Chromatography</li><li>2. Separation of dyes by Adsorption Chromatography using chalk</li><li>3. Estimation of DNA using Colorimeter</li><li>4. A. Determination of Lambda max of different solutions. B. Preparation of standard graph using serial dilution of KMnO<sub>4</sub>.</li></ol>

	<p>5. Application of DNA Fingerprinting in Criminology &amp; Problems based on DNA Fingerprinting.</p> <p>6. Study and identification of:</p> <ol style="list-style-type: none"> <li>1. Endanger Species - Asian Elephant, Bengal Tiger, Red Panda &amp; Lion-tailed Macaque</li> <li>2. Critically Endanger Species - Gharial, Indian Vulture, Bhupathy's Purple Frog &amp; Adaman white toothed shrew</li> </ol> <p>7. Study and identification of Animal Interactions:</p> <ol style="list-style-type: none"> <li>1. Commensalism - Remora &amp; Shark</li> <li>2. Mutualism - Hermit crab &amp; Sea anemones</li> <li>3. Competition - Tiger &amp; Leopard</li> <li>4. Predation - Tiger attacking deer</li> </ol> <p>8. Mark National parks and Sanctuaries on the map of India and mention the name of their brand animals stating reason for their decline</p> <p>9. Lessons on Wildlife Photography</p> <p>10. 1. Study tour - Visit to National Parks / Sanctuaries / and such other places to observe animals. 2. Submission of field visit report</p>
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<b>10</b>	<b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b>	
	<b>A. External Examination</b>	<b>Time: 3:00 hours</b>
	<b>30 marks</b>	
	<b>Format of Question Paper</b>	
	Sr. No.	Marks
	Experiment	
	Q.1	07
	Q.2	05
	Q.3	08
	Q.4	05
	Q.5	05
	<b>Total</b>	<b>30</b>
	<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>	
	No	Marks
	Assessment / Evaluation	
	1.	15
	2.	05
	Total	20

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

**First Year B. Sc.  
(Zoology)  
Semester- II**

**Title: Open Elective**

**Vertical - 3  
OE – 2 Credit**

**With effect from the  
Academic Year 2026-27**



HSNC Board's  
**Smt. Chandibai Himathmal Mansukhani College**  
(Autonomous)



(Affiliated to the University of Mumbai)  
University College Code: 217 | JD Office: T14

Faculty of Interdisciplinary

Vertical 3: List of Open Elective Skill Based Courses for First Year: Semester – II

Sr. No.	Nomenclature of the Paper
1	Cyber and Digital Safety
2	Audio -Video Editing Foundation for Graphics Design and Basics of Animation II
3	Basic Tools of AI for Economics and Education - II
4	English for Professional and Corporate World
5	Urbanisation and Real Estate
6	Business of Travel and Tours-II
7	Managing Family Wealth through Family Office
8	Interactive Web Design using Java Script
9	Basics of Nutrition II
10	Reels Production and Creator Branding
11	Performing Art
12	Data Analysis with Advanced Excel
13	Advanced Political Communication and Media Skills
14	Stress Management
15	Social Media and Society Identity, Power and Digital Citizenship
16	Mushroom Cultivation Training and Trading Level
17	Yoga and Fitness II
18	Basic Perfumery Course (Level-II)
19	Soft Skills II-Personal and Interpersonal Effectiveness
20	Beautician - Strategic Business Planning-II
21	Current Trends of Fashion Designing- Financial Perspective Level-II
22	Basic Accounting-II
23	Digital Marketing II
24	Online Trading and Stock Market-II
25	Event Management Course in Sindhi



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

**First Year B. Sc.  
(Zoology)  
Semester- II**

**Title: Apiculture**

**Vertical - 4  
VSC – 2 Credit**

**With effect from the  
Academic Year 2026-27**

**Course Title: Apiculture**  
(Course Code: CHMZOOI13)

S. No.	Heading	Particulars
1	<b>Description of the Course</b>	This vocational skill course introduces learners to the fascinating world of honeybees and their management for sustainable livelihood and environmental balance. It provides practical knowledge of bee biology, hive construction, seasonal colony management, and honey and wax extraction techniques. The course emphasizes the economic, agricultural, and ecological significance of apiculture, enabling students to develop entrepreneurial skills through hands-on training, field exposure, and value-added product development. Learners will gain the competence to establish and manage small-scale apiaries, contributing to pollination, biodiversity conservation, and rural entrepreneurship.
2	<b>Vertical</b>	VSC
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To provide scientific and practical understanding of honeybee species, their biology, hive management, and techniques of honey, wax, and propolis extraction.</p> <p><b>CO(A)2:</b> To develop entrepreneurial and analytical skills through hands-on training, feasibility studies, and innovative projects promoting sustainable apiculture practices.</p>
8	<b>Course Outcomes:</b>	<p>Upon completion of the course, the learners will:</p> <p><b>CO1:</b> Identify honeybee species, understand colony organization, detect diseases, and perform practical apicultural operations including honey analysis and hive management.</p> <p><b>CO2:</b> Evaluate and design small-scale apiculture enterprises through field visits, feasibility reports, and creative applications like models, demonstrations, and promotional content.</p>
9	<b>Syllabus</b>	<ol style="list-style-type: none"> <li>1. Study of different species of Indian honey bees (<i>Apis dorsata</i>, <i>A. florea</i>, <i>A. cerana indica</i>, <i>A. trigona</i> and <i>A. mellifera</i>)</li> <li>2. Study of external morphology, castes and life cycle of Honeybees.</li> <li>3. Temporary mounting of <ul style="list-style-type: none"> <li>• Mouth parts of Honeybee</li> <li>• Legs of Honeybee</li> <li>• Sting apparatus of Honeybee</li> </ul> </li> <li>4. Study of diseases and predators of honey bees.</li> <li>5. Analysis of adulteration of honey</li> <li>6. Study of moisture reduction of honey</li> </ol>

	<p>7. Study of different parts of bee box (artificial bee hive).</p> <p>8. Study of equipments and tools used for bee keeping (Apiculturing).</p> <p>9. Study of</p> <ul style="list-style-type: none"> <li>• Techniques of rearing of honey bees</li> <li>• Extraction of honey, bee wax, propolis and bee venom</li> <li>• Packaging materials and labeling</li> </ul> <p>10. Visit to an Apiary/Honey Packaging Industry and Submission of a Structured Field Report.</p> <p>11. <b>Submission and Presentation - Any one (Group Submission)</b></p> <ul style="list-style-type: none"> <li>• Feasibility Study on Establishing a Small-Scale Beekeeping Unit</li> <li>• Feasibility Report on Honey Production and Marketing Potential</li> <li>• Feasibility of Producing and Marketing Value-Added Bee Products</li> <li>• Feasibility of Establishing an Educational Apiculture Demonstration Unit</li> <li>• Feasibility of Developing a Pollinator Garden for Campus Bees</li> </ul> <p>12. <b>Experiential Assignments</b></p> <ul style="list-style-type: none"> <li>• Working model of bee box</li> <li>• Honey extraction demonstration</li> <li>• 3D model of bee hive / Life cycle of honey bee / Castes of honey bee</li> <li>• Creative Reels, Shorts &amp; Advertisement for Apiculture / Honey bee</li> </ul>
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<b>10</b>	<b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b>	
	<b>A. External Examination</b>	
	<b>30 marks</b>	<b>Time: 3:00 hours</b>
	<b>Format of Question Paper</b>	
	S. No.	Marks
	Q.1 Major experiment	08
	Q.2 Minor experiment	04
	Q.3 Identify and describe	06
	Q.4 Submission of Assignment / Field Report	07
	Q.5 Certified Journal	05
	<b>Total</b>	<b>30</b>
	<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>	
	No	Marks
	1. Evaluation through quizzes, class tests, presentations, projects, role plays, creative writing, and assignments.	15
	2. Overall conduct as a responsible student,	05
	Total	20

**11 Suggested Readings/References:**

10. Graham, J M (1992) The hive and the honey bee. Dadant and Sons, Hamilton, Illinois.
11. Mishra R.C. (1995) Honey bees and their management in India. ICAR Publication, New Delhi.
3. Singh, S. (1971) Beekeeping in India, ICAR publication.
12. The Biology of the Honey Bee: Mark L. Winston First Harvard Univ. Press 281 pages. ISBN: 0-674-07409 1987
13. The Anatomy of the Honey Bee: R.E. Snodgrass Forgotten Books 214 plus pages. ISBN: 1000193433 1910
14. The Hive and The Honey Bee version Editor: Joe Graham Dadant 943 plus pages. ISBN: 978-0-915698-16-5 2015
15. Honey Bee Biology & Beekeeping Authors: Dewey M Caron & Lawrence John Connor 2013 Wicwas Press 364 pages ISBN: 978-1-878075-29-1
16. Practical hand book of apiculture. A. G. Jaiswal. (2019). ISBN:9780359836161
17. Beekeeping: A Compressive Guide to Bees and Beekeeping. D. P. Abrol (2013). Scientific Publishers (India). ISBN:9789386237620
18. Apiary. Yogendra Kumar Payasi (2022). Orange Books Publication. ISBN:9789392878183

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

**First Year B. Sc.  
(Zoology)  
Semester- II**

**Title: Fish Value Added Products**

**Vertical - 4  
VSC – 2 Credit**

**With effect from the  
Academic Year 2026-27**

**Course Title: Fish Value Added Products**  
**(Course Code: CHMZOOII4 )**

S. No.	Heading	Particulars
1	<b>Description of the Course</b>	This course introduces learners to the science and technology behind developing value-added fish products for nutrition, livelihood, and entrepreneurship. It emphasizes processing, preservation, packaging, and marketing techniques that enhance product quality and shelf life. Through practical exposure and innovation-based assignments, students gain the skills required to transform raw fish into commercially viable, safe, and market ready products.
2	<b>Vertical</b>	SEC
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objective:</b>	<p><b>CO(A)1:</b> To impart practical knowledge of fish processing, preservation, and value addition techniques for improving product quality, safety, and market potential.</p> <p><b>CO(A)2:</b> To cultivate entrepreneurial and technical skills through hands-on training, product formulation, and feasibility studies promoting fish-based enterprise development.</p>
8	<b>Course Outcome:</b>	<p>Upon successful completion of this course, students will:</p> <p><b>CO1-</b> Understand and apply various methods of fish preservation, processing, packaging, and quality assessment to develop hygienic and value-added fish products.</p> <p><b>CO2-</b> Design innovative fish-based products, assess their commercial feasibility, and develop marketing strategies through experiential learning and creative project work.</p>
9	<b>Syllabus</b>	<ol style="list-style-type: none"> <li>1. Identification of commercial marine fin fish (<b>any 5</b>)- Bombay duck, Silver Pomfret, Black Pomfret, Chinese Pomfret, Seer fish, Indian Mackerel, Indian Oil Sardine, Croaker, Tuna &amp; Ribbon fish.</li> <li>2. Identification of commercial shell fish (<b>any 5</b>)- Mud crab, Blue swimming crab, Spiny lobster, Tiger Prawn, White Prawn, Solenocera Prawn, Metapenaeus Prawn, Edible Oyster, Clams, Squid, Cuttle fish and Mussels.</li> <li>3. Identification of freshwater fishes (<b>any 5</b>)- Rohu, Catla, Mrigal, Tilapia, Freshwater Eel, Mahaseer and Indian Loach</li> <li>4. Study of common fishing crafts and gears of India <ul style="list-style-type: none"> <li>• Crafts - Catamaran, Outrigger Canoe, Dinghy and Trawler</li> <li>• Gears - Gill net, Drift net, Bag net, Purse Seine and Otter Trawl</li> </ul> </li> <li>5. Basic methods of fish preservation techniques - Salting, Sun drying, Smoking and deep freezing</li> <li>6. Basic Cleaning and storing procedure of fish - Scaling, Cleaning, Gutting, Head removal,</li> </ol>

	<p>Filleting fish, Refrigerating and waste disposal.</p> <p>7. Study and Demonstration of Knots, Bends, and Hitches Used in Fishery Craft and Gear Operations</p> <ol style="list-style-type: none"> <li>1. Knots: Overhand Knot, Figure of Eight Knot, Reef Knot, Bowline Knot &amp; Fisherman's Knot</li> <li>2. Bends: Sheet Bend, Fisherman's Bend &amp; Double Fisherman's Bend</li> <li>3. Hitches: Clove Hitch, Half Hitch &amp; Rolling Hitch</li> </ol> <p>8. A. Study and Identification of Materials Used in Fishery Crafts and Gears B. Mending of Fishing Gears and Repairing of Fishing Crafts</p> <p>9. Preparation of :</p> <ol style="list-style-type: none"> <li>a. Fish / Prawn Pickle / Chutney</li> <li>b. Fish soup / sauce</li> <li>c. Fish / Prawn / Cuttle fish / Squid Cutlet</li> <li>d. Fish Sausage / Fish Balls.</li> </ol> <p>10. Project / Survey on packaged fish food products available in the market.</p> <p>11. Survey of challenges to commercial market of fish products. Market Survey of Fish Value-Added Products</p> <p>12. Submission of feasibility report on Small-Scale Fish Processing Unit</p> <p>13. Visit to fish processing centre/cold-storage facilities/ fish landing centres/ fishery institutes and preparation of report with photographs.</p>
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<b>10</b>	<b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b>	
	<b>A. External Examination</b>	
	<b>30 marks</b>	<b>Time: 2:00 hours</b>
	<b>Format of Question Paper</b>	
	S. No.	Marks
	Q.1	08
	Q.2	10
	Q.3	07
	Q.4	05
	<b>Total</b>	<b>30</b>
	<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>	
	No	Marks
	1.	15
	2.	05
	Total	<b>20</b>

<b>11</b>	<p><b>Suggested Readings/References:</b></p> <ol style="list-style-type: none"> <li>1. K K Balachandran (2002) - Post Harvest Technology of Fish and Fish Products, Daya Publications.</li> <li>2. G M Hall - Text Book of Fish Processing Technology. ICAR. (Ed). 1992.</li> <li>3. K Gopakumar - Textbook of fish processing technology</li> <li>4. Ninawe and Rathnakumar (2008) - Fish Processing Technology and Product Development, Narendra Publishing House.</li> <li>5. Wheaton and Lawson (1985) Processing Aquatic Food Products, John Wiley &amp; Sons.</li> </ol>
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| <ol style="list-style-type: none"><li>6. Prasanna Chandra (2020). Fundamentals of Financial Management, 7th Edition, McGraw Hill.</li><li>7. Aitken A (1982). Fish handling &amp; Processing: 2 nd edition, Ministry of Agriculture, Fisheries &amp; Food, Torry Research Station; Edinburgh.</li></ol> |
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HSNC Board's

# Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

(Affiliated to the University of Mumbai)

University College Code: 217 | JD Office: T14



## Faculty of Interdisciplinary

### Vertical 3: List of Open Elective Skill Based Courses for First Year: Semester – II

Sr. No.	Nomenclature of the Paper
1	Cyber and Digital Safety
2	Audio -Video Editing Foundation for Graphics Design and Basics of Animation II
3	Basic Tools of AI for Economics and Education - II
4	English for Professional and Corporate World
5	Urbanisation and Real Estate
6	Business of Travel and Tours-II
7	Managing Family Wealth through Family Office
8	Interactive Web Design using Java Script
9	Basics of Nutrition II
10	Reels Production and Creator Branding
11	Performing Art
12	Data Analysis with Advanced Excel
13	Advanced Political Communication and Media Skills
14	Stress Management
15	Social Media and Society Identity, Power and Digital Citizenship
16	Mushroom Cultivation Training and Trading Level
17	Yoga and Fitness II
18	Basic Perfumery Course (Level-II)
19	Soft Skills II-Personal and Interpersonal Effectiveness
20	Beautician - Strategic Business Planning-II
21	Current Trends of Fashion Designing- Financial Perspective Level-II
22	Basic Accounting-II
23	Digital Marketing II
24	Online Trading and Stock Market-II
25	Event Management Course in Sindhi



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

**First Year B.Sc.**

**Semester- II**

**Vertical – 5**

**Ability Enhancement Course (English)  
2 Credits**

**with effect from  
Academic Year 2026-2027**

**Title: Advanced English for Workplace and Academic Communication**

**Course Code: CHMBSCAECII**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description of the Course:</b>	<p>In an increasingly competitive academic and professional landscape, learners require advanced communication skills that enable clarity, precision, critical thinking, and professionalism. This course focuses on practical, real-world communication abilities needed for college-level academic work, job applications, workplace collaboration, and digital interactions.</p> <p>Through hands-on tasks, real-world assignments, and communication practice, learners become adept in using English confidently and appropriately in diverse settings.</p>
<b>2</b>	<b>Vertical 5</b>	<b>AEC: Advanced English for Workplace and Academic Communication</b>
<b>3</b>	<b>Type</b> Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	30 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks
<b>7</b>	<b>Course Objectives:</b>  <ol style="list-style-type: none"><li>1. To develop advanced communication skills required for academic and professional success.</li><li>2. To train learners in report writing, summary writing, and formal documentation.</li><li>3. To enhance proficiency in digital and virtual communication platforms.</li><li>4. To strengthen presentation, interview, and workplace communication skills.</li><li>5. To build confidence in expressing ideas clearly to varied audiences.</li></ol>	
<b>8</b>	<b>Learning Outcomes:</b> After completing this course, learners will be able to:  <b>LO-1:</b> Demonstrate clarity, precision, and professionalism in communication.  <b>LO-2:</b> Interpret and summarize written texts, visuals, and data accurately.  <b>LO-3:</b> Prepare well-structured reports, emails, and professional documents.	

**LO-4:** Use digital tools and virtual communication etiquette effectively.  
**LO-5:** Communicate confidently in interviews, presentations, and teamwork situations

9

**Syllabus**

**UNIT I: Communication for Academic & Professional Settings (15 Hours)**

**A. Communication in Academic & Workplace Contexts**

1. Features of formal communication
2. Audience-centered communication
3. Ethics in communication: integrity, attribution, clarity
4. Explaining concepts in simple and clear language
5. Interpreting graphs, charts, tables, and infographics
6. Summarizing data concisely

**B. Grammar & Style for Professional Writing**

1. Tone: formal, neutral, objective
2. Avoiding redundancy and ambiguity
3. Active vs. passive structures
4. Editing, revising, and proofreading techniques

**UNIT II: Practical Documentation & Employability Skills (15 Hours)**

1. Report writing (academic/field-based/observational)
2. Project summary reports
3. Preparing short presentations
4. Creating informational posters or digital slides
5. Writing a formal complaint or request email
6. Creating a short informational or awareness write-up

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

All questions are compulsory:

Question No	Nature of Questions	Marks
Q. 1	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 1</b> <b>OR</b> Attempt <b>Essay Type</b> question. (1 out of 2) - <b>Unit 1</b>	15
Q. 2	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 2</b> <b>OR</b>	15

	Attempt <b>Essay Type</b> question. (1 out of 2) - Unit 2	
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

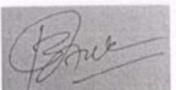
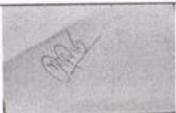

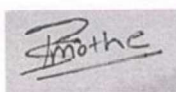
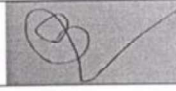
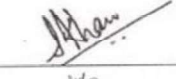
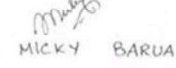

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Assignments on <b>any one</b> of the following topics: Academic/Scientific Report/ Informational Poster / Digital Infographic (Students are required to use AI assistance in the preparation of their drafts. Eg: Notion AI, Otter.ai, Grammarly, Google Gemini, Canva, Piktochart, etc)	15
2.	Class Attendance and Participation	05
	<b>Total</b>	<b>20</b>

**11**

**References:**

1. Adler, Ronald B., et al. *Understanding Human Communication*. 15th ed., Oxford UP, 2021.
2. Bailey, Stephen. *Academic Writing: A Handbook for International Students*. 5th ed., Routledge, 2018.
3. Cargill, Margaret, and Patrick O'Connor. *Writing Scientific Research Articles*. Wiley-Blackwell, 2013.
4. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.
5. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication: Process and Product*. 9th ed., Pearson, 2021.
6. Hewings, Martin. *Advanced Grammar in Use*. Cambridge UP, 2013.
7. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
8. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
9. Nordquist, Richard. *The Essentials of English Grammar*. McGraw-Hill Education, 2016.
10. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
11. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

### Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University)	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	 MICKY BARUA
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr.) Kailas Aute



Name & Signature of the Dean: Prof. (Dr.) Nitin Arekar



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

**First Year**

**Semester- II**

**Title: Cocurricular Course I**

**Vertical - 6  
Cocurricular Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Cocurricular Course - I**

**Course Code: CHMCCI6**


Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year.</p> <p>Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting.</p> <p>This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.</p>
2	<b>Vertical 6</b>	Cocurricular Course (Mandatory)
3	<b>Type Teaching Methods</b>	Non Theory Participation, Report Writing, Presentation etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities.</li> <li>2. To enhance personal and interpersonal skills through real-life experiences and teamwork.</li> <li>3. To foster a sense of responsibility, leadership, and community engagement among students.</li> <li>4. To develop self-confidence and emotional well-being through creative expression and collaboration.</li> <li>5. To integrate classroom learning with experiential learning for holistic growth.</li> </ol>
8	<b>Learning Outcomes:</b>	<p>By the end of the course, students will be able to:</p> <p><b>LO1:</b> Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences.</p> <p><b>LO2:</b> Demonstrate improved communication, leadership, and teamwork skills.</p> <p><b>LO3:</b> Exhibit increased awareness of social responsibility and civic engagement.</p> <p><b>LO4:</b> Build confidence through creative, cultural, and intellectual expressions.</p> <p><b>LO5:</b> Maintain a portfolio or activity log to track participation and personal development.</p>

9	<b>Syllabus</b>																											
	<b>Unit I - Suggested Areas of Participation in the activities:</b> <ul style="list-style-type: none"> <li>• <b>Cultural Events:</b> Drama, dance, music, literary events, debates, etc.</li> <li>• <b>Social Outreach:</b> Blood donation, awareness campaigns, cleanliness drives.</li> <li>• <b>Clubs &amp; Societies:</b> Photography, quiz, environment club, shram club, etc.</li> <li>• <b>Sports &amp; Fitness:</b> College tournaments, yoga, marathons, fitness challenges.</li> <li>• <b>Institutional Events:</b> Foundation Day, Annual Day, College Festivals, Intercollegiate events.</li> <li>• <b>National Festivals:</b> Independence Day, Republic Day etc.</li> </ul> <b>Unit II - Program Specific Topics</b> <ul style="list-style-type: none"> <li>• <b>Workshops/Seminars:</b> Report Writing, Personality Development, Soft Skills, Leadership Talks.</li> <li>• <b>Speak, Show, Shine:</b> Presentation / Poster Presentation / Viva and Learning Experience</li> </ul> <b>Mode of Evaluation:</b> <ul style="list-style-type: none"> <li>• <b>Faculty Coordinator:</b> To guide and evaluate student progress.</li> <li>• <b>Participation Proof:</b> Certificates, photos, attendance records.</li> <li>• <b>Reflective Journal:</b> Minimum 2-3 pages summarizing experiences, learning, and growth.</li> <li>• <b>Final Viva/Presentation:</b> 5-minute talk on poster presentation and on overall learning.</li> </ul>																											
10	<b>Scheme of Examination and Assessment Pattern</b> <b>Based on 3 approved Activities</b> <b>Semester End External - 30 marks</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Activity No</th> <th style="width: 65%;">Nature of Activities</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Title of Approved Activity - 1</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Title of Approved Activity - 2</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Title of Approved Activity - 3</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table> <b>Internal Examination: Continuous Evaluation – 20 marks</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 85%;">Assessment / Evaluation</th> <th style="width: 10%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Reflective journal</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Presentation/ poster presentation/viva</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>	Activity No	Nature of Activities	Marks	1.	Title of Approved Activity - 1	10	2.	Title of Approved Activity - 2	10	3.	Title of Approved Activity - 3	10	<b>Total</b>		<b>30</b>		Assessment / Evaluation	Marks	1.	Reflective journal	10	2.	Presentation/ poster presentation/viva	10	<b>Total</b>		<b>20</b>
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1.	Reflective journal	10																										
2.	Presentation/ poster presentation/viva	10																										
<b>Total</b>		<b>20</b>																										

**Suggested Readings:**

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

  
 Dr. Manju Lalwani Pathak



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

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

**Semester – III**

**Choice Based and Credit Based syllabus  
as per NEP 2020 with effect from the  
Academic Year 2026-2027**

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

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

**Semester- III**

**Title: Cell Biology**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

**Title: Cell Biology**  
**Course code: CHMZOOIII1**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	Cell biology is the study of the structure, function, and behavior of cells. Knowledge of cell biology is crucial for advancements in medicine, biotechnology, and genetics. It plays a key role in disease diagnosis, treatment, and addressing environmental challenges. Consequently, it has wide-ranging applications in fields such as cancer research, genetic engineering, agriculture, and many others. This dynamic field continues to evolve with discoveries in molecular biology and bioinformatics. Cell biology is closely linked to genetics, biochemistry, microbiology, biotechnology, and medicine. As a result, there is high demand for cell biologists in pharmaceuticals, healthcare, and biotech industries. Career opportunities include roles as research scientists, biomedical scientists, lab technicians, and positions in academia and biotech firms.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Theory
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<p><b>Course Objectives:</b> The objective of the course to acquaint the learner to</p> <p><b>CO(A) 1.</b> Understand the fundamental concepts of cell biology, including cell theory, cell structure, membrane organization, and mechanisms of membrane transport.</p> <p><b>CO(A) 2.</b> Explain the principles of cell communication, cell signalling, and the relationship between cellular organization, development, and body design in animals.</p> <p><b>CO(A) 3.</b> Analyze the significance of body size, compartmentalization, metabolism, and developmental processes in determining the structure and function of living organisms.</p> <p><b>CO(A) 4.</b> Develop scientific reasoning and an evolutionary perspective by relating cellular organization, developmental biology, and ontogenetic changes to animal diversity and adaptation.</p>	
8	<p><b>Course Outcomes:</b> Upon completion of the course student will</p> <p><b>CO1:</b> Describe the fundamental concepts of cell biology, including cell theory, plasma membrane structure, membrane transport, and distinguish between prokaryotic and eukaryotic cells.</p> <p><b>CO2:</b> Explain the principles of cell signalling, cell communication, and developmental stages from fertilization to metamorphosis, and interpret their biological significance.</p> <p><b>CO3:</b> Analyze the relationship between body size, surface area-to-volume ratio, compartmentalization, metabolism, and their influence on animal structure and physiological functions.</p> <p><b>CO4:</b> Evaluate developmental and evolutionary concepts, including morphogenesis, ontogeny, phylogeny, and heterochrony, to explain adaptation and diversity in animals.</p>	

9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>Unit I: Cell Biology I</b></p> <ul style="list-style-type: none"> <li>● <b>Introduction to cell biology:</b></li> <li>● Definition and scope of cell biology</li> <li>● Cell theory: concept and significance</li> <li>● Plasma membrane – Fluid Mosaic model, Functions of plasma membrane, Membrane transport, Exo-osmosis, Endo-osmosis</li> <li>● Prokaryotic and eukaryotic cell: size, shape, and structure.</li> <li>● Principles of cell signalling: Chemotaxis, Necessity of cell interaction/cell communication (fast vs slow), Levels and types of cell communication. Basic components of signalling pathway, general properties of signalling systems, one-way emphasis on “how the cell senses its environment”.</li> </ul> <p><b>Unit II: Cell Biology II</b></p> <ul style="list-style-type: none"> <li>● Ground Plan: Cell, Tissue, and Skeleton</li> <li>● Introduction to Development: Egg, Zygote, Blastula, Gastrula, Morphogenesis, Metamorphosis</li> <li>● Functional Consequences of Body Size in animals</li> <li>● Size and compartmentalization: Size, surface area and Volume Size and Transport,</li> <li>● Size and Metabolism</li> <li>● Advantages of Large Body Size</li> <li>● Ontogeny and Phylogeny: Heterochrony (pedomorphosis and Peramorphosis)</li> </ul>																								
10	<p><b>Scheme of Examination and Assessment Pattern (Paper – 50 Marks)</b></p> <p><b>A. External Examination: Semester End External - 30 marks</b> <span style="float: right;"><b>Time: 1:00 hour</b></span>  Format of Question Paper</p> <p><b>Attempt all questions.</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Question</th> <th style="width: 70%;">Nature of Questions</th> <th style="width: 15%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q1</td> <td>Attempt any three questions out of six (5 marks each) based on Unit-1</td> <td>15</td> </tr> <tr> <td>Q2</td> <td>Attempt any three questions out of six (5 marks each) based on Unit-2</td> <td>15</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td><b>30</b></td> </tr> </tbody> </table> <p><b>Note:</b> Equal Weightage is to be given to all the Units.</p> <p><b>B. Internal Examination: Continuous Evaluation - 20 marks</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;"></th> <th style="width: 70%;">Assessment / Evaluation</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.</td> <td>15</td> </tr> <tr> <td>2.</td> <td>Overall conduct as a responsible student and attentiveness</td> <td>5</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td><b>20</b></td> </tr> </tbody> </table>	Question	Nature of Questions	Marks	Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15	Q2	Attempt any three questions out of six (5 marks each) based on Unit-2	15	<b>Total</b>		<b>30</b>		Assessment / Evaluation	Marks	1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.	15	2.	Overall conduct as a responsible student and attentiveness	5	<b>Total</b>		<b>20</b>
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5. N. Arumugam (2019): Cell Biology and Molecular Biology, Saras Publication, ISBN 978-9386519627.
6. Veer Bala Rastogi (2021): A Text Book of Cell Biology and Genetics, Kedar Nath Ram Nath, ISBN 978-9380803524.
7. S. C. Rastogi (2002): Cell Biology, New Age International Pub, ISBN 978- 8122413977.
8. Singh Tomar, Cell Biology, Rastogi ISBN 9788171339693.
9. De Robertis E.D.P, E.M.F. De Robertis Jr. (2010): Cell and Molecular Biology, Publisher Walters Kluwer, ISBN: 9788184734508.
10. Geoffrey M. Cooper (2018): The Cell: A Molecular Approach, Sinauer Associates is an imprint of Oxford University Press, ISBN 978-1605357072.
11. Suruchi Tyagi and Dr. Seema Awasthi (2022): A Textbook of Cytology, Dominant Publishers & Distributors (P) Ltd., ISBN 978-81-78886-16-9.
12. Dr. C. B. Powar (2010): Cell Biology, Himalaya Publishing House, ISBN 978- 9350246696

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

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

Semester- III

Title: Biochemistry

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

**Title: Biochemistry**  
**Course Code: CHMZOOIII2**

S. No.	Heading	Particulars
1	<b>Description the Course:</b>	Biochemistry is the study of the chemical processes within and related to living organisms. It is essential for understanding the molecular basis of life and plays a critical role in drug development, disease diagnosis, and more. Biochemistry has applications in medicine, forensic science, environmental science, and many other fields, making it a fascinating and versatile discipline. It is closely interconnected with molecular biology, genetics, and pharmacology, which drives its high demand in industries such as pharmaceuticals, healthcare, food production, and research institutions. Career opportunities include roles in academia, research, biochemistry, clinical science, and more.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Theory
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course objectives:</b> Objective of the course is to train the learner to	<p><b>CO(A)1.</b> To develop understanding of the fundamental principles of biochemistry, including the biochemical basis of life, properties of water, and the structure, classification, and biological significance of carbohydrates, proteins, lipids, vitamins, and enzymes.</p> <p><b>CO(A)2.</b> To acquaint with the relationship between the structure and function of biomolecules and their roles in maintaining cellular organization, metabolism, and physiological processes.</p> <p><b>CO(A)3.</b> To correlate the chemical properties, reactions, and biological applications of biomolecules and enzymes, including their relevance to health, disease, and biotechnology.</p> <p><b>CO(A)4.</b> To develop scientific reasoning and problem-solving skills by applying biochemical concepts to interpret biological phenomena and appreciate the molecular basis of life.</p>
8	<b>Course Outcomes:</b> Upon successful completion of this course, students will:	<p><b>CO1:</b> Explain the fundamental concepts of biochemistry, the properties of water, and the structure, classification, nomenclature, and biological functions of carbohydrates and proteins.</p> <p><b>CO2:</b> Describe the structure, properties, classification, biological significance, and clinical importance of lipids and vitamins in living organisms.</p> <p><b>CO3:</b> Analyze the structure-function relationship of biomolecules, protein organization, lipid metabolism, and enzyme characteristics to explain their roles in cellular and physiological processes.</p> <p><b>CO4:</b> Evaluate enzyme kinetics, enzyme inhibition, cofactors, coenzymes, isoenzymes, and the practical applications of enzymes in medicine, industry, and biotechnology to solve biological problems.</p>

**Unit I: Biochemistry- I**

- Basics of Biochemistry
- Structure of water and its physiochemical properties,
- The concept of living state of the matter.
- The concept of biochemical unity in the living world.
- Carbohydrate: Definition, classification, nomenclature of carbohydrates
- Monosaccharides: Epimers and anomers, Glucose, Fructose
- Oligosaccharides: Glycosidic bond formation, maltose, lactose
- Polysaccharides: Structural and storage polysaccharide, cellulose, starch, glycogen, chitin
- Proteins: Structure and properties of amino acids
- Classification of amino acids
- Peptide bond formation
- Levels of protein structure– primary, secondary (alpha and beta helix, random coil), Ramachandran plot, tertiary and quaternary (Haemoglobin)
- Biological role of proteins

**Unit II: Biochemistry- II**

- Lipids: Definition, classification, physical and chemical properties of lipids
- Fatty acids – saturated fatty acids, unsaturated fatty acids, and their nomenclature
- Reactions of fatty acids – saponification, esterification,
- Essential fatty acids – triacylglycerols, phospholipids (cephalin and lecithin), waxes, steroids
- Biological role and clinical significance of lipids
- Vitamins: Definition and characteristics
- Water soluble vitamins – Vitamin B complex and Vitamin C
- Fat soluble vitamins – Vitamin A, Vitamin D, Biological significance of vitamins
- Enzymes: Definition and classification of enzymes and Properties of enzymes
- Enzyme kinetics: Inhibition, types of reversible inhibition, Factors affecting enzyme activity
- Coenzymes, co-factors, and isoenzymes, Application of enzymes

10

**Scheme of Examination and Assessment Pattern (Paper – 50 Marks)****A. External Examination: Semester End External - 30 marks****Time: 1:00 hour**

Format of Question Paper

**Attempt all questions.**

Question No	Nature of Questions	Marks
Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15
Q2	Attempt any three questions out of six (5 marks each) based on Unit-2	15
<b>Total</b>		<b>30</b>

**Note:** Equal Weightage is to be given to all the Units.

<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>		
	<b>Assessment / Evaluation</b>	<b>Marks</b>
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations, or quizzes.	15
2.	Overall conduct as a responsible student and attentiveness	5
		<b>Total 20</b>
<b>11</b>	<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Leininger A.L. Nelson D.L. and Cox M.M (2013). Principles of Biochemistry, W. H. Freeman Publisher, ISBN 978-1464109621.</li> <li>2. Dushyant Kumar Sharma (2010) Biochemistry, Alpha Science International Ltd. ISBN 978-1842655108.</li> <li>3. Ahil Chandra Deb (2001) Fundamentals of Biochemistry, New Central Book Agency, ISBN 978-8173811449.</li> <li>4. A.V.S.S.R Rao, Rao Rama V S, Surya Lakshmi A (1994). A Textbook of Biochemistry, UBS Publishers, ISBN 9788186112847.</li> <li>5. Geoffrey L. Zubay (). Biochemistry, Addison-Wesley ISBN 978-0201090918.</li> <li>6. Lubert Stryer (1990). Biochemistry, W. H. Freeman &amp; Co Ltd. ISBN 978-0716718437.</li> <li>7. Peter J. Kennelly, Kathleen M. Botham, Owen McGuinness, Victor W. Rodwell, P. Anthony Weil (2022). Harper's Illustrated Biochemistry, Thirty-Second Edition, McGraw Hill / Medical ISBN 978-1260469943.</li> <li>8. Erice Conn, Paul Stumpf (2009). Outline of Biochemistry, John Wiley &amp; Sons, ISBN 9788126509300.</li> <li>9. Biological Chemistry, 1998, Dr. B. M. Deoray, A.E Desai, Nirali Prakash Andr. C. B. Powar (2010): Cell Biology, Himalaya Publishing House, ISBN 978- 9350246696</li> </ol>	

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

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

Semester- III

**Title: Practical based on Cell Biology and  
Biochemistry**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Practical based on Cell Biology and Biochemistry

**Course code:** CHMZOOIII3

S. No	Head	Particular
1	<b>Description the Course:</b>	The hands-on practical course in cell biology provides students with essential laboratory skills to study cell structure, and function. The practical course in biochemistry provides students with hands-on experience in analyzing the chemical processes essential to life. Through laboratory experiments, students will explore biomolecules, enzymatic reactions, metabolic pathways, and molecular interactions.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Practical
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	The objective of the course is to acquaint the learners to  <b>CO(A)1.</b> To develop proficiency in fundamental laboratory techniques for studying cells, biomolecules, membrane transport, pH, and enzyme activity using standard biological and biochemical methods. <b>CO(A)2.</b> To perform qualitative and quantitative experiments to identify biomolecules, investigate membrane permeability, and analyze factors influencing enzyme activity with accuracy and scientific precision. <b>CO(A)3.</b> To interpret experimental observations by applying the principles of cell biology and biochemistry to explain cellular processes and biochemical reactions. <b>CO(A)4.</b> To demonstrate scientific temperament, laboratory ethics, safety practices, data recording, analysis, and communication skills through systematic experimentation and reporting.
8	<b>Course Outcomes:</b>	Upon completion of the course, the learners will:  <b>CO 1.</b> Perform basic cell biology techniques including cell size measurement, staining of prokaryotic and eukaryotic cells, and experiments demonstrating membrane permeability using appropriate laboratory instruments and procedures. <b>CO 2.</b> Conduct qualitative analysis of carbohydrates, proteins, lipids, and Vitamin C using standard biochemical tests and accurately interpret the experimental results. <b>CO 3.</b> Investigate enzyme activity by performing experiments on catalase and acid phosphatase, and analyze the effects of pH, enzyme concentration, and substrate concentration on enzyme kinetics. <b>CO 4.</b> Record, analyze, interpret, and present laboratory observations using scientific methods, appropriate statistical and graphical representation where applicable, while adhering to laboratory safety, ethics, and good laboratory practices.

9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>List of Practical</b></p> <ol style="list-style-type: none"> <li>1. Measurement of cell-size using oculometer and stage micrometer</li> <li>2. Study of permeability of cell through plasma membrane (osmosis in blood cells).</li> <li>3. Study of membrane permeability using beetroot pigment leakage.</li> <li>4. Study of prokaryotic cells (bacteria) by Crystal violet staining technique</li> <li>5. Study of eukaryotic cells (WBCs) from blood smear by Leishman's stain</li> <li>6. Preparation of titration curve for strong acid and strong base with the help of pH meter.</li> <li>7. Qualitative analysis of carbohydrates (Fehling's test, Anthrone test).</li> <li>8. Qualitative tests for proteins (Ninhydrin test, Biuret test, Millon's test).</li> <li>9. Qualitative tests for lipids (Solubility test, Sudan III test, Oil Red O test).</li> <li>10. Detection of Vitamin C from various suitable fruits.</li> <li>11. Demonstration of catalase enzyme activity using hydrogen peroxide</li> <li>12. Effect of varying pH on the activity of the enzyme Acid phosphatase</li> <li>13. Effect of varying enzyme concentration on the activity of the enzyme Acid phosphatase</li> <li>14. Effect of substrate concentration on Acid phosphatase enzyme activity.</li> <li>15. Study of Osazone formation using suitable reducing sugar.</li> </ol>																																	
10	<p style="text-align: center;"><b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b></p> <p><b>A. External Practical Examination: Semester End External-30 marks      Time: 3 hrs</b> Format of Question Paper</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S.No</th> <th style="width: 70%;">Experiment</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q.1</td> <td>One Major experiment</td> <td style="text-align: center;">07</td> </tr> <tr> <td>Q.2</td> <td>One Minor experiment</td> <td style="text-align: center;">05</td> </tr> <tr> <td>Q.3</td> <td>Identification (any four)</td> <td style="text-align: center;">08</td> </tr> <tr> <td>Q.4</td> <td>Field Report Submission &amp; Viva</td> <td style="text-align: center;">05</td> </tr> <tr> <td>Q.5</td> <td>Journal</td> <td style="text-align: center;">05</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table> <p><b>B. Internal Examination (20 marks)</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">No</th> <th style="width: 70%;">Assessment / Evaluation</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment.</td> <td style="text-align: center;">15</td> </tr> <tr> <td style="text-align: center;">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 style="text-align: center;">5</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>	S.No	Experiment	Marks	Q.1	One Major experiment	07	Q.2	One Minor experiment	05	Q.3	Identification (any four)	08	Q.4	Field Report Submission & Viva	05	Q.5	Journal	05	<b>Total</b>		<b>30</b>	No	Assessment / Evaluation	Marks	1.	Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment.	15	2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	5	<b>Total</b>		<b>20</b>
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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

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

Semester- III

Title: Biochemistry

**Vertical - 2  
Minor Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

**Title: Biochemistry**  
**Course Code: CHMZOOIII4**

S. No.	Heading	Particulars
1	<b>Description the Course:</b>	Biochemistry is the study of the chemical processes within and related to living organisms. It is essential for understanding the molecular basis of life and plays a critical role in drug development, disease diagnosis, and more. Biochemistry has applications in medicine, forensic science, environmental science, and many other fields, making it a fascinating and versatile discipline. It is closely interconnected with molecular biology, genetics, and pharmacology, which drives its high demand in industries such as pharmaceuticals, healthcare, food production, and research institutions. Career opportunities include roles in academia, research, biochemistry, clinical science, and more.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Theory
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course objectives:</b>	Objective of the course is to acquaint the learners to <b>CO(A)1.</b> To develop understanding of the fundamental principles of biochemistry, including the biochemical basis of life, properties of water, and the structure, classification, and biological significance of carbohydrates, proteins, lipids, vitamins, and enzymes. <b>CO(A)2.</b> To acquaint with the relationship between the structure and function of biomolecules and their roles in maintaining cellular organization, metabolism, and physiological processes. <b>CO(A)3.</b> To correlate the chemical properties, reactions, and biological applications of biomolecules and enzymes, including their relevance to health, disease, and biotechnology. <b>CO(A)4.</b> To develop scientific reasoning and problem-solving skills by applying biochemical concepts to interpret biological phenomena and appreciate the molecular basis of life.
8	<b>Course Outcomes:</b>	Upon successful completion of this course, students will: <b>CO1:</b> Explain the fundamental concepts of biochemistry, the properties of water, and the structure, classification, nomenclature, and biological functions of carbohydrates and proteins. <b>CO2:</b> Describe the structure, properties, classification, biological significance, and clinical importance of lipids and vitamins in living organisms. <b>CO3:</b> Analyze the structure-function relationship of biomolecules, protein organization, lipid metabolism, and enzyme characteristics to explain their roles in cellular and physiological processes. <b>CO4:</b> Evaluate enzyme kinetics, enzyme inhibition, cofactors, coenzymes, isoenzymes, and the practical applications of enzymes in medicine, industry, and biotechnology to solve biological problems.
9	<b>Unit I: Biochemistry- I</b>	<b>Syllabus</b>
	<ul style="list-style-type: none"> <li>• Basics of Biochemistry</li> <li>• Structure of water and its physiochemical properties,</li> <li>• The concept of living state of the matter.</li> </ul>	

- The concept of biochemical unity in the living world.
- Carbohydrate: Definition, classification, nomenclature of carbohydrates
- Monosaccharides: Epimers and anomers, Glucose, Fructose
- Oligosaccharides: Glycosidic bond formation, maltose, lactose
- Polysaccharides: Structural and storage polysaccharide, cellulose, starch, glycogen, chitin
- Proteins: Structure and properties of amino acids
- Classification of amino acids
- Peptide bond formation
- Levels of protein structure– primary, secondary (alpha and beta helix, random coil), Ramachandran plot, tertiary and quaternary (Haemoglobin)
- Biological role of proteins

### Unit II: Biochemistry- II

- Lipids: Definition, classification, physical and chemical properties of lipids
- Fatty acids – saturated fatty acids, unsaturated fatty acids, and their nomenclature
- Reactions of fatty acids – saponification, esterification,
- Essential fatty acids – triacylglycerols, phospholipids (cephalin and lecithin), waxes, steroids
- Biological role and clinical significance of lipids
- Vitamins: Definition and characteristics
- Water soluble vitamins – Vitamin B complex and Vitamin C
- Fat soluble vitamins – Vitamin A, Vitamin D, Biological significance of vitamins
- Enzymes: Definition and classification of enzymes and Properties of enzymes
- Enzyme kinetics: Inhibition, types of reversible inhibition, Factors affecting enzyme activity
- Coenzymes, co-factors, and isoenzymes, Application of enzymes

<b>10</b>	<b>Scheme of Examination and Assessment Pattern (Paper – 50 Marks)</b>		
	<b>A. External Examination: Semester End External - 30 marks</b>		<b>Time: 1:00 hour</b>
	Format of Question Paper		
	<b>Attempt all questions.</b>		
	<b>Question No</b>	<b>Nature of Questions</b>	<b>Marks</b>
	Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15
	Q2	Attempt any three questions out of six (5 marks each) based on Unit-2	15
	<b>Total</b>		<b>30</b>
	<b>Note:</b> Equal Weightage is to be given to all the Units.		
	<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>		
	<b>Assessment / Evaluation</b>	<b>Marks</b>	
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations, or quizzes.	15	
2.	Overall conduct as a responsible student and attentiveness	5	
<b>Total</b>		<b>20</b>	

**REFERENCES:**

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2. Dushyant Kumar Sharma (2010) Biochemistry, Alpha Science International Ltd. ISBN 978-1842655108.
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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

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

Semester- III

Title: Practical based on Cell Biology and  
Biochemistry

**Vertical - 2  
Minor Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

# Title: Practical based on Cell Biology and Biochemistry

Course code: CHMZOOIII5

S. No	Heading	Particulars
1	<b>Description the Course:</b>	The hands-on practical course in cell biology provides students with essential laboratory skills to study cell structure, and function. The practical course in biochemistry provides students with hands-on experience in analyzing the chemical processes essential to life. Through laboratory experiments, students will explore biomolecules, enzymatic reactions, metabolic pathways, and molecular interactions.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Practical
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To develop proficiency in fundamental laboratory techniques for studying cells, biomolecules, membrane transport, pH, and enzyme activity using standard biological and biochemical methods.</p> <p><b>CO(A)2.</b> To perform qualitative and quantitative experiments to identify biomolecules, investigate membrane permeability, and analyze factors influencing enzyme activity with accuracy and scientific precision.</p> <p><b>CO(A)3.</b> To interpret experimental observations by applying the principles of cell biology and biochemistry to explain cellular processes and biochemical reactions.</p> <p><b>CO(A)4.</b> To demonstrate scientific temperament, laboratory ethics, safety practices, data recording, analysis, and communication skills through systematic experimentation and reporting.</p>
8	<b>Course Outcomes:</b> Upon completion of the course, the learners will:	<p><b>CO 1.</b> Perform basic cell biology techniques including cell size measurement, staining of prokaryotic and eukaryotic cells, and experiments demonstrating membrane permeability using appropriate laboratory instruments and procedures.</p> <p><b>CO 2.</b> Conduct qualitative analysis of carbohydrates, proteins, lipids, and Vitamin C using standard biochemical tests and accurately interpret the experimental results.</p> <p><b>CO 3.</b> Investigate enzyme activity by performing experiments on catalase and acid phosphatase, and analyze the effects of pH, enzyme concentration, and substrate concentration on enzyme kinetics.</p> <p><b>CO 4.</b> Record, analyze, interpret, and present laboratory observations using scientific methods, appropriate statistical and graphical representation where applicable, while adhering to laboratory safety, ethics, and good laboratory practices.</p>

9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>List of Practical</b></p> <ol style="list-style-type: none"> <li>1. Measurement of cell-size using oculometer and stage micrometer</li> <li>2. Study of permeability of cell through plasma membrane (osmosis in blood cells).</li> <li>3. Study of membrane permeability using beetroot pigment leakage.</li> <li>4. Study of prokaryotic cells (bacteria) by Crystal violet staining technique</li> <li>5. Study of eukaryotic cells (WBCs) from blood smear by Leishman's stain</li> <li>6. Preparation of titration curve for strong acid and strong base with the help of pH meter.</li> <li>7. Qualitative analysis of carbohydrates (Fehling's test, Anthrone test).</li> <li>8. Qualitative tests for proteins (Ninhydrin test, Biuret test, Millon's test).</li> <li>9. Qualitative tests for lipids (Solubility test, Sudan III test, Oil Red O test).</li> <li>10. Detection of Vitamin C from various suitable fruits.</li> <li>11. Demonstration of catalase enzyme activity using hydrogen peroxide</li> <li>12. Effect of varying pH on the activity of the enzyme Acid phosphatase</li> <li>13. Effect of varying enzyme concentration on the activity of the enzyme Acid phosphatase</li> <li>14. Effect of substrate concentration on Acid phosphatase enzyme activity.</li> <li>15. Study of Osazone formation using suitable reducing sugar.</li> </ol>																																	
10	<p style="text-align: center;"><b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b></p> <p style="text-align: center;"><b>A. External Practical Examination: Semester End External-30 marks      Time: 3 hrs</b></p> <p>Format of Question Paper</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S. No</th> <th style="width: 70%;">Practical</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q.1</td> <td>One Major experiment</td> <td style="text-align: center;">07</td> </tr> <tr> <td>Q.2</td> <td>One Minor experiment</td> <td style="text-align: center;">05</td> </tr> <tr> <td>Q.3</td> <td>Identification (any four)</td> <td style="text-align: center;">08</td> </tr> <tr> <td>Q.4</td> <td>Field Report Submission &amp; Viva</td> <td style="text-align: center;">05</td> </tr> <tr> <td>Q.5</td> <td>Journal</td> <td style="text-align: center;">05</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table> <p><b>B. Internal Examination (20 marks)</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">No</th> <th style="width: 70%;">Assessment / Evaluation</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment.</td> <td style="text-align: center;">15</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 style="text-align: center;">5</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>	S. No	Practical	Marks	Q.1	One Major experiment	07	Q.2	One Minor experiment	05	Q.3	Identification (any four)	08	Q.4	Field Report Submission & Viva	05	Q.5	Journal	05	<b>Total</b>		<b>30</b>	No	Assessment / Evaluation	Marks	1.	Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment.	15	2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	5	<b>Total</b>		<b>20</b>
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11	<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Practical Biochemistry: Principles and Techniques by Wilson and Walker.</li> <li>2. Biochemistry Laboratory: Modern Theory and Techniques by Rodney Boyer.</li> <li>3. Practical Textbook of Biochemistry for Medical Students by D.M. Vasudevan.</li> <li>4. An Introduction to Practical Biochemistry by David T. Plummer.</li> <li>5. Molecular Biology of the Cell by Alberts et al.</li> <li>6. Microscopy and Microtechnique by R.K. Sharma</li> </ol>																																	

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

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

Semester- III

Open Elective

**Vertical - 3  
Open Elective- 2 Credit**

**With effect from the  
Academic Year 2026-27**



HSNC Board's  
**Smt. Chandibai Himathmal Mansukhani College**  
**(Autonomous)**

(Affiliated to the University of Mumbai)  
University College Code: 217 | JD Office: T14



**Faculty of Interdisciplinary**

**Vertical 3: List of Open Elective Skill Based Courses for Second Year: Semester – III**

Sr. No.	Nomenclature of the Paper
1	Data Analysis And Visualization Using Excel
2	2D Animation And Motion Graphics
3	Advance Tools Of AI For Economics And Education - I
4	English For Journalism And Advertising
5	Urbanization And Real Estate: Infrastructure, Technology And Urban Change
6	Tourism Marketing
7	Managing Family Wealth Through Family Office-III
8	Responsive & Modern Web Designing
9	Basics Of Nutrition -3
10	Reel Making For Media And Social Change
11	Performing Art- Dance-3
12	Data Analysis With Excel And Power BI
13	Digital Political Strategy, AI And Public Engagement Skills
14	Psychology Of Personal Relationship-I
15	Introduction To Sociology And Digital Society
16	Mushroom Cultivation Training And Trading Level 3
17	Yogasanas: Intermediate Series
18	Perfumery Course Level 3
19	Workplace And Professional Skills
20	Beautician: Strategic Business Planning III
21	Current Trends In Fashion Designing: Financial Perspective Level 3
22	Basics Of Accounting-III
23	Digital Marketing -III
24	Advanced Trading Strategies In Stock Market



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

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

Semester- III

Title: Intellectual Property Right

**Vertical - 4  
SEC3a - 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Intellectual Property Rights (SEC3a)

Course Code: CHMZOOIII7

S. No.	Heading	Particulars
1	<b>Description the Course</b>	Intellectual Property Rights (IPR) offer legal protection for innovations and creative works through patents, copyrights, and trademarks. Crucial for safeguarding innovation and promoting fair competition, IPR provides legal recognition and economic benefits to creators. It plays a vital role in industries such as biotechnology, pharmaceuticals, software, and the arts, garnering significant interest from businesses, researchers, and legal professionals. As a multidisciplinary field, IPR bridges law, business, science, technology, and the arts. Industries depend on IPR for competitive advantage, driving high demand for professionals such as patent attorneys, IP consultants, and trademark specialists.
2	<b>Vertical 3</b>	Skill Enhancement Course (SEC)
3	<b>Type</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	Objective of the course to acquaint the learners to <b>CO(A)1.</b> To explain the fundamentals and significance of Intellectual Property Rights (IPR). <b>CO(A)2.</b> To compare the different types of IPR: patents, copyrights, trademarks, designs, and acquire practical skills in procedures for registration, assignment, and licensing of copyrights and trademarks. <b>CO(A)3.</b> To analyse the legal framework for IPR protection acts and regulations and develop skills in drafting complete patent applications and specifications
8	<b>Course Outcome:</b>	Upon completion of the course, the learners should be able to: <b>CO-1:</b> Define and classify various types, differentiate between patents, copyrights, trademarks, and other forms of IP. <b>CO-2:</b> Explain the procedures for registration and licensing of copyrights and trademarks, including compliance with legal requirements. <b>CO-3:</b> Design patent specifications, including claims and technical descriptions.
9	<b>Syllabus</b>	<ul style="list-style-type: none"> <li>• Introduction to IPR: Definition, nature, classification Protection of intellectual property Importance of IPR. Types of IPR: Types of patents, Copyrights, Trademark, Designing of patent</li> <li>• <b>Copyrights:</b> Origin, definition &amp; types of copyrights, Registration procedure, Assignment &amp; license, Terms of copyrights, Piracy, infringement, remedies,</li> <li>• <b>Trademarks:</b></li> <li>• Concept of trademarks, Rationale behind the protection of trademarks</li> <li>• Trademark act 1940</li> <li>• <b>Procedure for registration:</b> submission of application.</li> <li>• <b>Criteria for patentability and non-patentability;</b> Products and process patent</li> </ul>

	<p>Software patents  Patenting of micro-organism  Rights of patentee</p> <ul style="list-style-type: none"> <li>• <b>Structure of Patent Complete Specification:</b>  A provisional (or preliminary) patent application  Title of the invention  Abstract of the disclosure  Background of the invention / Prior Art  Description of the invention (Technical field, background information, summary of the invention, detailed description, and drawings (If Applicable))</li> <li>• <b>Claims</b>  Alternative embodiment (Optional).  Case studies based on Indian patents (any 1).</li> <li>• Prepare a Literature survey / Patent survey on a suitable topic.</li> <li>• Prepare a draft claim based on an abstract on a suitable topic.</li> <li>• Prepare Patent Search Report (PSR) of a Case Study.</li> </ul>																														
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<b>11</b>	<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Act 39 of 1970 as amended by the Jan Vishwas (Amendment of Provisions) Act 2022 dt. 11-8-23. The Patents Act, 1970 by Commercial law Publishers (India) Pvt. Ltd.</li> <li>2. Act 47 of 1999 as amended by the Jan Vishwas (Amendment of Provisions) Act 2023 (18 of 2023), The trade mark Act 1999 by Universal LexisNexis.</li> <li>3. Dr. B L Wadehra revised by Hemant Kumar Pandey Law Relating to Intellectual property by Universal LexisNexis.</li> <li>4. Dr. B.L. Wadehra Intellectual Property Law, Universal Law Publishing Co. 6th Edition (2021).</li> <li>5. Dr. V K Ahuja Law relating to Intellectual Property Rights 9. Third Edition) by Universal LexisNexis.</li> <li>6. Lionel Bently &amp; Brad Sherman Principles of Intellectual Property Law Oxford University Press Publication. 5th Edition (2022).</li> </ol>																														

7. Mario Cimoli, Giovanni Dosi, Keith E. Maskus Intellectual Property Rights: Legal and Economic Challenges for Development by, Oxford University Press Publication. 1st Edition (2014).
8. Narayana P Intellectual Property Rights in India by, Eastern Law House Publication. 3rd Edition (2005).
9. Prabuddha Ganguli Intellectual Property Rights: Unleashing the Knowledge Economy by, Tata McGraw Hill Education Publication. 1st Edition (2001).
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11. Saurabh Bindal MCQ on Intellectual Property Law by Eastern Book Company (EBC) second Edition.
12. Siva Vaidhyanathan Intellectual Property: A Very Short Introduction, Oxford University Press Publication 1st Edition (2017).
13. V.K. Ahuja Law Relating to Intellectual Property Rights LexisNexis Publication. 3rd Edition (2022).
14. W.R. Cornish & David Llewelyn Intellectual Property: Patents, Copyright, Trade Marks & Allied Rights, Sweet & Maxwell Publication. 9th Edition (2019).

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

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

Semester- III

Title: Nature Educator

**Vertical - 4  
Skill Enhancement course (SEC3b)**

**With effect from the  
Academic Year 2026-27**

**Title: Nature Educator**  
**Course code: CHMZOOIII7**

S. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course offers hands-on training in biodiversity identification, conservation ethics, wildlife observation, and ecological studies, equipping students with essential skills for environmental education, sustainable tourism, and conservation efforts. With the growing demand in eco-tourism, research, and conservation sectors, the course connects with Environmental Science and Wildlife Management, opening up career opportunities as nature educators, conservationists, eco-tourism guides, and researchers.
2	<b>Vertical 4</b>	Skill Enhancement Course (SEC3b)
3	<b>Type</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	CO(A)1. To enhance learners' skills in applying responsible forest etiquette, administering first aid in wilderness settings, and utilizing wildlife photography techniques while observing and documenting wildlife behaviour. CO(A)2. To enable learners to analyze Indian forest ecosystems, biodiversity threats, and conservation strategies, including legal frameworks and protection measures, through case studies and field observations.
8	<b>Course Outcomes:</b> Upon completion of the course student will	<b>CO-1-</b> Implement ethical forest practices, provide first aid in outdoor environments, and effectively use wildlife photography equipment to document species and habitats. <b>CO-2-</b> Evaluate forest types, biodiversity threats, and conservation strategies while interpreting wildlife behavior and legal frameworks for species protection.
9	<b>Syllabus</b>	
	1. Practicing Forest Etiquette: A Guide for Responsible Nature Educators. (Dos and Don'ts during forest visit) 2. Introduction to Basic Equipments for Wildlife Photography: Camera (DSLR / Digital / Point & shoot), lenses, tripod, monopod, memory cards and batteries, smartphone, binoculars, weather protection gear. 3. Observation of social behaviour: alarm calls and mating calls in animals (birds, amphibians, mammals) (Based on field visits / recordings) . 4. Studying the tips to track Wildlife: Reading footprints and scat. 5. Common animal species found in Indian forests: Insects (weaver ant, tortoise beetle, Blue mormon butterfly, globe skimmer dragonfly, atlas moth, painted grasshopper), Amphibians (Tree frog, Bull frog, skittering frog, common toad), Reptiles (Spectacled Cobra, Russel's viper, common sand boa, Indian rock python, wolf snake, checkered keelback snake, oriental garden lizard), Aves (bulbuls, mynas, babblers, parakeets, bee-eater, Asian koel, kingfisher, lapwing), and Mammals (Langurs, Bonnet macaques, grey mongoose, jackal, leopard, Indian flying fox).	

6. Identification of marine intertidal fauna: Sea anemone, hermit crab, *Conus*, Mud skipper, Fiddler's crab, *Chiton*, *Nereis*, *Chthalamus*.
7. Identification of homes and architectures designs by animals: Tailor bird nest, weaver bird nest, lapwing nest, bat crevices, ant pagoda, termite hill, harvester ant nest, orb-weaver spider web.
8. Submit a report on the study of Biodiversity Hotspots in India:
  - The Western Ghats, The Himalayas, Indo-Burma (Northeastern India), Sundaland (Andaman and Nicobar Islands)
9. Submission of report on any one types of Indian Forests, and its related fauna.
10. Study of Indian Fauna Based on IUCN Red List Categories Examples of Indian Fauna for Each Category:
  - Extinct (EX) – Pink-headed Duck (*Rhodonessa caryophyllacea*)
  - Extinct in the Wild (EW) – Asiatic Cheetah (*Acinonyx jubatus venaticus*)
  - Critically Endangered (CR) – Snow leopard (*Panthera uncia*)
  - Endangered (EN) – Asiatic Lion (*Panthera leo persica*)
  - Vulnerable (VU) – Sloth Bear (*Melursus ursinus*)
  - Near Threatened (NT) – Purple frog (*Nasikabatrachus sahyadrensis*)
  - Least Concern (LC) – Indian Peafowl (*Pavo cristatus*)
  - Data Deficient (DD) – Slender racer snake (*Platyceps gracilis*)
  - Not Evaluated (NE) – Dromedary camel (*Camelus dromedarius*)
11. Preparation and submission of report on Wildlife Conservation Strategies in India: Case Studies and Impact Analysis (any one suitable example):
  - Project Tiger (Species-Specific Conservation)
  - Indian Rhino Vision 2020 (An initiative to increase the population of greater one-horned rhinos)
  - Olive Ridley Turtle Conservation at Velas Beach (Protected Area Conservation)
  - Nagaland Amur Falcon Conservation (Community-Based Conservation)
  - Captive Breeding of Gharials (Ex-Situ Conservation)
  - Vulture Conservation Project at Shriwardhan (Private Protected Area)
12. Visit to any National Park / Sanctuary / Zoo / Zoological Research Centre / Nocturnal Wildlife Observation / Suitable habitat and submit a report.

**10 Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)**

**A. External Practical Examination: Semester End External-30 marks Time: 2 hrs**

Format of Question Paper

S. No	Practical	Marks
Q.1	One Major experiment	07
Q.2	One Minor experiment	05
Q.3	Identification (any four)	08
Q.4	Field Report Submission & Viva	05
Q.5	Journal	05
<b>Total</b>		<b>30</b>

**B. Internal Examination (20 marks)**

No	Assessment / Evaluation	Marks
1.	Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment.	15
2.	Overall conduct as a responsible student,	5
<b>Total</b>		<b>20</b>

**11****References:**

1. David C. Coleman (1998). Soil Ecology and Management, Blackwell Publishing, ISBN: 9780471196688.
2. D. Ehrenfeld (1994). Conservation Biology: A Primer for the Twenty-First Century, Oxford University Press, ISBN: 9780195078747.
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17. William M. Adams (2004). The Conservation Handbook: Research, Management, and Policy, Blackwell Publishing, ISBN: 9781405106394.

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

**Second Year B.Sc.**

**Semester- III**

**Vertical – 5**

**Ability Enhancement Course (English)  
2 Credits**

**(To be offered to Students who  
opted Sindhi AEC in Sem I & II)**

**with effect from  
Academic Year 2026-2027**

**Title: Introduction to Communication Skills in English**

**Course Code: CHMBSCAECIV**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>Effective communication is the cornerstone of academic and professional success. This course introduces learners to foundational skills in English communication, with a focus on both oral and written competencies essential in academic, social, and workplace contexts. It aims to equip learners with the ability to read critically, write precisely, speak confidently, and listen actively. Emphasis is placed on building clarity, coherence, and conciseness in communication, along with an understanding of audience, purpose, and tone.</p> <p>The course integrates grammar reinforcement, vocabulary building, reading comprehension, and practice-oriented modules such as email etiquette, group discussion, and formal writing. Through dynamic classroom interactions and practical assessments, learners will gain confidence in using English effectively and purposefully.</p>
2	<b>Vertical 4</b>	Ability Enhancement Course
3	<b>Type</b> Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"><li>1. To introduce learners to the fundamentals of effective communication and its components.</li><li>2. To enhance learners' reading comprehension through exposure to multiple genres and contexts.</li><li>3. To develop grammatical accuracy and lexical resourcefulness for academic and professional communication.</li><li>4. To strengthen verbal and non-verbal presentation skills and promote interactive speaking abilities.</li></ol>

	5. To build competence in real-world writing tasks such as email drafting, bio-data preparation, and descriptive writing.
<b>8</b>	<b>Learning Outcomes:</b> Student will be able to LO-1: Understand and apply key principles of effective communication in varied contexts. LO-2: Comprehend and analyze written texts using appropriate reading strategies. LO-3: Recognize and correct common grammatical and lexical errors. LO-4: Engage in clear, confident, and context-appropriate spoken interactions. LO-5: Produce structured, coherent, and grammatically correct written content for academic and workplace use.

## Syllabus

### UNIT I: Foundations of English Communication

#### A) Core Concepts of Communication

- Principles of Effective Communication: The 7 Cs
- Verbal and Non-verbal Communication with Examples
- Cross-cultural Communication in the Globalized World
- Technology in Communication: Email, Messaging, Video Conferencing
- Listening for Detail and Intent: Barriers to Listening and Strategies

#### B) Reading Comprehension

- Understanding the Main Idea and Supporting Details
  - Interpreting Tone, Purpose, and Bias
  - Using Context Clues for Vocabulary Building
  - Reading Visual Texts: Graphs, Charts, and Infographics
- Sample readings will include excerpts from news articles, reports, editorials, and educational essays (200–250 words).*

#### C) Grammar and Vocabulary

- Subject-Verb Agreement
- Sentence Structures
- Punctuation and Capitalization
- Commonly Confused Words
- Editing and Proofreading Practice

*A remedial and functional approach will be followed with contextual exercises.*

### UNIT II: Applied Communication Skills

#### A) Speaking and Listening Skills

- Introducing Oneself in Academic/Professional Settings
- Participating in Group Discussions and Expressing Opinions
- Delivering a Short Speech (2–3 minutes) on Familiar Topics
- Understanding and Responding to Instructions
- Listening Comprehension Practice through Audio/Video Clips

#### B) Functional Writing Skills

- Formal Email Writing with Subject and Tone Sensitivity
- Descriptive Paragraph Writing (People, Places, Processes)
- Bio-data and Resume Writing
- Drafting Job Applications (Solicited and Unsolicited)
- Writing a Statement of Purpose

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**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Question No	Nature of Questions	Marks
Q. 1	<b>Short Notes (Attempt any 3 out of 5) - Unit 1</b> <b>OR</b> <b>Essay-Type Question (Attempt any 1 out of 2)- Unit 1</b>	15
Q. 2	<b>Short Notes (Attempt any 3 out of 5) - Unit 2</b> <b>OR</b> <b>Essay-Type Question (Attempt any 1 out of 2)- Unit 2</b>	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Students are required to draft a job application letter along with a resume using the following AI assistance: Canva Resume Builder, Resume.oi, Zety, Novopresume, Rezi etc <b>OR</b> Draft an SoP with the help of the following AI assistance: Quillbot, Yocket, Writesonic, Jasper AI	15
2.		05
	<b>Total</b>	<b>20</b>

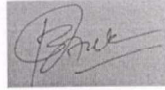
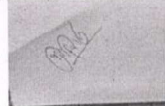

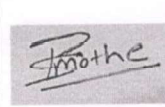
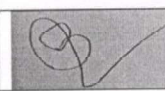
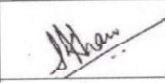
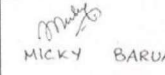
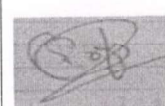
11

**REFERENCES:**

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8. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.

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11. Jones, Leo. *Functions of English: Communication Practice in English*. Cambridge UP, 1981.
12. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
13. Lynch, Tony. *Listening in Language Learning*. Longman, 1988.
14. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
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17. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
18. Straus, Jane, et al. *The Blue Book of Grammar and Punctuation*. 12th ed., Jossey-Bass, 2021.
19. Wallace, Catherine. *Reading*. Oxford UP, 1992.
20. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

### Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University)	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	 MICKY BARUA
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr.) Kailas Aute



Name & Signature of the Dean: Prof. (Dr.) Nitin Arekar



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

**Second Year**

**Semester - III**

**Title: Environmental Management and  
Sustainable Development-I**

**Vertical - 5  
VEC Subject - 2 Credits**

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

**Title: Environmental Management and Sustainable Development-I**  
**Course Code: CHMVECI**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course introduces students to the basics of environmental management and sustainable development. It explains how ecosystems work, the importance of biodiversity, and the need to protect our natural resources. Students will learn about different environmental problems, human impact on nature, and how to manage disasters. The course also covers Indian environmental movements, ethics, and the role of public awareness. Real-life examples and case studies help students understand the connection between nature and human communities in a simple and practical way.
2	<b>Vertical 5</b>	VEC
3	<b>Type &amp; Teaching Methods</b>	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To introduce about ecosystems, biodiversity and to make aware for the need of conservation.</p> <p><b>CO(A)2:</b> To sensitize students towards environmental concerns, issues, and impacts of human population.</p> <p><b>CO(A)3:</b> To analyze the impact of human population growth and development activities on the environment, including issues related to displacement, disaster response, and rehabilitation.</p> <p><b>CO(A)4:</b> To foster awareness of environmental ethics and the role of cultural and social movements in shaping sustainable environmental practices through communication, policy, and activism.</p>
8	<b>Course Outcomes:</b>	<p>Student will be able to</p> <p><b>CO1:</b> Explain the interrelationships within ecosystems and analyze energy flow and succession, using examples from various ecological zones.</p> <p><b>CO2:</b> Critically evaluate biodiversity levels and conservation strategies, applying knowledge of endemic species, threats, and ecological services to real-world scenarios.</p> <p><b>CO3:</b> Assess the socio-environmental implications of population growth, displacement, and disasters, incorporating case studies to understand sustainable development challenges.</p> <p><b>CO4:</b> Demonstrate an understanding of environmental ethics and advocacy, by interpreting the influence of cultural values, environmental movements, and communication strategies on sustainability.</p>

## Syllabus

### UNIT I: Ecosystems, Biodiversity and Conservation

- Introduction, structure, and function of ecosystems; Energy flow: food chains, food webs and ecological succession. Case studies of the following:
  - Forest ecosystem
  - Grassland ecosystem
  - Desert ecosystem
  - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
- Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns.
- India as a mega-biodiversity nation; Endangered and endemic species of India.
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value.

### UNIT II: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g. CNG vehicles in Delhi).

### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hours**

Format of Question Paper

**Attempt any 3 out of 4 questions.**

Question No	Nature of Questions	Marks
Q1	Theory based on Unit I	10
Q2	Theory based on Unit I	10
Q3	Theory based on Unit II	10
Q4	Theory based on Unit II	10
<b>TOTAL</b>		<b>30</b>

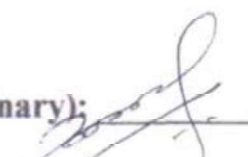
**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test, Creative writing/visits/role play (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Quiz)	10
2.	Project /Presentation / Viva/Group Discussion/Case study	10
<b>TOTAL</b>		<b>20</b>

**11****REFERENCES:**

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5. Sodhi, N. S., Gibson, L., & Raven, P. H. (Eds.). (2013). *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
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9. Harper, Charles L. (2017). *Environment and Society: Human Perspectives on Environmental Issues* (6th Edition). Routledge.
10. Rajagopalan, R. (2011). *Environmental Studies: From Crisis to Cure*. Oxford University Press.
11. Harris, Frances (2012). *Global Environmental Issues* (2nd Edition). Wiley-Blackwell.

Name &amp; Signature of the Dean &amp; Ad-hoc BoS Chairperson (Interdisciplinary):

  
Dr. Nitin Arekar

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

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

**Semester- III & IV**

**Title: Field Project**

**Vertical - 6  
FP – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Field Project

Course code:

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	The Field Project course, introduced under CHM Autonomy in alignment with the NEP 2020, aims to bridge theoretical knowledge with practical experience. It provides students with hands-on exposure to real-world socio-economic contexts through field visits, observation, and analysis in both urban and rural settings. By engaging directly with development-related issues, students enhance their research, problem-solving, and analytical skills while fostering social responsibility and environmental awareness. The course ultimately prepares learners for employability and active participation in nation-building.
2	<b>Vertical 6</b>	Field Project
3	<b>Type &amp; Teaching Methods</b>	Field work
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	
		1. To connect theoretical learning with real-world socio-economic contexts through practical field experiences. 2. To develop analytical, problem-solving, and teamwork skills in addressing contemporary social issues. 3. To cultivate an appreciation for research and its role in promoting societal and national development.
8	<b>Learning Outcomes:</b>	
	<b>students will be able to:</b>	
	<b>LO1:</b> Apply classroom knowledge to analyze real-life socio-economic challenges effectively.	
	<b>LO2:</b> Demonstrate critical thinking, teamwork, and decision-making skills through field-based activities.	
	<b>LO3:</b> Reflect on the relevance of research and experiential learning in contributing to social and national progress.	

## Guidelines for Field Project

Following are the general guidelines for the conduct of Field Project (Semester III & IV)

### Head of the Department (HOD)/ Field Project Co-ordinator

1. To ensure that FP program aligns with departmental and academic objectives as per NEP Structure within syllabus framework.
2. Appointment of field project incharges from the faculty of the department for group of Students.
3. To conduct orientation of FP Supervisor and decide the time line of the project.
4. To support the student for Filed Project.

### FP Supervisor:

1. To give Guidelines for the field project.
2. To monitor student progress and provide guidance.

### Project (Dissertation) Report:

Students are required to submit a report of the field project at the end of the semester in following suggested format.

The project should be typed on A4 sheets  
 Font Size 12, Times New Roman, 1.5 line Spacing  
 The project report shall have student details with signature of Field Project Incharge and photographs if any and it should be of minimum of 10 pages.

10

### Scheme of Examination and Assessment Pattern



**External Examination: Semester End External - 30 marks**  
**Format of Question Paper**


Nature of Evaluation	Marks
Field Project Report	30
<b>Total 30</b>	

### **Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Involvement in Survey of Field Project /	05
2.	Field visit participation & completion	10
3.	Overall Impression	05
<b>Total 20</b>		

<p>11</p>	<p style="text-align: center;"><b>Appendix I</b></p> <p style="text-align: center;"><b>Attendance of the Student: Active Participation</b></p> <p>I, the undersigned Ms / Mr. _____ Roll No. ___ studying in the _____ Year of _____ Full-time Course is doing my project work under the guidance of Dr./Ms./Mr. _____, I wish to state that I have met my Internal guide on the following dates mentioned below for Project Guidance: -</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Sr.No.</th> <th style="text-align: center;">Date</th> <th style="text-align: center;">Signature of the Internal Guide</th> </tr> </thead> <tbody> <tr> <td style="height: 40px;"> </td> <td> </td> <td> </td> </tr> <tr> <td style="height: 40px;"> </td> <td> </td> <td> </td> </tr> <tr> <td style="height: 40px;"> </td> <td> </td> <td> </td> </tr> </tbody> </table> <p style="text-align: center;">_____</p> <p style="text-align: center;"><b>Signature of the Candidate Supervisor</b></p> <p style="text-align: center;">_____</p> <p style="text-align: center;"><b>Signature of Field Project Supervisor</b></p>	Sr.No.	Date	Signature of the Internal Guide									
Sr.No.	Date	Signature of the Internal Guide											
	<p style="text-align: center;"><b>Appendix II</b></p> <p style="text-align: center;"><b>Name of the Department/College/Institute</b></p> <p style="text-align: center;"><b>Certificate</b></p> <p>I hereby certify that Mr./Ms. _____ Student of _____ studying in _____, has completed a project titled _____ in the area of _____ specialization for the academic year 2025-2026 to the best of my knowledge the work of the student is original and the information included in the project is correct.</p> <p style="text-align: center;">_____</p> <p style="text-align: center;"><b>Field Project Supervisor</b></p> <p style="text-align: center;">_____</p> <p style="text-align: center;"><b>Head of the Department/Principal</b></p>												

   
**Board of Examination**

  
**Principal & Chief Controller**  
**Board of Examination**

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

**First Year**

**Semester- III**

**Title: Cocurricular Course I**

**Vertical - 6  
Cocurricular Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Cocurricular Course - I**

**Course Code: CHMCCI6**


Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year.</p> <p>Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting.</p> <p>This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.</p>
2	<b>Vertical 6</b>	Cocurricular Course (Mandatory)
3	<b>Type Teaching Methods</b>	Non Theory Participation, Report Writing, Presentation etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities.</li> <li>2. To enhance personal and interpersonal skills through real-life experiences and teamwork.</li> <li>3. To foster a sense of responsibility, leadership, and community engagement among students.</li> <li>4. To develop self-confidence and emotional well-being through creative expression and collaboration.</li> <li>5. To integrate classroom learning with experiential learning for holistic growth.</li> </ol>
8	<b>Learning Outcomes:</b>	<p>By the end of the course, students will be able to:</p> <p><b>LO1:</b> Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences.</p> <p><b>LO2:</b> Demonstrate improved communication, leadership, and teamwork skills.</p> <p><b>LO3:</b> Exhibit increased awareness of social responsibility and civic engagement.</p> <p><b>LO4:</b> Build confidence through creative, cultural, and intellectual expressions.</p> <p><b>LO5:</b> Maintain a portfolio or activity log to track participation and personal development.</p>

9	<b>Syllabus</b>																											
	<b>Unit I - Suggested Areas of Participation in the activities:</b> <ul style="list-style-type: none"> <li>• <b>Cultural Events:</b> Drama, dance, music, literary events, debates, etc.</li> <li>• <b>Social Outreach:</b> Blood donation, awareness campaigns, cleanliness drives.</li> <li>• <b>Clubs &amp; Societies:</b> Photography, quiz, environment club, shram club, etc.</li> <li>• <b>Sports &amp; Fitness:</b> College tournaments, yoga, marathons, fitness challenges.</li> <li>• <b>Institutional Events:</b> Foundation Day, Annual Day, College Festivals, Intercollegiate events.</li> <li>• <b>National Festivals:</b> Independence Day, Republic Day etc.</li> </ul> <b>Unit II - Program Specific Topics</b> <ul style="list-style-type: none"> <li>• <b>Workshops/Seminars:</b> Report Writing, Personality Development, Soft Skills, Leadership Talks.</li> <li>• <b>Speak, Show, Shine:</b> Presentation / Poster Presentation / Viva and Learning Experience</li> </ul> <b>Mode of Evaluation:</b> <ul style="list-style-type: none"> <li>• <b>Faculty Coordinator:</b> To guide and evaluate student progress.</li> <li>• <b>Participation Proof:</b> Certificates, photos, attendance records.</li> <li>• <b>Reflective Journal:</b> Minimum 2–3 pages summarizing experiences, learning, and growth.</li> <li>• <b>Final Viva/Presentation:</b> 5-minute talk on poster presentation and on overall learning.</li> </ul>																											
10	<b>Scheme of Examination and Assessment Pattern Based on 3 approved Activities Semester End External - 30 marks</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Activity No</th> <th style="width: 65%;">Nature of Activities</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Title of Approved Activity - 1</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Title of Approved Activity - 2</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Title of Approved Activity - 3</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table> <b>Internal Examination: Continuous Evaluation – 20 marks</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 75%;">Assessment / Evaluation</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Reflective journal</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Presentation/ poster presentation/viva</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>	Activity No	Nature of Activities	Marks	1.	Title of Approved Activity - 1	10	2.	Title of Approved Activity - 2	10	3.	Title of Approved Activity - 3	10	<b>Total</b>		<b>30</b>		Assessment / Evaluation	Marks	1.	Reflective journal	10	2.	Presentation/ poster presentation/viva	10	<b>Total</b>		<b>20</b>
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	Assessment / Evaluation	Marks																										
1.	Reflective journal	10																										
2.	Presentation/ poster presentation/viva	10																										
<b>Total</b>		<b>20</b>																										

**Suggested Readings:**

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

  
 Dr. Manju Lalwani Pathak



**HSNC Board's  
Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar  
(Autonomous)**

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

**Semester-IV**

**Choice Based and Credit Based Syllabus**

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

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

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

**Semester- IV**

**Title: Genetics**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2025-26**

**Title: Genetics**  
**Course code: CHMZOOIV1**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	The course provides a strong foundation in genetics and molecular biology, covering key topics such as Mendelian inheritance, chromosomal mechanisms, and gene expression. It then progresses to more advanced subjects like mutations, genetic disorders. These concepts are crucial for breakthroughs in medical genetics, biotechnology, and forensic science. With the rising demand in healthcare, pharmaceuticals, and bioinformatics, the course opens up diverse career opportunities in research, diagnostics, and genetic counselling. Additionally, it complements studies in biotechnology, biochemistry, and environmental science, promoting interdisciplinary innovation and real-world applications.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Theory
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<p><b>Course Objectives:</b></p> <p><b>CO(A)1.</b> To understand the fundamental principles of genetics, including Mendelian inheritance, chromosomal basis of heredity, gene interactions, linkage, crossing over, and patterns of inheritance.</p> <p><b>CO(A)2.</b> To explain the mechanisms of sex determination, chromosomal abnormalities, genetic disorders, and the molecular and chromosomal basis of inheritance in living organisms.</p> <p><b>CO(A)3.</b> To analyze patterns of inheritance using genetic principles, pedigree analysis, and probability to interpret normal and abnormal genetic traits in humans and other organisms.</p> <p><b>CO(A)4.</b> To develop scientific reasoning, ethical awareness, and problem-solving skills by applying genetic concepts to genetic counselling, disease diagnosis, and contemporary issues in human genetics.</p>	
8	<p><b>Course Outcomes:</b> Upon completion of this course student will</p> <p><b>CO1:</b> Explain the basic concepts of genetics, Mendel's laws of inheritance, chromosomal basis of heredity, gene interactions, linkage, crossing over, and extranuclear inheritance.</p> <p><b>CO2:</b> Apply the principles of inheritance, probability, and genetic crosses to predict inheritance patterns and solve genetics-related problems involving Mendelian and non-Mendelian traits.</p> <p><b>CO3:</b> Analyze the mechanisms of sex determination, chromosomal mutations, and the genetic basis of inherited disorders by interpreting pedigree charts and patterns of inheritance.</p> <p><b>CO4:</b> Evaluate the role of genetic counselling, pedigree analysis, and ethical considerations in the diagnosis, prevention, and management of hereditary disorders and genetic diseases.</p>	

**Unit I: Genetics I**

- **Introduction to Genetics:**

Definition and scope and importance of genetics

Brief explanation of the following terms: Allele, Wild type and Mutant alleles, Locus, Dominant and Recessive traits, Homozygous and Heterozygous, Genotype and Phenotype, Genome, Cistron, Muton, Recon.

- **Mendelism and heredity**

Mendel's laws of inheritance (Law of segregation, Law of Independent Assortment)

Types of Genetic crosses (Monohybrid, Dihybrid, Test cross, Back cross)

Chromosomal basis of inheritance

Mendelian inheritance and Laws of Probability

- **Extension of Mendelism**

Dominance relationships: Complete Dominance, Incomplete Dominance and Co-dominance

Lethal Alleles (Dominant, recessive and intermediate lethal)

Multiple Alleles

Polygenic Inheritance

Epistasis

Pleiotropy

- **Linkage:** Concept and Types – Complete and Incomplete

- **Crossing Over:** Stern's experiment, mechanism and types

- **Extrachromosomal / Maternal inheritance**

**Unit II: Genetics II**

- **Sex determination and sex linkages**

Types of sex determination (XX/XO, XX/XY, ZZ/ZW and haplo- diploidy) Genic balance theory

Environment and sex determination – Bonellia and crocodiles

Sex linked determination– Colour blindness, haemophilia, hypertrichosis of the ear

Sex-influenced and sex-limited traits

- **Nondisjunction and its implications**

Deletion and its types

Duplication and its types

Inversion

Translocation

- **Genetic disorders**

Inborn errors of metabolism (PKU, Alkaptonuria, Albinism, G6PD deficiency)

Single gene disorder (cystic fibrosis)

Multifactorial (Breast cancer)

Genetic imprinting / Uniparental disomy (Prader-Willi and Angelman syndrome)

- **Genetic counselling and Pedigree analysis (Symbols and types)**

Genetic counselling (Introduction, process, ethical and legal issues)

Pedigree analysis (Symbols and types)

<b>10</b>	<b>Scheme of Examination and Assessment Pattern (Paper – 50 Marks)</b>		
	<b>A. External Examination: Semester End External - 30 marks</b>		<b>Time: 1:00 hour</b>
	Format of Question Paper		
	<b>Attempt all questions.</b>		
	S. No.	Questions	Marks
	Q.1.	Attempt any three out of six from Unit I	15
	Q. 1	Attempt any three out of six from Unit II	15
	<b>Total</b>		30
	<b>Note:</b> Equal Weightage is to be given to all the Units.		
	<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>		
	<b>Assessment / Evaluation</b>	<b>Marks</b>	
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.	15	
2.	Overall conduct as a responsible student and attentiveness	05	
		<b>Total 20</b>	
<b>11</b>	<b>Suggested Readings/References:</b>		
	<ul style="list-style-type: none"> <li>● Fraser, G. R., Mayo, O. (1975). Textbook of Human Genetics. Blackwell Scientific. ISBN 9780632089901, 0632089903.</li> <li>● Griffiths, A. J. (2004). An Introduction to Genetic Analysis. WH Freeman and Company. ISBN 0716749394.</li> <li>● Hartl, D. L. (2018). Essential genetics and genomics. 7th edition. Jones &amp; Bartlett Learning. ISBN 9781284152456, 1284152456.</li> <li>● Mange, E. J., Mange, A. P. (1999). Basic Human Genetics. United States: Sinauer Associates, Incorporated. ISBN 9780878934973, 0878934979.</li> <li>● Pierce, B. A. (2020). Genetics: a conceptual approach. 7th edition. Macmillan International Higher Education. ISBN 2019952819, 9781319297145.</li> <li>● Russell, P. J. (2009). Genetics. 3rd edition. San Francisco: Benjamin Cummings. ISBN 0321569768, 9780321569769.</li> <li>● Simmons, M. J., &amp; Snustad, D. P. (2015). Principles of genetics. 7th edition. John Wiley &amp; Sons. ISBN 1119142288, 9781119142287.</li> </ul>		
	<b>ONLINE TOOLS AND WEB RESOURCES</b>		
	<ul style="list-style-type: none"> <li>● <a href="https://swayam.gov.in/courses/4922-genetics-and-genomics">https://swayam.gov.in/courses/4922-genetics-and-genomics</a></li> <li>● <a href="https://www.coursera.org/learn/genetics-evolution">https://www.coursera.org/learn/genetics-evolution</a></li> <li>● <a href="https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/">https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/</a></li> <li>● <a href="https://learn.genetics.utah.edu/">https://learn.genetics.utah.edu/</a></li> </ul>		

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

**Second Year B. Sc.  
(Zoology)  
Semester- IV**

**Title: Molecular Biology**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2025-26**

## Title: Molecular Biology

Course Code: CHMZOOIV2

S. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course explores molecular biology, covering topics such as nucleic acid structure, genome organization, replication, gene expression, and mutations. It plays a crucial role in biotechnology, genetic engineering, and medical research, addressing industry needs in healthcare, pharmaceuticals, and forensic science. Career prospects include roles in research, diagnostics, and bioinformatics. Additionally, the course integrates with genetics, biotechnology, and biochemistry, fostering interdisciplinary progress.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Theory
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives: The objective of the course is to enable the learners to</b>	<p><b>CO(A)1. Understand</b> the structure, organization, and biological significance of nucleic acids, genome organization, and the molecular basis of heredity.</p> <p><b>CO(A)2. Explain</b> the mechanisms of DNA replication, gene expression, and mutations, and their roles in maintaining genetic continuity and generating biological variation.</p> <p><b>CO(A)3. Analyze</b> the experimental evidence supporting DNA and RNA as genetic material, and interpret the molecular mechanisms underlying genetic information flow.</p> <p><b>CO(A)4. Develop</b> scientific reasoning and problem-solving skills by applying molecular biology concepts to modern biotechnological tools such as Polymerase Chain Reaction (PCR) and DNA fingerprinting.</p>
8	<b>Course Outcomes:</b> Upon completion of this course, students will	<p><b>CO1:</b> Describe the structure, organization, and biological functions of DNA, RNA, genomes, chromosomes, and extrachromosomal genetic material, and explain the experimental evidence establishing nucleic acids as the genetic material.</p> <p><b>CO2:</b> Explain the molecular mechanisms of DNA replication, the genetic code, and protein synthesis, and relate these processes to the flow of genetic information in prokaryotic and eukaryotic cells.</p> <p><b>CO3:</b> Analyze different types of gene mutations, the action of physical and chemical mutagens, and their consequences on gene expression and protein function.</p> <p><b>CO4:</b> Evaluate the principles, applications, and significance of modern molecular biology techniques such as Polymerase Chain Reaction (PCR) and DNA fingerprinting in research, medicine, forensic science, and biotechnology.</p>

9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>Unit I: Molecular Biology I</b></p> <ul style="list-style-type: none"> <li>○ <b>Nucleic Acids</b> Structure of Nucleic acids – DNA and RNA A, B, Z forms of DNA, Supercoiled DNA, Relaxed DNA Types of RNA – non-genetic (mRNA, tRNA and rRNA) and genetic RNA Biological Significance of Nucleic acids</li> <li>○ <b>DNA as a Genetic Material</b> Griffith's transformation experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment</li> <li>● <b>RNA as a Genetic Material:</b> TMV experiment</li> <li>● <b>Genome and Its Organization</b> Concept of gene, intron and exons, regulatory sequences Packaging of DNA into chromosomes Extrachromosomal DNA – Chloroplast DNA and Mitochondrial DNA</li> </ul> <p><b>Unit II: Molecular Biology - II</b></p> <ul style="list-style-type: none"> <li>○ <b>DNA Replication:</b> Prokaryotic, Eukaryotic</li> <li>○ <b>Gene Expression:</b> Genetic Code with properties, Protein Synthesis</li> <li>○ <b>Mutation:</b> Types of Mutation Point mutations - substitution, deletion and insertion mutations Substitution mutations - silent, missense and nonsense mutations, transition and transversion Deletion and Insertion mutations - frameshift mutations Mutagens – Physical and Chemical Mutagens</li> <li>● <b>Recent advances in Molecular Biology</b> Polymerase Chain Reaction DNA Fingerprinting</li> </ul>																											
10	<p style="text-align: center;"><b>Scheme of Examination and Assessment Pattern (Paper – 50 Marks)</b></p> <p><b>A. External Examination: Semester End External - 30 marks</b> <span style="float: right;"><b>Time: 1:00 hour</b></span> Format of Question Paper</p> <p><b>Attempt all questions.</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S. No.</th> <th style="width: 70%;">Evaluation type</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>S. No.</td> <td>Questions</td> <td>Marks</td> </tr> <tr> <td>Q.1.</td> <td>Attempt any three out of six from Unit I</td> <td>15</td> </tr> <tr> <td>Q. 2</td> <td>Attempt any three out of six from Unit II</td> <td>15</td> </tr> <tr> <td colspan="2">Total</td> <td>30</td> </tr> </tbody> </table> <p><b>Note:</b> Equal Weightage is to be given to all the Units.</p> <p><b>C. Internal Examination: Continuous Evaluation - 20 marks</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 80%;">Assessment / Evaluation</th> <th style="width: 15%;">Marks</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations, or quizzes.</td> <td>15</td> </tr> <tr> <td>3.</td> <td>Overall conduct as a responsible student and attentiveness</td> <td>05</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td><b>20</b></td> </tr> </tbody> </table>	S. No.	Evaluation type	Marks	S. No.	Questions	Marks	Q.1.	Attempt any three out of six from Unit I	15	Q. 2	Attempt any three out of six from Unit II	15	Total		30		Assessment / Evaluation	Marks	1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations, or quizzes.	15	3.	Overall conduct as a responsible student and attentiveness	05	<b>Total</b>		<b>20</b>
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11

**Suggested Readings/References:**

- Ankaneccha Jain, Richa Jain and Saurabh Jain (2020). Basic Techniques in Biochemistry, Microbiology and Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-1493998609.
- Green, M. R., & Sambrook, J. (2013). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press. ISBN 978-1621821045.
- Karp, G. (Year). Cell and molecular biology: A laboratory manual (8th ed.). Wiley. ISBN 978-1119553441.
- Madhuri, A. (2023). Molecular biology and microbial genetics with practicals. Divya Lakshmi Publishers and Distributors. ISBN 978-9391576233.
- Mamata Behera, M, Swain, R., Singh, A. P. (2024). A Practical manual on fundamentals of Genetics. Bigfoot Publications, ISBN 978-8197034770.
- N. Arumugam (2019). Cell Biology and Molecular Biology - Saras publications
- Robert J. Slater (1986). Experiments in Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-0-89603-082-4.
- Simmonds, P. J. R., & McAllister, S. W. (Year). Experiments in molecular biology. Pearson Education. ISBN 978-0321541161.
- Suchetha Kumari N (2018). Multidisciplinary Research Methods - A Practical Manual - A Practical Manual. Paras Medical Books. ISBN 9789386480323.
- Verma P.S. and Agarwal V.K. (2004). Molecular Biology- ISBN-13: 978-8121931915- S. Chand Publications.
- Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2004). Molecular biology of the gene (xth ed.). Pearson. ISBN 978-0805346428.
- Zhang. S., & Li, P. (2017). Essential experiments for molecular biology: A student's guide (Paperback). Medtech Publication. ISBN 978-9386479136.

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

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

Semester- IV

Title: Practical based on Genetics and  
Molecular Biology

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2025-26**

**Title: Practical based on Genetics and Molecular Biology**  
**Course code: CHMZOOIV3**

<b>1</b>	<b>Description the Course:</b>	<p>The hands-on practical course in genetics and molecular biology provides students with essential laboratory skills to study heredity, and molecular mechanisms governing life. Covering fundamental topics such as Mendelian inheritance, chromosomal organization, and gene expression, the course progresses to advanced concepts like mutations, and genetic disorders. Students will gain experience in DNA extraction, gel electrophoresis, and karyotyping.</p> <p>The practical course in molecular biology provides students with hands-on experience in key laboratory techniques, including DNA/RNA extraction and estimation, and gel electrophoresis.</p>
<b>2</b>	<b>Vertical 1</b>	Major
<b>3</b>	<b>Type</b>	Practicum
<b>4</b>	<b>Credit</b>	2
<b>5</b>	<b>Hours allotted</b>	60 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks
<b>7</b>	<p><b>Course Objectives:</b> The objective of the course is to train the learners to</p> <p><b>CO(A)1.</b> Develop proficiency in fundamental laboratory techniques related to genetics and molecular biology, including nucleic acid extraction, cytological preparations, chromosome analysis, and molecular biology instrumentation.</p> <p><b>CO(A)2.</b> Apply experimental and analytical methods to investigate cell division, patterns of inheritance, pedigree analysis, and quantitative genetic data using standard scientific procedures.</p> <p><b>CO(A)3.</b> Interpret experimental observations and solve genetics and molecular biology problems by integrating theoretical knowledge with laboratory findings.</p> <p><b>CO(A)4.</b> Demonstrate scientific inquiry, laboratory ethics, biosafety, data analysis, technical reporting, and effective communication skills through practical exercises and virtual laboratory experiences.</p>	
<b>8</b>	<p><b>Course Outcomes:</b> Upon completion of the course, the learners will:</p> <p><b>CO 1.</b> Perform basic molecular biology and cytogenetic techniques, including DNA and RNA extraction, nucleic acid detection, Barr body staining, mitotic studies, and chromosome morphology analysis using appropriate laboratory procedures.</p> <p><b>CO 2.</b> Analyze cytological and genetic data by calculating the mitotic index, RNA/DNA ratio, and solving problems related to Mendelian inheritance, X-linked inheritance, multiple alleles, and pedigree analysis.</p> <p><b>CO 3.</b> Identify and explain the principles, functions, and applications of essential molecular biology laboratory instruments, and demonstrate awareness of their role in research, diagnostics, and biotechnology.</p> <p><b>CO 4.</b> Record, interpret, and communicate experimental observations through laboratory reports and virtual laboratory activities while adhering to laboratory safety, ethical practices, and scientific documentation standards.</p>	

9	<p style="text-align: center;"><b>Syllabus</b></p> <ol style="list-style-type: none"> <li>1. Extraction by SDS method and detection of DNA by DPA method from onion.</li> <li>2. Extraction by phenol method and detection of RNA by Orcinol method from onion.</li> <li>3. Observation of Barr bodies – staining and mounting.</li> <li>4. Study of Mitosis using onion root tip.</li> <li>5. Calculation of mitotic index using photographs.</li> <li>6. Problems based on monohybrid, dihybrid, X-linked inheritance and multiple alleles.</li> <li>7. Study of chromosome morphology.</li> <li>8. Pedigree analysis (identification of symbols and problems).</li> <li>9. Calculation of RNA / DNA ratio from given data.</li> <li>10. Identification of various Molecular Biology laboratory instruments — Gel electrophoresis instrument, Laminar Air flow, Gel Documentation System, DNA Sequencer, Microcentrifuge Cryogenic Freezer, Thermocycler, Nano drop.</li> <li>11. Problems based on Molecular Biology.</li> <li>12. Visit to virtual lab of molecular biology laboratory and submission of report.</li> </ol>																			
10	<p style="text-align: center;"><b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b></p> <p><b>A. External Practical Examination: Semester End External</b>  <b>30 marks</b> <span style="float: right;"><b>Time: 2 hrs</b></span></p> <p style="text-align: center;">Format of Question Paper</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;">Q.1</td> <td style="width: 70%;">           Colorimetric estimation of DNA by DPA method  <b>OR</b>            Colorimetric estimation of RNA by Orcinol method         </td> <td style="width: 20%; text-align: center;">07</td> </tr> <tr> <td style="text-align: center;">Q.2</td> <td>           Preparation of mitotic chromosomes using onion root tip.  <b>OR</b>            Mounting and staining of Barr bodies in squamous epithelium.  <b>OR</b>            a. Problems (any one) based on monohybrid/ dihybrid/ test cross /back cross            b. Calculation of RNA: DNA ratio from given data  <b>OR</b>            a. Problems on Molecular Biology (any one)            b. Calculation of mitotic index         </td> <td style="text-align: center;">05</td> </tr> <tr> <td style="text-align: center;">Q.3</td> <td> <b>Identify and describe:</b>            a) Mendelian trait in humans/ Chromosome morphology            b) Pedigree symbol            c) Gel electrophoresis instrument / Laminar Air flow / Gel Documentation System / DNA Sequencer            d) Microcentrifuge / Cryogenic Freezer / Thermocycler / Nano drop         </td> <td style="text-align: center;">08</td> </tr> <tr> <td style="text-align: center;">Q.4</td> <td><b>Virtual lab visits report &amp; Viva</b></td> <td style="text-align: center;">05</td> </tr> <tr> <td style="text-align: center;">Q.5</td> <td><b>Certified journal</b></td> <td style="text-align: center;">05</td> </tr> <tr> <td></td> <td><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </table>		Q.1	Colorimetric estimation of DNA by DPA method <b>OR</b> Colorimetric estimation of RNA by Orcinol method	07	Q.2	Preparation of mitotic chromosomes using onion root tip. <b>OR</b> Mounting and staining of Barr bodies in squamous epithelium. <b>OR</b> a. Problems (any one) based on monohybrid/ dihybrid/ test cross /back cross b. Calculation of RNA: DNA ratio from given data <b>OR</b> a. Problems on Molecular Biology (any one) b. Calculation of mitotic index	05	Q.3	<b>Identify and describe:</b> a) Mendelian trait in humans/ Chromosome morphology b) Pedigree symbol c) Gel electrophoresis instrument / Laminar Air flow / Gel Documentation System / DNA Sequencer d) Microcentrifuge / Cryogenic Freezer / Thermocycler / Nano drop	08	Q.4	<b>Virtual lab visits report &amp; Viva</b>	05	Q.5	<b>Certified journal</b>	05		<b>Total</b>	<b>30</b>
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Q.5	<b>Certified journal</b>	05																		
	<b>Total</b>	<b>30</b>																		

**B. Internal Examination (20 marks)**

	Assessment / Evaluation	Marks
1.	Evaluation through: Quizzes/ Class Tests/ Presentation/ Project/ Role play/ Filed visit/ Creative writing/ Assignment.	15
2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	5
<b>Total</b>		<b>20</b>

**11 Suggested reading/References:**

- Ankancha Jain, Richa Jain and Saurabh Jain (2020). Basic Techniques in Biochemistry, Microbiology and Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-1493998609.
- Green, M. R., & Sambrook, J. (2013). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press. ISBN 978-1621821045.
- Karp, G. (Year). Cell and molecular biology: A laboratory manual (8th ed.). Wiley. ISBN 978-1119553441.
- Madhuri, A. (2023). Molecular biology and microbial genetics with practicals. Divya Lakshmi Publishers and Distributors. ISBN 978-9391576233.
- Mamata Behera, M, Swain, R., Singh, A. P. (2024). A Practical manual on fundamentals of Genetics. Bigfoot Publications, ISBN 978-8197034770.
- Pranab Kumar Banerjee (2011). Problems on Genetics Molecular Genetics and Evolutionary Genetics. New Central Book Agency; 2nd edition
- Robert J. Slater (1986). Experiments in Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-0-89603-082-4.
- Simmonds, P. J. R., & McAllister, S. W. Experiments in molecular biology. Pearson Education. ISBN 978-0321541161.
- Suchetha Kumari N (2018). Multidisciplinary Research Methods - A Practical Manual - A Practical Manual. Paras Medical Books. ISBN 9789386480323.
- Zhang. S., & Li, P. (2017). Essential experiments for molecular biology: A student's guide (Paperback). Medtech Publication. ISBN 978-9386479136.

**ONLINE TOOLS AND WEB RESOURCES**

- <https://swayam.gov.in/courses/4922-genetics-and-genomics>
- <https://www.coursera.org/learn/genetics-evolution>
- <https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/>
- <https://learn.genetics.utah.edu/>

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

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

Semester- IV

Title: Molecular Biology

**Vertical - 2  
Minor Subject – 2 Credit**

**With effect from the  
Academic Year 2025-26**

## Title: Molecular Biology

Course Code: CHMZOOIV4

S. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course explores molecular biology, covering topics such as nucleic acid structure, genome organization, replication, gene expression, and mutations. It plays a crucial role in biotechnology, genetic engineering, and medical research, addressing industry needs in healthcare, pharmaceuticals, and forensic science. Career prospects include roles in research, diagnostics, and bioinformatics. Additionally, the course integrates with genetics, biotechnology, and biochemistry, fostering interdisciplinary progress.
2	<b>Vertical 2</b>	Minor
3	<b>Type</b>	Theory
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives: The objective of the course is to enable the learners to</b>	<p><b>CO(A)1. Understand</b> the structure, organization, and biological significance of nucleic acids, genome organization, and the molecular basis of heredity.</p> <p><b>CO(A)2. Explain</b> the mechanisms of DNA replication, gene expression, and mutations, and their roles in maintaining genetic continuity and generating biological variation.</p> <p><b>CO(A)3. Analyze</b> the experimental evidence supporting DNA and RNA as genetic material, and interpret the molecular mechanisms underlying genetic information flow.</p> <p><b>CO(A)4. Develop</b> scientific reasoning and problem-solving skills by applying molecular biology concepts to modern biotechnological tools such as Polymerase Chain Reaction (PCR) and DNA fingerprinting.</p>
8	<b>Learning Outcomes: Upon completion of this course, students will</b>	<p><b>CO1:</b> Describe the structure, organization, and biological functions of DNA, RNA, genomes, chromosomes, and extrachromosomal genetic material, and explain the experimental evidence establishing nucleic acids as the genetic material.</p> <p><b>CO2:</b> Explain the molecular mechanisms of DNA replication, the genetic code, and protein synthesis, and relate these processes to the flow of genetic information in prokaryotic and eukaryotic cells.</p> <p><b>CO3:</b> Analyze different types of gene mutations, the action of physical and chemical mutagens, and their consequences on gene expression and protein function.</p> <p><b>CO4:</b> Evaluate the principles, applications, and significance of modern molecular biology techniques such as Polymerase Chain Reaction (PCR) and DNA fingerprinting in research, medicine, forensic science, and biotechnology.</p>

9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>Unit I: Molecular Biology I</b></p> <ul style="list-style-type: none"> <li>○ <b>Nucleic Acids</b> Structure of Nucleic acids – DNA and RNA A, B, Z forms of DNA, Supercoiled DNA, Relaxed DNA Types of RNA – non-genetic (mRNA, tRNA and rRNA) and genetic RNA Biological Significance of Nucleic acids</li> <li>○ <b>DNA as a Genetic Material</b> Griffith's transformation experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment</li> <li>● <b>RNA as a Genetic Material:</b> TMV experiment</li> <li>● <b>Genome and Its Organization</b> Concept of gene, intron and exons, regulatory sequences Packaging of DNA into chromosomes Extrachromosomal DNA – Chloroplast DNA and Mitochondrial DNA</li> </ul> <p><b>Unit II: Molecular Biology - II</b></p> <ul style="list-style-type: none"> <li>○ <b>DNA Replication:</b> Prokaryotic, Eukaryotic</li> <li>○ <b>Gene Expression:</b> Genetic Code with properties, Protein Synthesis</li> <li>○ <b>Mutation:</b> Types of Mutation Point mutations - substitution, deletion and insertion mutations Substitution mutations - silent, missense and nonsense mutations, transition and transversion Deletion and Insertion mutations - frameshift mutations Mutagens – Physical and Chemical Mutagens</li> <li>● <b>Recent advances in Molecular Biology</b> Polymerase Chain Reaction DNA Fingerprinting</li> </ul>																								
10	<p style="text-align: center;"><b>Scheme of Examination and Assessment Pattern (Paper – 50 Marks)</b></p> <p><b>A. External Examination: Semester End External – 30 marks</b> <span style="float: right;"><b>Time: 1:00 hour</b></span></p> <p style="text-align: center;">Format of Question Paper</p> <p><b>Attempt all questions.</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Question No</th> <th style="width: 70%;">Nature of Questions</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q1</td> <td>Attempt any three questions out of six (5 marks each) based on Unit-1</td> <td>15</td> </tr> <tr> <td>Q2</td> <td>Attempt any three questions out of six (5 marks each) based on Unit-2</td> <td>15</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td><b>30</b></td> </tr> </tbody> </table> <p><b>Note:</b> Equal Weightage is to be given to all the Units.</p> <p><b>B. Internal Examination: Continuous Evaluation - 20 marks</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 75%;">Assessment / Evaluation</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations, or quizzes.</td> <td>15</td> </tr> <tr> <td>3.</td> <td>Overall conduct as a responsible student and attentiveness</td> <td>05</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td><b>20</b></td> </tr> </tbody> </table>	Question No	Nature of Questions	Marks	Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15	Q2	Attempt any three questions out of six (5 marks each) based on Unit-2	15	<b>Total</b>		<b>30</b>		Assessment / Evaluation	Marks	1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations, or quizzes.	15	3.	Overall conduct as a responsible student and attentiveness	05	<b>Total</b>		<b>20</b>
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Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15																							
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<b>Total</b>		<b>20</b>																							

<p><b>11</b></p>	<p><b>Suggested Readings/References:</b></p> <ol style="list-style-type: none"> <li>1. Ankancha Jain, Richa Jain and Saurabh Jain (2020). Basic Techniques in Biochemistry, Microbiology and Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-1493998609.</li> <li>2. Green, M. R., &amp; Sambrook, J. (2013). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press. ISBN 978-1621821045.</li> <li>3. Karp, G. (Year). Cell and molecular biology: A laboratory manual (8th ed.). Wiley. ISBN 978-1119553441.</li> <li>4. Madhuri, A. (2023). Molecular biology and microbial genetics with practicals. Divya Lakshmi Publishers and Distributors. ISBN 978-9391576233.</li> <li>5. Mamata Behera, M, Swain, R., Singh, A. P. (2024). A Practical manual on fundamentals of Genetics. Bigfoot Publications, ISBN 978-8197034770.</li> <li>6. N. Arumugam (2019). Cell Biology and Molecular Biology - Saras publications</li> <li>7. Robert J. Slater (1986). Experiments in Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-0-89603-082-4.</li> <li>8. Simmonds, P. J. R., &amp; McAllister, S. W. (Year). Experiments in molecular biology. Pearson Education. ISBN 978-0321541161.</li> <li>9. Suchetha Kumari N (2018). Multidisciplinary Research Methods - A Practical Manual - A Practical Manual. Paras Medical Books. ISBN 9789386480323.</li> <li>10. Verma P.S. and Agarwal V.K. (2004). Molecular Biology- ISBN-13: 978- 8121931915- S. Chand Publications.</li> <li>11. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., &amp; Losick, R. (2004). Molecular biology of the gene (xth ed.). Pearson. ISBN 978-0805346428.</li> <li>12. Zhang. S., &amp; Li, P. (2017). Essential experiments for molecular biology: A student's guide (Paperback). Medtech Publication. ISBN 978-9386479136.</li> </ol>
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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

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

Semester- IV

Title: Practical based on Molecular Biology

**Vertical - 2  
Minor Subject – 2 Credit**

**With effect from the  
Academic Year 2025-26**

**Title: Practical based on Molecular Biology**  
**Course code: CHMZOOIV5**

S. No	Head	Particular
1	<b>Description the Course:</b>	The hands-on practical course molecular biology provides students with essential laboratory skills to study heredity, and molecular mechanisms governing life. Students will gain experience in DNA extraction, gel electrophoresis, and karyotyping. The practical course in molecular biology provides students with hands-on experience in key laboratory techniques, including DNA/RNA extraction, estimation, and gel electrophoresis.
2	<b>Vertical 2</b>	Minor
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives: To acquaint the learners to</b>	<p><b>CO(A)1.</b> Develop proficiency in fundamental laboratory techniques related to genetics and molecular biology, including nucleic acid extraction, cytological preparations, chromosome analysis, and molecular biology instrumentation.</p> <p><b>CO(A)2.</b> Apply experimental and analytical methods to investigate cell division, patterns of inheritance, pedigree analysis, and quantitative genetic data using standard scientific procedures.</p> <p><b>CO(A)3.</b> Interpret experimental observations and solve genetics and molecular biology problems by integrating theoretical knowledge with laboratory findings.</p> <p><b>CO(A)4.</b> Demonstrate scientific inquiry, laboratory ethics, biosafety, data analysis, technical reporting, and effective communication skills through practical exercises and virtual laboratory experiences.</p>
8	<b>Course Outcomes:</b> Upon completion of the course, the learners will:	<p><b>CO 1.</b> Perform basic molecular biology and cytogenetic techniques, including DNA and RNA extraction, nucleic acid detection, Barr body staining, mitotic studies, and chromosome morphology analysis using appropriate laboratory procedures.</p> <p><b>CO 2.</b> Analyze cytological and genetic data by calculating the mitotic index, RNA/DNA ratio, and solving problems related to Mendelian inheritance, X-linked inheritance, multiple alleles, and pedigree analysis.</p> <p><b>CO 3.</b> Identify and explain the principles, functions, and applications of essential molecular biology laboratory instruments, and demonstrate awareness of their role in research, diagnostics, and biotechnology.</p> <p><b>CO 4.</b> Record, interpret, and communicate experimental observations through laboratory reports and virtual laboratory activities while adhering to laboratory safety, ethical practices, and scientific documentation standards.</p>

9	<b>Syllabus</b>	
<ol style="list-style-type: none"> <li>1. Extraction by SDS method and detection of DNA by DPA method from onion.</li> <li>2. Extraction by phenol method and detection of RNA by Orcinol method from onion.</li> <li>3. Quantitative estimation of DNA and proteins by spectrophotometer.</li> <li>4. Quantitative estimation of proteins by Folin-Lowry's method.</li> <li>5. Study of mitotic chromosomes using onion root tip.</li> <li>6. Observation of Barr bodies – staining and mounting.</li> <li>7. Calculation of RNA / DNA ratio from given data.</li> <li>8. Identification of various Molecular Biology laboratory instruments — Gel electrophoresis instrument, Laminar Air flow, Gel Documentation System, DNA Sequencer, Microcentrifuge Cryogenic Freezer (Liquid Nitrogen or – 80°C Freezer), Thermocycler, Nano drop.</li> <li>9. Problems based on Molecular Biology.</li> <li>10. Virtual visit to molecular biology laboratory and submission of report.</li> </ol>		
10	<b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b>	
<b>A. External Practical Examination: Semester End External-</b>		
<b>30 marks</b>		<b>Time: 2 hrs</b>
Format of Question Paper		
Q.1	Extraction by SDS method and detection of DNA by DPA method from onion.  <p style="text-align: center;"><b>OR</b></p> Extraction by phenol method and detection of RNA by Orcinol method from onion.  <p style="text-align: center;"><b>OR</b></p> Quantitative estimation of proteins by Folin-Lowry's method	07
Q.2	Problems based on Molecular Biology <p style="text-align: center;">OR</p> Study of mitotic chromosomes using onion root tip. <p style="text-align: center;">OR</p> Observation of Barr bodies – staining and mounting. <p style="text-align: center;">OR</p> Calculation of RNA / DNA ratio from given data.	05
Q.3	Identification (any four)  Gel electrophoresis instrument, Laminar Air flow, Gel doc System, DNA Sequencer, Microcentrifuge Cryogenic Freezer, Thermocycler, Nano drop.	08
Q.4	<b>Field Report Submission &amp; Viva</b>	05
Q.5	<b>Certified journal</b>	05
	<b>Total</b>	<b>30</b>

<b>B. Internal Examination (20 marks)</b>		
	Assessment / Evaluation	Marks
1.	Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment.	15
2.	Overall conduct as a responsible student,	05
		<b>Total 20</b>
<b>11</b>	<p><b>References:</b></p> <ul style="list-style-type: none"> <li>● Ankanocha Jain, Richa Jain and Saurabh Jain (2020). Basic Techniques in Biochemistry, Microbiology and Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-1493998609.</li> <li>● Green, M. R., &amp; Sambrook, J. (2013). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press. ISBN 978-1621821045.</li> <li>● Karp, G. (Year). Cell and molecular biology: A laboratory manual (8th ed.). Wiley. ISBN 978-1119553441.</li> <li>● Madhuri, A. (2023). Molecular biology and microbial genetics with practicals. Divya Lakshmi Publishers and Distributors. ISBN 978-9391576233.</li> <li>● Mamata Behera, M, Swain, R., Singh, A. P. (2024). A Practical manual on fundamentals of Genetics. Bigfoot Publications, ISBN 978-8197034770.</li> <li>● Pranab Kumar Banerjee (2011). Problems on Genetics Molecular Genetics and Evolutionary Genetics. New Central Book Agency; 2nd edition</li> <li>● Robert J. Slater (1986). Experiments in Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-0-89603-082-4.</li> <li>● Simmonds, P. J. R., &amp; McAllister, S. W. Experiments in molecular biology. Pearson Education. ISBN 978-0321541161.</li> <li>● Suchetha Kumari N (2018). Multidisciplinary Research Methods - A Practical Manual - A Practical Manual. Paras Medical Books. ISBN 9789386480323.</li> <li>● Zhang. S., &amp; Li, P. (2017). Essential experiments for molecular biology: A student's guide (Paperback). Medtech Publication. ISBN 978-9386479136.</li> </ul> <p><b>ONLINE TOOLS AND WEB RESOURCES</b></p> <ul style="list-style-type: none"> <li>● <a href="https://swayam.gov.in/courses/4922-genetics-and-genomics">https://swayam.gov.in/courses/4922-genetics-and-genomics</a></li> <li>● <a href="https://www.coursera.org/learn/genetics-evolution">https://www.coursera.org/learn/genetics-evolution</a></li> <li>● <a href="https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/">https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/</a></li> <li>● <a href="https://learn.genetics.utah.edu/">https://learn.genetics.utah.edu/</a></li> </ul>	

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

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

Semester- IV

Title: Open Elective

**Vertical - 3  
OE - 2 Credit**

**With effect from the  
Academic Year 2025-26**



HSNC Board's  
**Smt. Chandibai Himathmal Mansukhani College**  
(Autonomous)  
(Affiliated to the University of Mumbai)  
University College Code: 217 | JD Office: T14



Faculty of Interdisciplinary

List of Skill Based Open Electives for Second Year: Semester – IV

Sr. No.	Semester IV Subject
1	Digital Interface, Web Design And Publishing
2	3D Modeling And Character Animation Fundamentals
3	Advance Tools Of AI For Economics And Education - II
4	English For Leadership and Strategic Communication
5	Urbanization And Real Estate: Applied Urban Planning, Design And Sustainable Cities
6	Travel Agency And Tour Operators Business
7	Managing Family Wealth Through Family Office-IV
8	Advanced Web Designing & Portfolio Development
9	Basics Of Nutrition - 4
10	Keel Strategy And Influencer Management
11	Performing Art- Dance-4
12	Data Analysis Project Based Approach
13	Strategic Political Communication, Digital Governance And AI-Driven Public Engagement Skills
14	Psychology Of Personal Relationship-II
15	Digital Society And Social Change
16	Mushroom Cultivation Training And Trading Level 4
17	Pranayama And Yogic Breathing Practices
18	Perfumery Course Level 4
19	Career Launchpad: Communication And Employability Skills
20	Beautician: Strategic Business Planning -IV
21	Current Trends In Fashion Designing, Financial Perspective Level 4
22	Basics Of Accounting-IV
23	Digital Marketing -IV
24	Online Trading For Investment Management



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

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

Semester- IV

Title: Pest Control

**Vertical - 4  
VSC - 2 Credit**

**With effect from the  
Academic Year 2025-26**

## Title: Pest Control (VSC)

Course Code: CHMZOOIV7

S. No.	Heading	Particulars
1	<b>Description the Course</b>	<p>Pest control plays an important role in agriculture and household pest management. It is crucial for protecting public health by preventing disease transmission and maintaining ecological balance by preventing invasive species from disrupting ecosystems.</p> <p>Pest control technology is particularly beneficial to farmers, as it relates to various agricultural fields, including apiculture, sericulture, and vermiculture. The pest control industry faces a unique set of challenges and opportunities in managing pests.</p> <p>A career in pest control offers insight into the work of a pest control technician, a profession that is currently in high demand and provides stable job prospects for those pursuing this field.</p>
2	<b>Vertical 4</b>	Vocational Skill Course (VSC)
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To explain the fundamental concepts of identification of pest and their control measures.</p> <p><b>CO(A)2.</b> To impart the knowledge of Pest Monitoring Techniques, IPM practices and Chemical Control, Insecticides, and Formulations.</p> <p><b>CO(A)3.</b> To acquaint learners to various insect pests and associated diseases, as well as calculate economic injury and threshold levels.</p>
8	<b>Learning Outcomes:</b>	<p>Upon completion of the course, the learners will:</p> <p><b>LO-1-</b> Identify insect pests, their nature of damage and their control measures.</p> <p><b>LO-2-</b> Demonstrate understanding preparation about doses/concentrations of insecticides.</p> <p><b>LO-3-</b> Apply advanced technology for pest control.</p>
9	<b>List of Practical</b>	<ul style="list-style-type: none"><li>• Estimation of insect population and damage caused using suitable sample techniques [Absolute estimates (Quadrat method, Line-transect method, Capture, Marking, Release and the Recapture Technique) and Relative estimates].</li><li>• Identification of Insect pests of field crops: <p>Rice: Thrips (<i>Stenchaetothrips biformis</i>) and Brown plant leafhopper (<i>Nilaparvata lugens</i>)Wheat: Armyworm (<i>Mythimna separata</i>) and Wheat Aphid (<i>Macrosiphum miscanthi</i>) Mulberry: Pink mealy bug (<i>Maconellicoccus hirsutus</i>) and Leaf webber (<i>Diaphania pulverulentalis</i>) Mango: Mango stem borer (<i>Batocera rufomaculata</i>) and Mango Fruit fly (<i>Bactrocera (Dacus) dorsalis</i>) Banana: Banana weevil (<i>Cosmopolites sordidus</i>) andFruit rust thrips (<i>Chaetanaphothrips signipennis</i>).</p></li><li>• Study of non-insect pests of field crops: Birds, Crabs, Snails and Slugs, Millepedes, Mites, Rats and Squirrels.</li></ul>

- Study of life cycle of rice weevil or flour beetle or suitable pest.
- Study of Household pests: Cockroach, Termite, Bed bug, Mice and House fly.
- Study pest surveillance methods such as field incidence, light traps, and pheromone traps.
- Study on the distribution patterns of insects in crop ecosystems by
  - Regular / Uniform distribution
  - Random /Poison distribution
  - Clumped / Aggregated / Over-dispersed / Contagious distribution
- IPM practices: Physical (Temperature, Sound, Controlled Atmospheres Irradiation) and mechanical methods (Hand picking, Use of Hand-nets and Bag-nets, Clipping, Pruning and Crushing, Sieving and Winnowing, Flaming and Burning).
- IPM practices: Cultural (Crop rotation, Period of sowing, Irrigation, Pruning, Tillage and Fertilizer) and biological methods (Parasite, Parasitoid, Predator)
- Calibration of different insecticides formulation by preparation of spray fluid and Pearson method.
- Study the Pesticide appliances (Types of Sprayers and Types of Dusters) and their maintenance.
- Visit near by a Farm field / Agriculture institute / Krishi Seva Kendra for collection of information about crop insect pests.

10

**Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)**

**A. External Practical Examination: Semester End External-  
30 marks**

**Time: 2 hrs**

Format of Question Paper

No	Experiment	Marks
Q.1	One Major experiment	07
Q.2	One Minor experiment	05
Q.3	Identification (any four)	08
Q.4	Field Report Submission & Viva	05
Q.5	Journal	05
	<b>Total</b>	<b>30</b>

**B. Internal Examination (20 marks)**

No	Assessment / Evaluation	Marks
1.	Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment.	<b>15</b>
2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	<b>05</b>
	Total	<b>20</b>

11

**Suggested reading/ References:**

15.A. D Imms (1977). A General textbook of entomology, Asia Publication, ISBN No.: 978-0412152108.

16.Alaka Prakash and Fennemore (2006). Applied Entomology, New Age Publishers, ISBN

- No.10. 8122418333; 13. 978-8122418330.
- 17.A. Woods, (1974). Pest control: A Survey, McGraw Hill, London, ISBN No. 10: 0470960019; 13: 978-047096001.
- 18.David and Ananthakrishnan (1978). General and applied Entomology, Tata McGraw Hill, ISBN No.10. 9780070434356; 13. 978-0070434356.
- 19.D. B. Tembhare, (2016). Modern Entomology, D. B. Himalaya Publishing House, Mumbai, ISBN No. 978-93-5051-828-1.
- 20.D. P. Abrol and Uma Shankar (2012). Integrated Pest Management: Principles and Practices, CABI, ISBN No. 1845938089, 9781845938086.
- 21.Jason H. Byrd and James L. Castner. (2001). Forensic Entomology-The utility of Arthropods in legal investigations, CRC Press, ISBN No. 843981202, 9780843981209.
22. Larry P. Pedigo (1996). Entomology and Pest Management, by Pearson Education, ISBN No. 13: 978-0133735314; 10: 0133735311.
- 23.Mary Louise Flint and Steve H. Dreistadt, (1998). Natural Enemies Handbook, UC Division of Agriculture and Natural Sciences, ISBN No. 0520218019, 9780520218017.
- 24.M. M. Trigunayat (2009). A manual of practical entomology, Scientific Publication, ISBN No. 10: 8172335660; 13: 9788172335663.
- 25.Pedigo L. P (1998). Entomology and Pest Management, III Edition. Prentice Hall, New Jersey, USA, 691p; ISBN No. 10: 013780024X; 13: 9780137800247.
- 26.Sathe T. V. (1998). Book Sericultural Crop Protection, Asawari Publication, ISBN No. 978-93-80224-008.
27. Sengupta, K., Govindaiah and Kumar. P (1991). Diseases and Pests of Mulberry and their Control. Central Sericultural Research and Training Institute, Srirampura, Mysore- 570 008.
- 28.T. V. Sathe and Jyoti M. Oulkar, (2010). Insect Pest Management: Ecological Concepts, Daya Publishing House, ISBN No. 9383048263; 9789383048267.
- 29.V. B. Awasthi. (2002). Introduction to general and applied Entomology, Scientific Publication, ISBN No. 81-7233-295-5.
- 30.V. B. Awasthi (2011). Agricultural insect pests and their control, Scientific Publication, ISBN No.: 9788172337148.
31. Wang, K. H., Uyeda, J and Sugano, J (2018). Banana Pest and Disease Management in the Tropical Pacific: A guidebook for banana growers. University of Hawaii at Manoa, Pp: 1-70.
32. William D. Hutchison, Rafael E. Cancelado and Edward B. Radcliffe, (2008). Integrated Pest Management: Concepts, Tactics, Strategies and Case Studies, Cambridge University Press, ISBN No. 9780511626463.
33. W. W. Kilgore and R. L. Doult, (1967). Pest control: Biological, Physical and Selected Methods, Academic Press, New York, ISBN No.10: 012406650X; 13: 978- 0124066502.

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

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

Semester- IV

Title: Dairy Science

**Vertical - 4  
VSC - 2 Credit**

**With effect from the  
Academic Year 2025-26**

**Title: Dairy Science (VSC)**  
**Course Code:CHMZOOIV8**

Sr. No.	Heading	Particulars
1	<b>Description of the course:</b>	Dairy Science is a highly relevant and valuable course with numerous applications in the dairy industry. It encompasses the study of dairy farming, milk production, processing, and management. In India, the demand for professionals in dairy science is substantial, offering opportunities in both the government and private sectors. Career prospects include roles such as dairy farm manager, milk quality control supervisor, and dairy processing technologist. Graduates can also pursue careers in research and development, dairy extension services, or even start their own dairy businesses. Overall, a Dairy Science course provides a pathway to a rewarding and dynamic career in the dairy industry.
2	<b>Vertical 4</b>	Vocational Skill Course (VSC)
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To acquaint learners to the indigenous breeds, exotic breed and cross breeds.</p> <p><b>CO(A)2.</b> To familiarize the learners to practical dairy science through activities, including projects, experiments, and farm visits.</p>
8	<b>Course Outcomes:</b>	<p>After successful completion of this Course learners will:</p> <p><b>CO 1.</b> Classify and identify cattle breeds, buffalo breeds, use knowledge about casting of farm animals, trimming of dairy cattle and shoeing of bullocks.</p> <p><b>CO 2.</b> Develop entrepreneurial skills with confidence to establish and manage a dairy-based business.</p>
9	<b>Syllabus</b>	
	<ol style="list-style-type: none"> <li>1. Classification of Cattle Breeds. <ul style="list-style-type: none"> <li>• Milch breed: Gir, Sahiwal, Red Sindhi</li> <li>• Draught: Khillar, Dangi, Red Kandhari</li> <li>• Dual: Deoni, Hariyana</li> <li>• Exotic: Jersey, Holstein Friesian</li> <li>• Cross breed: Holdeo, Jerdeo</li> </ul> </li> <li>2. Study of buffalo breeds: <ul style="list-style-type: none"> <li>• Murrah</li> </ul> </li> </ol>	

	<ul style="list-style-type: none"> <li>• Jaffrabadi</li> <li>• Nagpuri</li> <li>• Pandharpuri</li> <li>• Surti</li> </ul> <ol style="list-style-type: none"> <li>3. Casting of farm animals, trimming of dairy cattle and shoeing of bullocks.</li> <li>4. Preparation and submission of report related to: cattle feed, vaccination schedule of dairy cattle, dairy animal diseases, cost of milk production, Dairy Farm layout.</li> <li>5. Deworming of dairy cattle.</li> <li>6. Milking of Dairy animals (machinery).</li> <li>7. Study of milk density by lactometer.</li> <li>8. Measurement of pH of milk with suitable method.</li> <li>9. Colorimetric estimation of total fat in the milk of different varieties by FeCl<sub>3</sub> method.</li> <li>10. To find adulteration in the milk – starch and urea.</li> <li>11. Preparation of paneer, curd, ghee from milk.</li> </ol> <p>Visit to dairy farm and preparation of project report.</p>
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<b>10</b>	<p align="center"><b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b></p> <p align="center"><b>A. External Practical Examination: Semester End External- 30 marks</b> <span style="float: right;"><b>Time: 2 hrs</b></span></p> <p align="center">Format of Question Paper</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">No</th> <th style="width: 70%;">Experiment</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q.1</td> <td>One Major experiment</td> <td align="center">07</td> </tr> <tr> <td>Q.2</td> <td>One Minor experiment</td> <td align="center">05</td> </tr> <tr> <td>Q.3</td> <td>Identification (any four)</td> <td align="center">08</td> </tr> <tr> <td>Q.4</td> <td>Field Report Submission &amp; Viva</td> <td align="center">05</td> </tr> <tr> <td>Q.5</td> <td>Journal</td> <td align="center">05</td> </tr> <tr> <td></td> <td><b>Total</b></td> <td align="center"><b>30</b></td> </tr> </tbody> </table> <p><b>B. Internal Examination (20 marks)</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">No</th> <th style="width: 70%;">Assessment / Evaluation</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td align="center">1.</td> <td>Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment.</td> <td align="center">15</td> </tr> <tr> <td align="center">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 align="center">05</td> </tr> <tr> <td></td> <td><b>Total</b></td> <td align="center"><b>20</b></td> </tr> </tbody> </table>		No	Experiment	Marks	Q.1	One Major experiment	07	Q.2	One Minor experiment	05	Q.3	Identification (any four)	08	Q.4	Field Report Submission & Viva	05	Q.5	Journal	05		<b>Total</b>	<b>30</b>	No	Assessment / Evaluation	Marks	1.	Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment.	15	2.	Overall conduct as a responsible student, manners, attentiveness and inquisitiveness, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05		<b>Total</b>	<b>20</b>
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**Reference Books:**

1. C.P. Ananthakrishnan (1964). Milk products preparation and quality control, Indian Council of Agricultural Research ISBN 8138-2756-6.
2. C.P. Ananthakrishnan (1993). The technology of milk processing. Shri Lakshmi Publ., ISBN 978-9350302637.
3. Eckles, Combs, Harold Macy (1943). Milk and milk products. McGraw-Hill book Company ISBN 978-0758184597.
4. G. C. Banerjee (2019). Text Book of Animal Husbandry. Oxford & IBH Publishing Co Pvt. Ltd ISBN: 978-8120412606.
5. Gosta Bylund (2003). Dairy processing handbook. Tetra Pak Processing Systems AB Publication ISBN-10. 9163134276.
6. Jagdish Prasad (2016). Principles and practices of Dairy farm. Kalyani ISBN- 978-9327264302.
7. Lincoln M. Lampert (1998). Modern Dairy products. Chemical Publishing Co Inc., U.S. ISBN 978-0820602301.
8. Madan Mohan (1989). Dairy management in India. Mittal Publications. ISBN: 81-7099-124-6.
9. M. M. Roy (2018). Dairy Chemistry and Animal Nutrition, Sonali Publication, ISBN 978-8193699904.
10. Roy N K. (1991). A Textbook of Practical Dairy Chemistry, Kalyani Publishers, ISBN 978-8170964421.
11. Sukumar De (2001). Outlines of Dairy Technology, Oxford Publication, ISBN 978-0195611946.
12. W.C. Frazier (2017). Food microbiology, McGraw Hill Publication, ISBN- 978-1259062513.
13. Webb Johnson and Alfred Fundamentals (2005). Dairy Chemistry, CBS Publication, ISBN 978-8123911991.

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

**Second Year B.Sc.**

**Semester- IV**

**Vertical – 5**

**Ability Enhancement Course (English)  
2 Credits**

**(To be offered to Students who  
opted Sindhi AEC in Sem I & II)**

**with effect from  
Academic Year 2026-2027**

**Title: Advanced English for Workplace and Academic Communication**

**Course Code: CHMBSCAECIV**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description of the Course:</b>	<p>In an increasingly competitive academic and professional landscape, learners require advanced communication skills that enable clarity, precision, critical thinking, and professionalism. This course focuses on practical, real-world communication abilities needed for college-level academic work, job applications, workplace collaboration, and digital interactions.</p> <p>Through hands-on tasks, real-world assignments, and communication practice, learners become adept in using English confidently and appropriately in diverse settings.</p>
<b>2</b>	<b>Vertical 5</b>	<b>AEC: Advanced English for Workplace and Academic Communication</b>
<b>3</b>	<b>Type</b> Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	30 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks
<b>7</b>	<b>Course Objectives:</b>	<ol style="list-style-type: none"><li>1. To develop advanced communication skills required for academic and professional success.</li><li>2. To train learners in report writing, summary writing, and formal documentation.</li><li>3. To enhance proficiency in digital and virtual communication platforms.</li><li>4. To strengthen presentation, interview, and workplace communication skills.</li><li>5. To build confidence in expressing ideas clearly to varied audiences.</li></ol>
<b>8</b>	<b>Learning Outcomes:</b> After completing this course, learners will be able to:	<p><b>LO-1:</b> Demonstrate clarity, precision, and professionalism in communication.</p> <p><b>LO-2:</b> Interpret and summarize written texts, visuals, and data accurately.</p> <p><b>LO-3:</b> Prepare well-structured reports, emails, and professional documents.</p>

**LO-4:** Use digital tools and virtual communication etiquette effectively.

**LO-5:** Communicate confidently in interviews, presentations, and teamwork situations

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### Syllabus

**UNIT I: Communication for Academic & Professional Settings (15 Hours)**

**A. Communication in Academic & Workplace Contexts**

1. Features of formal communication
2. Audience-centered communication
3. Ethics in communication: integrity, attribution, clarity
4. Explaining concepts in simple and clear language
5. Interpreting graphs, charts, tables, and infographics
6. Summarizing data concisely

**B. Grammar & Style for Professional Writing**

1. Tone: formal, neutral, objective
2. Avoiding redundancy and ambiguity
3. Active vs. passive structures
4. Editing, revising, and proofreading techniques

**UNIT II: Practical Documentation & Employability Skills (15 Hours)**

1. Report writing (academic/field-based/observational)
2. Project summary reports
3. Preparing short presentations
4. Creating informational posters or digital slides
5. Writing a formal complaint or request email
6. Creating a short informational or awareness write-up

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#### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

All questions are compulsory:

Question No	Nature of Questions	Marks
Q. 1	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 1</b> <b>OR</b> Attempt <b>Essay Type</b> question. (1 out of 2) - <b>Unit 1</b>	15
Q. 2	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 2</b> <b>OR</b> Attempt <b>Essay Type</b> question. (1 out of 2) - <b>Unit 2</b>	15
<b>Total</b>		<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

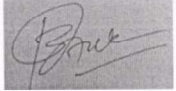
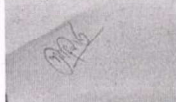

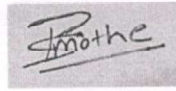
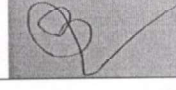
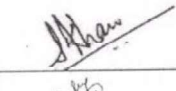
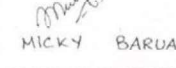

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Assignments on <b>any one</b> of the following topics: Academic/Scientific Report/ Informational Poster / Digital Infographic (Students are required to use AI assistance in the preparation of their drafts. Eg: Notion AI, Otter.ai, Grammarly, Google Gemini, Canva, Piktochart, etc)	15
2.	Class Attendance and Participation	05
	<b>Total</b>	<b>20</b>

**11**

**References:**

1. Adler, Ronald B., et al. *Understanding Human Communication*. 15th ed., Oxford UP, 2021.
2. Bailey, Stephen. *Academic Writing: A Handbook for International Students*. 5th ed., Routledge, 2018.
3. Cargill, Margaret, and Patrick O'Connor. *Writing Scientific Research Articles*. Wiley-Blackwell, 2013.
4. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.
5. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication: Process and Product*. 9th ed., Pearson, 2021.
6. Hewings, Martin. *Advanced Grammar in Use*. Cambridge UP, 2013.
7. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
8. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
9. Nordquist, Richard. *The Essentials of English Grammar*. McGraw-Hill Education, 2016.
10. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
11. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

### Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University)	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	 MICKY BARUA
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr.) Kailas Aute



Name & Signature of the Dean: Prof. (Dr.) Nitin Arekar



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

**Second Year**

**Semester - IV**

**Title: Environmental Management and  
Sustainable Development - II**

**Vertical - 5  
VEC Subject - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Environmental Management and Sustainable Development - II**

**Course Code: CHMVEC2**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course examines the relationship between environmental pollution and human health, with detailed coverage of air, water, soil, noise, thermal, and radioactive pollution and their sources, standards, and impacts. It enables learners to understand pollution generation processes, waste management challenges, and the assimilative capacity of the environment. The course also introduces environmental laws, constitutional provisions, and regulatory frameworks, along with tools such as Environmental Management Systems (ISO 14001), life cycle analysis, and cost–benefit analysis. Emphasis is placed on sustainable practices, pollution control measures, the 3R concept, ecolabeling, and global initiatives such as the Sustainable Development Goals and Mission LiFE.
2	<b>Vertical 5</b>	VEC
3	<b>Type &amp; Teaching Methods</b>	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To develop a comprehensive understanding of various types of environmental pollution, their sources, standards, and impacts on human health and ecosystems.</p> <p><b>CO(A)2:</b> To familiarize students with environmental laws, constitutional provisions, and regulatory frameworks related to environmental protection and management.</p> <p><b>CO(A)3:</b> To equip learners with knowledge of environmental management tools, pollution control measures, and sustainable waste management practices.</p> <p><b>CO(A)4:</b> To create awareness about global and national sustainability initiatives such as the Sustainable Development Goals, Mission LiFE, and their role in achieving sustainable development.</p>

8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO1:</b> Identify and analyze different types of environmental pollution and assess their impacts on human health and ecological systems.</p> <p><b>CO2:</b> Explain key environmental laws, constitutional provisions, and institutional mechanisms for environmental protection.</p> <p><b>CO3:</b> Apply environmental management tools and sustainable waste management practices in real-world contexts.</p> <p><b>CO4:</b> Evaluate sustainability initiatives such as the SDGs and Mission LiFE and relate them to environmental management and sustainable development practices.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Environmental Pollution and Health</b></p> <ul style="list-style-type: none"> <li>• Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution.</li> <li>• Air pollution: Sources of air pollution; Primary and secondary pollutants; Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards.</li> <li>• Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life.</li> <li>• Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health.</li> <li>• Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health.</li> <li>• Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.</li> </ul> <p><b>UNIT II: Environmental Management</b></p> <ul style="list-style-type: none"> <li>• Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights;</li> <li>• Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001 Life cycle analysis; Cost-benefit analysis</li> <li>• Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme.</li> <li>• Introduction to Millennium Development Goals, Sustainable Development Goals, &amp; Mission Life.</li> </ul>

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hours**

Format of Question Paper

**Attempt any 3 out of 4 questions.**

Question No	Nature of Questions	Marks
Q1	Theory Question based on Unit I	10
Q2	Theory Question based on Unit I	10
Q3	Theory Question based on Unit II	10
Q4	Theory Question based on Unit II	10
<b>TOTAL</b>		<b>30</b>

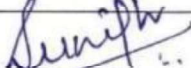
**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Assignment / Project	10
2.	Case Study / Assignment	10
<b>TOTAL</b>		<b>20</b>

11

**REFERENCES:**

1. Barrow, C. J. (2012). *Environmental management for sustainable development* (2nd ed.). Routledge.
2. Doabia, T. S. (2023). *Environmental and pollution laws in India* (4th ed.). Eastern Book Company.
3. Kumar, S. (2009). *Environmental policies in India*. Northern Book Centre.
4. Rajagopalan, R. (2023). *Environmental studies* (4th ed.). Oxford University Press India.
5. Rogers, P. P., Jalal, K. F., & Boyd, J. A. (2007). *An introduction to sustainable development*. Earthscan.
6. Singh, J., Singh, A., & Gupta, S. (2019). *Environmental science and engineering*. New Age International Publishers.

Sr No	Name of the Faculty	Designation and College	Signature
1.	Dr. Sunil Lalchandani	Dean, Faculty of Interdisciplinary	



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

**First Year**

**Semester- IV**

**Title: Cocurricular Course I**

**Vertical - 6  
Cocurricular Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Cocurricular Course - I**

**Course Code: CHMCCI6**


Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year.</p> <p>Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting.</p> <p>This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.</p>
2	<b>Vertical 6</b>	Cocurricular Course (Mandatory)
3	<b>Type Teaching Methods</b>	Non Theory Participation, Report Writing, Presentation etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities.</li> <li>2. To enhance personal and interpersonal skills through real-life experiences and teamwork.</li> <li>3. To foster a sense of responsibility, leadership, and community engagement among students.</li> <li>4. To develop self-confidence and emotional well-being through creative expression and collaboration.</li> <li>5. To integrate classroom learning with experiential learning for holistic growth.</li> </ol>
8	<b>Learning Outcomes:</b>	<p>By the end of the course, students will be able to:</p> <p><b>LO1:</b> Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences.</p> <p><b>LO2:</b> Demonstrate improved communication, leadership, and teamwork skills.</p> <p><b>LO3:</b> Exhibit increased awareness of social responsibility and civic engagement.</p> <p><b>LO4:</b> Build confidence through creative, cultural, and intellectual expressions.</p> <p><b>LO5:</b> Maintain a portfolio or activity log to track participation and personal development.</p>

9	<b>Syllabus</b>																											
	<b>Unit I - Suggested Areas of Participation in the activities:</b> <ul style="list-style-type: none"> <li>• <b>Cultural Events:</b> Drama, dance, music, literary events, debates, etc.</li> <li>• <b>Social Outreach:</b> Blood donation, awareness campaigns, cleanliness drives.</li> <li>• <b>Clubs &amp; Societies:</b> Photography, quiz, environment club, shram club, etc.</li> <li>• <b>Sports &amp; Fitness:</b> College tournaments, yoga, marathons, fitness challenges.</li> <li>• <b>Institutional Events:</b> Foundation Day, Annual Day, College Festivals, Intercollegiate events.</li> <li>• <b>National Festivals:</b> Independence Day, Republic Day etc.</li> </ul> <b>Unit II - Program Specific Topics</b> <ul style="list-style-type: none"> <li>• <b>Workshops/Seminars:</b> Report Writing, Personality Development, Soft Skills, Leadership Talks.</li> <li>• <b>Speak, Show, Shine:</b> Presentation / Poster Presentation / Viva and Learning Experience</li> </ul> <b>Mode of Evaluation:</b> <ul style="list-style-type: none"> <li>• <b>Faculty Coordinator:</b> To guide and evaluate student progress.</li> <li>• <b>Participation Proof:</b> Certificates, photos, attendance records.</li> <li>• <b>Reflective Journal:</b> Minimum 2–3 pages summarizing experiences, learning, and growth.</li> <li>• <b>Final Viva/Presentation:</b> 5-minute talk on poster presentation and on overall learning.</li> </ul>																											
10	<b>Scheme of Examination and Assessment Pattern Based on 3 approved Activities Semester End External - 30 marks</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Activity No</th> <th style="width: 65%;">Nature of Activities</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Title of Approved Activity - 1</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Title of Approved Activity - 2</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Title of Approved Activity - 3</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table> <b>Internal Examination: Continuous Evaluation – 20 marks</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 80%;">Assessment / Evaluation</th> <th style="width: 15%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Reflective journal</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Presentation/ poster presentation/viva</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>	Activity No	Nature of Activities	Marks	1.	Title of Approved Activity - 1	10	2.	Title of Approved Activity - 2	10	3.	Title of Approved Activity - 3	10	<b>Total</b>		<b>30</b>		Assessment / Evaluation	Marks	1.	Reflective journal	10	2.	Presentation/ poster presentation/viva	10	<b>Total</b>		<b>20</b>
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<b>Total</b>		<b>20</b>																										

**Suggested Readings:**

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

  
 Dr. Manju Lalwani Pathak





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

# **Bachelor of Science**

## **(Zoology)**

### **(Aided)**

## **Semester – V**

S. No	Vertical	Code	Name of the Paper	Theory/ Practical	Credits
1	Major	CHMZOOV1	Classification of Non- Chordates	Theory	2
2	Major	CHMZOOV2	Laboratory exercise based on classification of Non- Chordates	Practical	2
3	Major	CHMZOOV3	Hematology and Immunology	Theory	2
4	Major	CHMZOOV4	Laboratory exercise based on Hematology and Immunology	Practical	2
5	Major	CHMZOOV5	ZOOLOGY IKS	Theory	2
6	VSC	CHMZOOV6	Aquaculture	Practical	2
7	Major Elective	CHMZOOV7	Medical Diagnostic	Theory	2
8	Major Elective	CHMZOOV8	Laboratory exercise based on medical diagnostic	Practical	2
9	Minor	CHMZOOV9	Animal classification	Theory/ Practical	2
10	FP	CHMZOOV10	--	--	2
11	CC	CHMZOOV10	---	--	2
Total					<b>22</b>

**Choice Based and Credit Based syllabus**  
**as per NEP 2020 with effect from**  
**the Academic Year 2026-2027**

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

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

**Title: Classification of Non-Chordates**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Classification of Non-Chordates

Course Code: CHMZOOV1

S. No.	Heading	Particulars
1	Description of the Course	This course delivers a comprehensive grasp of animal taxonomy and biological classification up to the class level, building on higher secondary knowledge with the scientific rationale behind divisions, phyla, and classes. Dive into evolutionary hallmarks like symmetry, coelom, and segmentation, alongside levels of organization from cellular to organ-system. Through in-depth type studies of key animals, explore structural adaptations and their pivotal role in classification.
2	Vertical	Major
3	Type	Theory
	Teaching methods	Lecture, Seminar, Group discussion, Presentation, simulations, field visits, AV mode etc.
4	Credit	2
5	Hours allotted	30 Hours
6	Marks allotted	50 Marks
7	<b>Course Objectives:</b> CO(A)1: To provide a comprehensive understanding of the fundamental principles of animal organization and their significance in the classification and evolution of non-chordate animals. CO(A)2: To develop knowledge of the taxonomy, classification, and distinguishing characteristics of Protista and major non-chordate phyla up to class level. CO(A)3: To equip students with the skills to identify and classify representative non-chordate animals using standard taxonomic principles and diagnostic features. CO(A)4: To foster an understanding of the structural adaptations, ecological importance, and evolutionary diversity of non-chordates in maintaining ecosystem stability and biodiversity.	
8	<b>Course Outcomes:</b> Upon completion of this course student will CO1: Explain the principles of biological organization, symmetry, coelom, segmentation, and their evolutionary significance in animal classification. CO2: Classify Protista and major non-chordate phyla up to class level using internationally accepted taxonomic criteria and nomenclature. CO3: Apply taxonomic keys and diagnostic characters for scientific identification and classification of representative non-chordate animals. CO4: Evaluate structural adaptations and ecological roles of non-chordates in maintaining biodiversity and ecosystem stability.	
9	<b>Syllabus</b>	
	<b>Unit I: Basis of Animal Classification</b> <b>1.1 Levels of Organization:</b> Basic concept and types of - Cellularity, Symmetry, Coelom, Metamerism. <b>1.2 Kingdom Protista:</b> 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*) and Phylum Sporozoa- Class Aconoidasida (*Plasmodium*); Class Conoidasida (*Toxoplasma*)

**Unit II: Taxonomy**

**2.1 Kingdom Animalia - I:** General characters and classification up to class with distinguishing features and suitable examples: Phylum Porifera, Phylum Cnidaria, Phylum Platyhelminthes, Phylum Nematoda.

**2.2 Kingdom Animalia - II:** General characters and classification up to class with distinguishing features and suitable examples: Phylum Annelida, Phylum Arthropoda, Phylum Mollusca, Phylum Echinodermata, Phylum Hemichordata.

**10 Scheme of Examination and Assessment Pattern (Paper – 50 Marks)**

**A. External Examination: Semester End External - 30 marks** **Time: 1:00 hour**  
Format of Question Paper

**Attempt all questions.**

Question	Nature of Questions	Marks
Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15
Q. 2	Attempt any three questions out of six (5 marks each) based on Unit-2	15
<b>Total</b>		<b>30</b>

**Note:** Equal Weightage is to be given to all the Units.

**B. Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / Evaluation	Marks
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes. Continuous Internal evaluation	15
2.	Overall conduct as a responsible student and attentiveness	05
<b>Total</b>		<b>20</b>

**11 References:**

1. Invertebrate Zoology: E.L. Jordan and P.S. Verma
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.
5. Zoology for Degree Students: Dr. V. K. Agarwal, S. Chand Publication.
6. Introduction to Zoology – Vol I: K. K. Chaki, G. Kundu and S. Sarkar, New Crystal Book Agency.
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.
9. Invertebrate Zoology by E. L. Jordan & P. S. Verma, Rev. edition, 2009, Chand Publications
10. Invertebrate Zoology by P. S. Verma, edition, 2009, Chand Publications
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: Laboratory exercises based on classification of Non-  
Chordates**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Laboratory exercises based on classification of non-Chordates

**Course Code: CHMZOOV2**

S. No.	Heading	Particulars
1	Description of the Course	This course equips learners with taxonomy fundamentals, biological organization from cellular to organ-system levels, modern classification up to class level, and evolutionary traits like symmetry, coelom, and segmentation. It covers Linnaean hierarchy, binomial nomenclature, and six-kingdom system, explaining the rationale for placing animals in divisions, phyla, and classes highlighting distinctive features. Hands-on dissection of type specimens like Sepia reveals structural adaptations and their taxonomic relevance.
2	Vertical	Major
3	Type	Practicum
4	Credit	2
5	Hours allotted	60 Hours
6	Marks allotted	50 Marks
7	Course Objectives:	<p><b>CO(A) 1: To develop</b> practical skills in dissection, specimen preparation, microscopy, and observation of non-chordate animals using standard laboratory techniques.</p> <p><b>CO(A) 2: To train</b> students in the identification and classification of representative non-chordate specimens, larval forms, and adaptive structures based on diagnostic taxonomic characters.</p> <p><b>CO(A) 3: To enhance</b> understanding of the structural organization, functional adaptations, and evolutionary significance of non-chordate animals through practical investigations.</p> <p><b>CO(A) 4: To cultivate</b> scientific skills in recording, analyzing, interpreting, and communicating laboratory observations using appropriate biological terminology and scientific methods.</p>
8	Course Outcomes:	<p>Upon completion of this course student will</p> <p><b>CO1:</b> Perform dissections, temporary mount preparations, and microscopic observations using appropriate laboratory techniques.</p> <p><b>CO2:</b> Identify representative non-chordate specimens, larval forms, and adaptive structures using standard taxonomic characters.</p> <p><b>CO3:</b> Interpret structural organization, adaptive features, and evolutionary significance of selected non-chordate animals.</p> <p><b>CO4:</b> Record, analyze, and present laboratory observations using scientific methods and appropriate biological terminology.</p>

9.	<b>Syllabus</b>		
	<ol style="list-style-type: none"> <li>1. Dissection of <i>Earthworm</i> or <i>Cockroach</i> to study its Digestive System, Reproductive System and Nervous System</li> <li>2. Temporary mounting of Septal nephridia in <i>Earthworm</i></li> <li>3. Temporary mounting of foraminiferan shells from sand sample</li> <li>4. Study of Crustacean larvae: <i>Nauplius</i>, <i>Zoea</i>, <i>Mysis</i>, <i>Megalopa</i>, <i>Phyllosoma</i>.</li> <li>5. Temporary mounting of types of legs, mouth parts, and wings of honeybee and / Cockroach</li> <li>6. Study of foot &amp; shell in Mollusca</li> <li>7. Study of Echinoderm larvae: <i>Bipinnaria</i>, <i>Brachiolaria</i>, <i>Auricularia</i>, <i>Doliolaria</i>, <i>Echinopluteus</i>, <i>Ophiopluteus</i></li> <li>8. 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</li> </ol>		
10	<b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b>		
	<b>Duration: 3 hrs</b>		<b>Marks-30</b>
	Sr. No.	Experiment	Marks
	Q.1	Major Dissection	<b>10</b>
	Q.2	Minor Question	<b>06</b>
	Q.3	Identification A. Study of Foot in Mollusca or Study of Shell in Mollusca b. Study of Crustacean Larvae or Study of Echinoderm Larvae	<b>04</b>
	Q.4	Field report submission and Viva	<b>05</b>
	Q.5	Journal	<b>05</b>
		Total	<b>30</b>
	<b>Internal Practical Examination Paper pattern: Marks 20</b>		
	No	Assessment /Evaluation	<b>Marks</b>
	Q1	Concept Mapping/ Flash Presentation/ Phylogenetic Tree Construction/ Peer Teaching Modules/ Case Study Analysis/ Digital Poster / Infographic Creation	<b>15</b>
	Q2	Overall conduct as a responsible student and attentiveness	<b>05</b>
		Total .	<b>20</b>

**References:**

1. **Verma, P. S. (2013). A Manual of Practical Zoology: Invertebrates.** New Delhi: S. Chand & Company Pvt. Ltd.
2. **Verma, P. S. (2013). A Manual of Practical Zoology: Chordates.** New Delhi: S. Chand & Company Pvt. Ltd.
3. **Lal, S. S. (2012). Practical Zoology: Invertebrates.** Meerut: Rastogi Publications.
4. **Lal, S. S. (2012). Practical Zoology: Chordates.** Meerut: Rastogi Publications.
5. **Rastogi, V. B. (2014). Practical Zoology.** Meerut: Kedarnath Ram Nath Publications.
6. **Agarwal, V. K., & Chaturvedi, L. D. (2015). Practical Zoology.** Agra: Pragati Prakashan.
7. **Kotpal, R. L. (2012). Modern Textbook of Zoology: Invertebrates.** Meerut: Rastogi Publications.
8. **Kotpal, R. L. (2012). Modern Textbook of Zoology: Vertebrates.** Meerut: Rastogi Publications.
9. **Rao, K. R. (2010). Zoology Practical Manual: Animal Diversity (Invertebrates).** New Delhi: Emkay Publications.
10. **Hickman, C. P., Roberts, L. S., Keen, S. L., Larson, A., Eisenhour, D. J., & I'Anson, H. (2017). Animal Diversity (7th ed.).** New York: McGraw-Hill Education.

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

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

**Title: Hematology and Immunology**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

**Title: Hematology and Immunology**  
**Course Code: CHMZOOV3**

S. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course introduces the fundamental concepts of blood and the immune system, focusing on their structure, functions, and roles in maintaining physiological balance and defense. It highlights key mechanisms, cellular components, and major disorders to build a strong foundation in human health and disease.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>  <b>Teaching methods</b>	Theory  Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To explain the structure, composition, physiological functions, and homeostatic mechanisms of blood and the immune system in maintaining human health.</p> <p><b>CO(A)2.</b> To analyze hematological processes, immune responses, antigen–antibody interactions, and mechanisms underlying normal and pathological conditions.</p> <p><b>CO(A)3.</b> To evaluate hematological and immunological disorders using scientific principles, laboratory findings, and diagnostic approaches.</p> <p><b>CO(A)4.</b> To apply concepts of hematology and immunology in disease prevention, vaccination, public health, and biomedical sciences while adhering to ethical and professional practices.</p>
8	<b>Course Outcomes:</b>	<p>Upon completion of this course student will</p> <p><b>CO1:</b> Describe innate and adaptive immune mechanisms, immune cells, antibodies, cytokines, and antigen–antibody interactions.</p> <p><b>CO2:</b> Analyze hematological disorders, immunodeficiency diseases, autoimmune diseases, hypersensitivity reactions, and their diagnostic significance.</p> <p><b>CO3:</b> Interpret the scientific basis of blood grouping, blood transfusion, coagulation, vaccination, and immunization for disease prevention.</p> <p><b>CO4:</b> Apply hematological and immunological principles to understand laboratory diagnosis, healthcare practices, and public health interventions.</p>
9	<b>Unit I: Hematology</b>	<p style="text-align: center;"><b>Syllabus</b></p> <ul style="list-style-type: none"> <li>• <b>Blood &amp; Blood cells:</b> Composition (Plasma &amp; formed elements), Physical &amp; chemical properties, functions of blood. Blood Cells (RBC, WBC, Platelets): Synthesis (hematopoiesis), types, structure, function.</li> <li>• <b>Hemoglobin:</b> Structure, types, functions of hemoglobin, derivatives of hemoglobin, Oxygen transport mechanism (relaxed &amp; tensed forms).</li> </ul>

- **Blood grouping & transfusion:** Concept of Rh factor, ABO blood grouping, Blood transfusion, Hazards of incompatible blood transfusion, Blood bank & its advantages.
- **Hemostasis & coagulation:** Mechanism of blood clotting, Extrinsic & Intrinsic pathway of blood clotting, Blood clotting factors, concept of bleeding time.
- **Various disorders of blood:** RBC related (anemia & its types), WBC related (Leukemia, Lymphoma), Platelet related (thrombocytopenia & thrombocytosis), Hemophilia, Von-Willebrand disease.

### Unit II: Immunology

- **Introduction to immunology:** Types of immunity: innate and adaptive, Characteristics of immune response. Cells and Organs of Immune System (Primary lymphoid organs (bone marrow, thymus) Secondary lymphoid organs (spleen, lymph nodes), Immune cells: B cells, T cells, macrophages, dendritic cells.
- **Antigens, Antibodies:** Properties of antigens, Structure of antibodies (IgG, IgM, IgA, IgE, IgD), Antigen-antibody interactions. **Types of immune response:** Humoral immunity (B-cell mediated), Cell-mediated immunity (T-cell mediated), Cytokines and their role.
- **Hypersensitivity Reactions:** Types I, II, III, IV hypersensitivity, Allergic responses,
- **Immunological Disorders:** Autoimmune diseases (Rheumatoid arthritis, Multiple sclerosis, Type I diabetes), Immunodeficiency disorders (e.g., AIDS)
- **Vaccines and Immunization:** Types of vaccines (live, killed, subunit, etc. with example), Principles of vaccination.

### 10 Scheme of Examination and Assessment Pattern (Paper – 50 Marks)

**C. External Examination: Semester End External - 30 marks** **Time: 1:00 hour**  
Format of Question Paper

**Attempt all questions.**

Question	Nature of Questions	Marks
Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15
Q. 2	Attempt any three questions out of six (5 marks each) based on Unit-2	15
<b>Total</b>		<b>30</b>

**Note:** Equal Weightage is to be given to all the Units.

### D. Internal Examination: Continuous Evaluation - 20 marks

No	Assessment / Evaluation	Marks
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.	15
2.	Continuous Internal evaluation	05
3.	Total	20

**11** **References:**

1. Wintrobe's Clinical Hematology, 14th Edition – Robert T. Means Jr., John P. Greer, et al.
2. Williams Hematology, 10th Edition – Kenneth Kaushansky, Marshall A. Lichtman, et al.
3. Hoffbrand's Essential Haematology, 8th Edition – A. Victor Hoffbrand and Paul A. H. Moss
4. Rodak's Hematology: Clinical Principles and Applications, 6th Edition – Elaine M. Keohane, Larry J. Smith, Jeanine M. Walenga
5. Clinical Laboratory Hematology, 4th Edition – Shirlyn B. McKenzie and Lynne Williams
6. Clinical Hematology and Fundamentals of Hemostasis, 6th Edition – Denise M. Harming
7. Cellular and Molecular Immunology, 10th Edition – Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai
8. Janeway's Immunobiology, 10th Edition – Kenneth Murphy and Casey Weaver
9. Kuby Immunology, 8th Edition – Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne
10. Roitt's Essential Immunology, 13th Edition – Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt
11. Clinical Immunology and Serology: A Laboratory Perspective, 5th Edition – Christine Dorresteyn Stevens
12. Mims' Medical Microbiology and Immunology, 6th Edition – Richard V. Goering, et al.

**Online Tools & Web Resources**

1. National Center for Biotechnology Information (NCBI) – <https://www.ncbi.nlm.nih.gov/>
2. PubMed – <https://pubmed.ncbi.nlm.nih.gov/>
3. World Health Organization (WHO) – <https://www.who.int/>
4. Centers for Disease Control and Prevention (CDC) – <https://www.cdc.gov/>
5. Mayo Clinic – <https://www.mayoclinic.org/>
6. MedlinePlus – <https://medlineplus.gov/>
7. American Society of Hematology – <https://www.hematology.org/>
8. British Society for Immunology – <https://www.immunology.org/>

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

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

**Semester- V**

**Title: Laboratory exercises based on  
Hematology and Immunology**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

# Title: Laboratory exercises based on Hematology and Immunology

**Course Code: CHMZOOV4**

S. No.	Heading	Particulars
1	<b>Description the Course:</b>	This practical course provides hands-on training in fundamental hematological and immunological techniques, including blood analysis, identification of cellular components, and basic antigen–antibody reactions. It emphasizes laboratory skills, data interpretation, and diagnostic understanding relevant to clinical and research applications.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Practicum
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To perform hematological and immunological laboratory techniques accurately using standard protocols, laboratory instruments, and biosafety practices.</p> <p><b>CO(A)2.</b> To analyze hematological parameters, immunological assays, and pathological reports for scientific interpretation and diagnosis.</p> <p><b>CO(A)3.</b> To demonstrate competency in laboratory instrumentation, quality control, data recording, and interpretation of experimental findings.</p> <p><b>CO(A)4.</b> To apply laboratory ethics, scientific communication, teamwork, and problem-solving skills while conducting hematological and immunological investigations.</p>
8	<b>Course Outcomes:</b> Upon completion of this course student will	<p><b>CO1:</b> Perform hematological investigations such as hemoglobin estimation, blood cell counting, blood glucose estimation, and serum protein analysis using standard laboratory procedures.</p> <p><b>CO2:</b> Conduct basic immunological techniques including antigen–antibody interaction assays and immunodiffusion while following laboratory safety guidelines.</p> <p><b>CO3:</b> Interpret hematological and immunological laboratory reports for identifying normal and abnormal physiological conditions.</p> <p><b>CO4:</b> Identify and explain the principles and applications of commonly used hematological and immunological laboratory instruments.</p>
9	<b>Syllabus</b>	<ol style="list-style-type: none"> <li>1. Microscopic examination of hematin crystals (Minor) (E)</li> <li>2. Quantitative estimation of hemoglobin by Drabkin’s method/cyanmethemoglobin method. (E) (major)</li> <li>3. Study of blood cells: RBC &amp; WBC using Neubauer hemocytometer.</li> <li>4. Screening of anemic and non-anemic persons using CuSO<sub>4</sub> (Minor)</li> <li>5. Quantitative estimation of blood glucose using DNS reagent <b>OR</b> GOD-POD method. (Major)</li> </ol>

	<ol style="list-style-type: none"> <li>6. Separation of serum proteins using PAGE.</li> <li>7. Interpretation of given pathological report based on hematological and immunological parameters.</li> <li>8. Identify the instrument &amp; state its clinical use: ESR (Wintrobe &amp; Westergren), Sahli's Haemometer, micro-hemocrit centrifuge.</li> <li>9. Interpret of the medical condition/abnormality from the given set of symptoms, give diagnostic tool/treatment if any.</li> <li>10. Study of antigen- antibody interaction using Latex Agglutination Test.</li> <li>11. Study of immunodiffusion technique (Ouchterlony).</li> <li>12. Identify &amp; describe:</li> <li>13. ELISA microplate reader, Organs of Immune system: Thymus, Bone marrow, Lymph node.</li> <li>14. Visit to nearby pathology lab and prepare report based on it.</li> </ol>																					
<b>10</b>	<b>External Practical examination skeleton Paper pattern</b> <b>Marks: 30</b> <span style="float: right;"><b>Time: 3 hrs</b></span>																					
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S. No</th> <th style="width: 80%;">Experiment</th> <th style="width: 10%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q1</td> <td>Major question</td> <td style="text-align: center;">07</td> </tr> <tr> <td>Q2</td> <td>Minor Question</td> <td style="text-align: center;">05</td> </tr> <tr> <td>Q3</td> <td>Solve the given problem/interpret the pathological report.</td> <td style="text-align: center;">04</td> </tr> <tr> <td>Q4</td> <td>Identify &amp; describe (3×3)</td> <td style="text-align: center;">09</td> </tr> <tr> <td>Q5</td> <td>Journal (03) &amp; viva (02)</td> <td style="text-align: center;">05</td> </tr> <tr> <td colspan="2" style="text-align: center;">Total</td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table>	S. No	Experiment	Marks	Q1	Major question	07	Q2	Minor Question	05	Q3	Solve the given problem/interpret the pathological report.	04	Q4	Identify & describe (3×3)	09	Q5	Journal (03) & viva (02)	05	Total		<b>30</b>
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	<ol style="list-style-type: none"> <li>1. Practical Manual of Hematology-Girish Kamat-A standard lab manual covering basic hematology techniques and procedures</li> <li>2. Dacie and Lewis Practical Haematology, 10th Edition – S. Mitchell Lewis, Barbara J. Bain, Imelda Bate</li> <li>3. A Laboratory Guide to Clinical Hematology (2019) – Valentin Villatoro &amp; Michelle</li> <li>4. Manual of Molecular and Clinical Laboratory Immunology – Barbara Detrick, Robert G. Hamilton, James D. Folds</li> <li>5. Immunology: Overview and Laboratory Manual, 2nd Edition – Tobili Y. Sam-Yellowe</li> </ol>																					

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

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

**Semester- V**

**Title: ZOOLOGY IKS**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

**Title: Zoology IKS**  
**Course Code: CHMZOOV5**

S. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course explores zoological concepts through Indian Knowledge Systems, emphasizing traditional animal classification, behavior, conservation, and indigenous practices. It integrates cultural, ethical, and ecological perspectives, enabling students to understand biodiversity through classical texts and community knowledge while developing skills in observation, documentation, and sustainable interaction with fauna and the environment.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Theory
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> Explain zoological concepts through Indian Knowledge Systems (IKS) and relate traditional biological knowledge with contemporary zoological sciences.</p> <p><b>CO(A)2:</b> Analyze indigenous knowledge related to biodiversity, animal behavior, conservation, ethnoveterinary practices, and sustainable resource management using scientific principles.</p> <p><b>CO(A)3:</b> Evaluate the relevance of Indian Knowledge Systems in biodiversity conservation, environmental sustainability, animal welfare, and community development.</p> <p><b>CO(A)4:</b> Apply ethical values, documentation skills, and scientific approaches to preserve, validate, and promote indigenous biological knowledge for sustainable development.</p>
8	<b>Course Outcomes:</b>	<p>Upon completion of this course student will</p> <p><b>CO1:</b> Explain the historical development, scope, and scientific relevance of Indian Knowledge Systems in zoology and biological sciences.</p> <p><b>CO2:</b> Compare traditional zoological knowledge with modern scientific concepts related to animal diversity, ecology, conservation, and animal husbandry.</p> <p><b>CO3:</b> Analyze indigenous practices associated with biodiversity conservation, ethnoveterinary medicine, fisheries, apiculture, sericulture, and sustainable resource utilization.</p> <p><b>CO4:</b> Integrate traditional knowledge with modern biological sciences to address contemporary environmental and societal challenges.</p>
9	<b>Syllabus</b>	
	<b>UNIT I: Foundations of Indian Knowledge Systems in Zoology and Biological Understanding</b>	

### **Introduction to Indian Knowledge Systems and Zoological Thought**

- Concept, scope, and significance of Indian Knowledge Systems (IKS) in biological sciences
- Historical sources of zoological knowledge in Indian literature and traditions
- Contributions of indigenous knowledge to understanding animal life and natural systems

### **Traditional Perspectives on Animal Diversity and Classification**

- Indigenous approaches to classification of animals based on habitat, morphology, life processes, and utility
- Comparative understanding of traditional and modern zoological classification systems
- Philosophical and ecological dimensions of biodiversity in Indian traditions

### **Animal Life, Ecology, and Environmental Relationships in Indian Traditions**

- Traditional understanding of animal behavior, ecological interactions, and ecosystem balance
- Biodiversity, food relationships, and coexistence reflected in classical narratives and folklore
- Indigenous ecological knowledge and sustainability principles

### **Ethical, Cultural, and Conservation Dimensions of Zoology**

- Ethical perspectives toward animals, including compassion, coexistence, and environmental stewardship
- Cultural and symbolic significance of animals in Indian society
- Traditional practices promoting biodiversity conservation and ecological harmony

## **UNIT II: Applied Zoology, Indigenous Practices, and Contemporary Relevance**

### **Indigenous Practices in Animal Care, Management, and Sustainable Livelihoods**

- Traditional systems of animal husbandry, animal health, and ethnoveterinary knowledge
- Indigenous methods of breeding, resource management, and sustainable use of animals
- Role of animal-based practices in rural livelihoods and socio-economic sustainability

### **Traditional Ecological Knowledge and Sustainable Resource Management**

- Indigenous pest control, biological management, and eco-friendly agricultural practices
- Community-based approaches to biodiversity conservation and ecosystem management
- Traditional knowledge related to apiculture, sericulture, fisheries, and allied biological resources

### **Documentation, Field-Based Learning, and Community Knowledge Systems**

- Methods for identifying, documenting, and preserving indigenous biological knowledge
- Field exposure to biodiversity sites, traditional practices, and community interactions
- Preparation of reports, case studies, and reflective learning documentation

### **Contemporary Applications and Integration of IKS in Zoology**

- Relevance of traditional knowledge in modern zoology, biodiversity studies, and sustainability
- Integration of indigenous and scientific approaches for environmental problem-solving
- Ethical responsibility, conservation awareness, and community engagement in biological sciences

<p><b>10</b></p>	<p><b>Scheme of Examination and Assessment Pattern (Paper – 50 Marks)</b></p> <p><b>External Examination: Semester End External – 30 marks</b> <span style="float: right;"><b>Time: 1:00 hour</b></span></p> <p style="text-align: center;">Format of Question Paper</p> <p><b>Attempt all questions.</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Question</th> <th style="width: 65%;">Nature of Questions</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Q1</td> <td>Attempt any three questions out of six (5 marks each) based on Unit-1</td> <td style="text-align: center;">15</td> </tr> <tr> <td style="text-align: center;">Q. 2</td> <td>Attempt any three questions out of six (5 marks each) based on Unit-2</td> <td style="text-align: center;">15</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table> <p><b>Note:</b> Equal Weightage is to be given to all the Units.</p> <p><b>E. Internal Examination: Continuous Evaluation - 20 marks</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S. No</th> <th style="width: 70%;">Assessment / Evaluation</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.</td> <td style="text-align: center;">15</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Continuous Internal evaluation</td> <td style="text-align: center;">05</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>	Question	Nature of Questions	Marks	Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15	Q. 2	Attempt any three questions out of six (5 marks each) based on Unit-2	15	<b>Total</b>		<b>30</b>	S. No	Assessment / Evaluation	Marks	1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.	15	2.	Continuous Internal evaluation	05	<b>Total</b>		<b>20</b>
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<p><b>11</b></p>	<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Indian Knowledge Systems – B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R.</li> <li>2. Traditional Knowledge Systems of India – Amit Jha</li> <li>3. This Fissured Land: An Ecological History of India – Madhav Gadgil &amp; Ramachandra Guha</li> <li>4. Ecology and Equity: The Use and Abuse of Nature in Contemporary India – Madhav Gadgil &amp; Ramachandra Guha</li> <li>5. Indigenous Knowledge Systems and Sustainable Development – Various Authors (IGNOU Publications)</li> <li>6. Biodiversity and Indigenous Knowledge Systems in India – M. K. Rai, R. K. Upadhyay</li> <li>7. Ethnobiology in Human Welfare – U. P. Singh, J. N. Govil, V. K. Sinha</li> <li>8. Handbook of Indian Veterinary Medicine – Traditional Practices Compilation</li> <li>9. Panchatantra – Vishnu Sharma (for animal behavior insights)</li> <li>10. Jataka Tales – Buddhist Literature (Animal ethics and ecological understanding).</li> </ol>																								

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

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

**Title: Mandatory Elective  
Medical Diagnostics**

**Vertical - 1  
Major subject: 2 Credits**

**With effect from the  
Academic Year 2026-27**

## Title: Mandatory Elective: Medical Diagnostics

Course Code: CHMZOOV7

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course provides a comprehensive introduction to medical diagnostics, covering fundamental principles, classification of diagnostic methods, and the role of public health systems in delivering accessible diagnostic services in India. The course aims at imparting knowledge on body fluid analysis, CBC interpretation, urine examination, biosafety, and proper sample handling. The course also introduces the construction, working, and applications of essential diagnostic instruments—from basic tools like thermometers, pulse oximeters, and glucometers to advanced technologies such as ECG, ultrasound, CT, MRI, and PET scans. Emphasizing safety, accuracy, and emerging innovations, the course prepares learners to interpret diagnostic results and apply modern diagnostic practices in healthcare settings.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Theory
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies. Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To explain the principles, classifications, and applications of medical diagnostic techniques, biomedical instruments, and laboratory investigations in healthcare.</p> <p><b>CO(A)2:</b> To analyze diagnostic data obtained from body fluids, laboratory investigations, imaging techniques, and clinical reports for disease identification and health assessment.</p> <p><b>CO(A)3:</b> To evaluate the applications, advantages, limitations, and safety aspects of conventional and advanced diagnostic technologies used in modern healthcare.</p> <p><b>CO(A)4:</b> To apply principles of biosafety, biomedical waste management, ethical practices, and quality assurance in medical diagnostics to support evidence-based healthcare and public health services.</p>
8	<b>Course Outcomes:</b>	<p>Upon completion of this course student will</p> <p><b>CO1:</b> Interpret diagnostic reports including CBC, urine analysis, blood biochemistry, ECG, and imaging investigations for assessment of normal and pathological conditions.</p> <p><b>CO2:</b> Differentiate the principles, applications, advantages, and limitations of commonly used biomedical diagnostic instruments and advanced imaging technologies.</p> <p><b>CO3:</b> Apply biosafety guidelines, specimen handling procedures, biomedical waste management, and quality assurance practices in diagnostic laboratories.</p> <p><b>CO4:</b> Evaluate the role of diagnostic technologies in disease prevention, patient care, public health, and personalized medicine.</p>

## Syllabus

### UNIT I: Fundamentals of medical diagnostics

#### Basics of medical diagnostics

- Definition and importance in disease detection and healthcare
- Classification of diagnostic techniques — Invasive vs. non-invasive, Bedside vs. laboratory-based, Manual vs. automated diagnostics
- Role of paramedical professionals and lab technicians
- Importance of simple diagnostics equipment's at home

#### Basics of body fluid testing

- Types of diagnostic fluids, Importance of biological fluids in health assessment
- Blood diagnostics – Components and their functions, Complete Blood Count (CBC): parameters, significance, and interpretation,
- Urine analysis — Composition, physical, chemical, and microscopic examination, Diagnostic significance in renal and systemic diseases
- Other common diagnostic fluids – sputum, cerebrospinal fluid (CSF), Synovial fluid, Pleural and peritoneal fluids: collection methods, and their significance

#### Biosafety and sample handling in medical diagnostics

- Personal Protective Equipment (PPE) – Gloves, masks, gowns, face shields, eye protection, Correct donning (putting on) and doffing (removal) procedures, and safe handling of specimens, Use of biosafety cabinets and containment devices.
- Types of biomedical waste, Colour-coded waste segregation (red, yellow, blue, black bins), Safe disposal methods (incineration, autoclaving).
- Disinfection and waste disposal — Difference between cleaning, disinfection, and sterilization, alcohols, bleach (sodium hypochlorite), hydrogen peroxide.

### Unit II: Diagnostic Instruments and Emerging Techniques

#### Basic diagnostic equipment's

- Digital thermometers – Construction, working and advantages over mercury thermometers
- Pulse oximeter – Principle, measurement of SpO<sub>2</sub> and pulse rate, normal values
- Sphygmomanometers – Principle, components, Interpretation of readings
- Glucometer and continuous glucose meter – Principle, strip types, normal fasting and postprandial ranges, advantages of continuous glucose meter over glucometer
- Digital BP monitor – Principle, advantages over classic BP apparatus, and limitations
- Stethoscope – Parts, uses and interpretation of results

#### Routine diagnostic equipments

- Automatic cell counters – Principle, components, and applications
- Bioanalyzers – Principle, components, and applications
- ECG Machine – Principle, Electrodes placement, reading basic waveforms (P, QRS, T), applications in heart health monitoring
- Nebulizer – Principle, working, applications in asthma and chronic obstructive pulmonary disease (COPD)
- Portable ultrasound – Principle, components, applications in real-time imaging for pregnancy
- Handheld X-Ray devices– Principle, components, role in fracture detection and chest imaging, safety protocols

#### Specialised High-End Diagnostic equipments

Principle, core components, common applications and associated risk

- CT Scan (Computed Tomography Scan)

	<ul style="list-style-type: none"> <li>• MRI (Magnetic Resonance Imaging)</li> <li>• PET Scan (Positron Emission Tomography)</li> <li>• EEG (Electroencephalogram)</li> <li>• Sonography / ultrasound – 2D and 3D</li> <li>• Amniocentesis – for genetic testing</li> </ul>																								
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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

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

**Semester- V**

**Title: Laboratory exercise based on  
Medical Diagnostics**

**Vertical - 1  
Major Elective – 2 Credit**

**With effect from the  
Academic Year 2026-27**

# Title: Laboratory exercise based on Medical Diagnostics

Course Code: CHMZOOV8

S. No.	Heading	Particulars
1	Description of the Course	This practical course provides learners with hands-on training in commonly used diagnostic tools, biomedical devices, and laboratory techniques essential for clinical and healthcare practice. Learners develop proficiency in measuring blood glucose, oxygen saturation, blood pressure, temperature, and understand basic ECG readings. The course includes practical skill for rapid diagnostic tests for infectious diseases, blood smear interpretation, use of stethoscopes and nebulizers, and demonstrations of ELISA and PCR techniques. Learners comprehend the working of high-end diagnostic instruments such as CT, MRI, PET, and automatic cell counters while interpreting clinical reports including CBC, biochemistry, and ECG. A mandatory visit or virtual tour of a NABH/NABL-accredited laboratory enhances practical understanding.
2	Vertical	Major
3	Type	Practicum
4	Credit	2
5	Hours allotted	60 Hours
6	Marks allotted	50 Marks
7	Course Objectives:	<p>CO(A)1. To acquaint learners with routine clinical diagnostic procedures using commonly employed biomedical instruments and laboratory techniques following standard operating procedures.</p> <p>CO(A)2. To analyze and interpret laboratory investigations, physiological measurements, and diagnostic reports for identification of normal and abnormal health conditions.</p> <p>CO(A)3. To develop competency in operating diagnostic equipment while maintaining laboratory safety, biosafety, quality assurance, and professional ethics.</p> <p>CO(A)4: To develop scientific communication, analytical reasoning, problem-solving, and documentation skills through laboratory investigations and clinical case-based learning.</p>
8	Course Outcomes: Upon completion of the course students will	<p>CO1: Perform routine diagnostic procedures including measurement of blood glucose, blood pressure, body temperature, oxygen saturation, urine glucose testing, and rapid diagnostic tests using standard laboratory protocols.</p> <p>CO2: Identify the working principles, components, and clinical applications of commonly used biomedical diagnostic instruments and advanced imaging technologies.</p> <p>CO3: Analyze and interpret laboratory reports including CBC, urine analysis, blood biochemistry, ECG, and rapid diagnostic test results to assess health conditions.</p> <p>CO4: Prepare scientific laboratory records and reports based on experimental observations, clinical data interpretation, and diagnostic investigations.</p>

<b>9</b>	<b>Syllabus</b>																						
	<ol style="list-style-type: none"> <li>1. Measurement of blood glucose using glucometer (strip-based methods).</li> <li>2. Measuring oxygen saturation using pulse oximeter.</li> <li>3. Measurement of blood pressure using digital machine / Sphygmomanometers.</li> <li>4. Measurement of temperature using clinical / digital thermometers.</li> <li>5. Rapid test for Dengue / Malaria by using kit – Interpretation and usage.</li> <li>6. Identification of malaria, sickle cell anaemia using blood smear method. (Readymade slides / photographs with positive results can be shown).</li> <li>7. Qualitative Test for Glucose in urine (Benedict’s Test).</li> <li>8. Demonstration of use of stethoscope and nebulizer with help of videos.</li> <li>9. Demonstration of ELISA technique (using kits or virtual labs).</li> <li>10. Identification of medical devices/equipment’s: CT scan, MRI, PET scan, Portable ultrasound, Bioanalyzers, Pulse oximeter, Automatic cell counter, Nebulizer, Handheld X-ray device (Working principal, components and applications).</li> <li>11. Interpretation of diagnostic reports:            CBC            Blood biochemistry — Glucose, HbA1c, Creatinine, BUN (Blood Urea Nitrogen), Liver enzymes (ALT, AST, ALP), Cholesterol (LDL, HDL), triglycerides.            Urine Routine – Physical, Chemical and microscopic examination.            ECG (normal, bradycardia, tachycardia, arrhythmia, fibrillation).</li> <li>12. Report submission on visit to (or virtual tour of) a NABH / NABL — accredited lab or hospital / suitable diagnostic centre.</li> </ol>																						
<b>10</b>	<b>External Practical Examination Skeleton Paper pattern</b> <b>Marks: 50</b> <span style="float: right;"><b>Time: 3 hrs</b></span>																						
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7. Chernecky, C. C., & Berger, B. J. (2013). *Laboratory Tests and Diagnostic Procedures*. 6th Edition, Saunders/Elsevier. ISBN: 978-1-4557-4693-4
8. Coleman, W. B., & Tsongalis, G. J. (Eds.). (2023). *Diagnostic Molecular Pathology: A Guide to Applied Molecular Testing (2nd Edition)*. Elsevier. ISBN: 978-0-12-822824-1

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

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

**Title: Animal classification**

**Vertical - 2  
Minor Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Animal classification

Course Code: CHMZOOV9

S. No.	Heading	Particulars
1	Description of the Course	This course provides a comprehensive understanding of animal classification, taxonomy, and systematics, covering both invertebrates and vertebrates. It introduces the historical development, principles, and importance of classification, including artificial, natural, and phylogenetic systems. The course explains the basis of classification such as levels of organization, symmetry, germ layers, body cavity, and segmentation. Detailed study of major invertebrate and vertebrate phyla is included with representative examples. The syllabi also includes modern approaches like molecular systematics, DNA barcoding and their relevance to biodiversity conservation.
2	Vertical	Minor
3	Type	Theory
	Teaching methods	Lecture, Seminar, Group discussion, Presentation, simulations, field visits, AV mode etc.
4	Credit	2
5	Hours allotted	30 Hours
6	Marks allotted	50 Marks
7	Course Objectives:	The course is designed to acquaint the learners to, CO(A)1. The principles, history, and need for animal classification and taxonomy. CO(A)2. The diagnostic characters and classification of major invertebrate and vertebrate animal. CO(A)3. Modern and applied aspects of systematics and their role in biodiversity studies.
8	Course Outcomes:	On completion of the course the learner will: CO 1 Classify animals based on structural, developmental, and evolutionary features. CO 2 Identify and compare major invertebrate and vertebrate phyla with suitable examples. CO 3 Understand modern taxonomic tools and their applications in evolutionary biology and conservation.
9	<b>Syllabus</b>  <b>Unit I: Animal Classification I</b> <b>1.3 Introduction and History of Animal Classification</b> <ul style="list-style-type: none"><li>• Definition, scope, and importance of animal classification</li><li>• Contributions of Aristotle, Linnaeus, Lamarck, Cuvier, R.H. Whittaker, Carl Woese</li><li>• Concept of species, binomial nomenclature, and taxonomic hierarchy</li></ul> <b>1.2 Basis of animal Classification</b> <ul style="list-style-type: none"><li>• Levels of organization: cellular, tissue, organ, and organ-system level</li><li>• Body symmetry: asymmetry, radial symmetry, and bilateral symmetry</li><li>• Germ layers: diploblastic and triploblastic organization</li><li>• Body cavity: acoelomate, pseudocoelomate, and coelomate condition</li></ul>	

- Segmentation and cephalization

### 1.3 Classification of Invertebrata – Acoelomates and pseudocoelomates

- Kingdom Protista (Protozoa – Animal-like protists) – General characters and classification with examples
- Phylum Amoebozoa: *Amoeba proteus*
- Phylum Ciliophora: *Paramecium caudatum*
- Phylum Euglenozoa or Zoomastigophora: *Euglena*
- Phylum Apicomplexa or Sporozoa: *Plasmodium*
- Phylum Porifera – General characters; examples: *Sycon*, *Spongilla*
- Phylum Cnidaria – General characters; examples: *Hydra*, *Aurelia*
- Phylum Platyhelminthes – General characters; examples: *Taenia solium*, *Fasciola hepatica*.
- Phylum Nematoda – General characters; examples: *Ascaris lumbricoides*, *Wuchereria bancrofti*.

### 1.4 Classification of Invertebrata – Coelomates

- Phylum Annelida – General characters; examples: *Pheretima*, *Nereis*
- Phylum Arthropoda – General characters; examples: *Periplaneta americana*, *Penaeus* sp.
- Phylum Mollusca – General characters; examples: *Pila globosa*, *Sepia*.
- Phylum Echinodermata – General characters; examples: *Asterias*, *Echinus*
- Comparison of main characters of Invertebrate phyla.

## Unit II Animal Classification II

### 2.1 Concepts of Taxonomy, Phylogeny and Systematics

### 2.2 Classification of Chordates

- Characteristic features of Phylum Chordates
- Classification of Protochordates – Subphylum Cephalochordata (*Branchiostoma*) and Subphylum Urochordata (*Herdmania*)

### 2.3 Classification of Subphylum Vertebrata

- General features of subphylum vertebrata,
- Infraphylum Cyclostomata (jawless fishes): examples *Petromyzon marinus*, *Eptatretus* spp
- Infraphylum Gnathostomata (jawed fishes): examples: *Scoliodon laticaudus*, *Labeo rohita*
- Class Amphibia: examples: *Hoplobatrachus tigerinus*, *Ichthyophis bombayensis*
- Class Reptilia: examples: *Calotes versicolor*, *Geochelone elegans*
- Class Aves: examples: *Ardea alba*, *Passer domesticus*
- Class Mammalia: examples: *Pteropus giganteus*, *Delphinus delphis*

### 2.4 Modern & Applied Systematics

- DNA Barcoding & Phylocode: Recent developments in molecular identification and nomenclature
- Zoogeography: Animal distribution, biogeographic realms, factors affecting distribution, endemic species
- Relevance: Biodiversity conservation, understanding evolutionary patterns (speciation, macroevolution)

<b>10</b>	<b>Scheme of Examination and Assessment Pattern (Paper – 50 Marks)</b>		
	<b>A. External Examination: Semester End External - 30 marks</b>		<b>Time: 1:00 hour</b>
	Format of Question Paper		
	<b>Attempt all questions.</b>		
	<b>Question</b>	<b>Nature of Questions</b>	<b>Marks</b>
	Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15
	Q2	Attempt any three questions out of six (5 marks each) based on Unit-1	15
	<b>Total</b>		<b>30</b>
	<b>Note:</b> Equal Weightage is to be given to all the Units.		
	<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>		
<b>No</b>	<b>Assessment / Evaluation</b>	<b>Marks</b>	
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.	15	
2.	Overall conduct as a responsible student and attentiveness	05	
<b>Total</b>		<b>20</b>	
<b>11</b>	<b>References:</b>		
	<ol style="list-style-type: none"> <li>Zakryś, B; Milanowski, R; Karnkowska, Anna (2017). "Evolutionary Origin of Euglena". <i>Euglena: Biochemistry, Cell and Molecular Biology. Advances in Experimental Medicine and Biology.</i> Vol. 979. pp. 3–17. doi:10.1007/978-3-319-54910-1_1. ISBN 978-3-319-54908-8.PMID 28429314.</li> <li>Cavalier-Smith T (1981). "Eukaryote kingdoms: seven or nine?". <i>Bio Systems.</i> 14 (3–4): 461–481. doi:10.1016/0303-2647(81)90050-2. PMID 7337818.</li> <li>Euglenozoa". <i>Encyclopedia of Life. National Museum of Natural History - Smithsonian Institution.</i> Retrieved 16 January 2020.</li> <li>Hodda et al. (2022) Phylum Nematoda: a classification, catalogue and index of the species, <i>Zootaxa.</i> 5114 (1): 1–289.</li> <li>Francis Polkinghorne Pascoe (2023). <i>Zoological Classification; a Handy Book of Reference with Tables of the Subkingdoms, Classes, Orders, etc., of the Animal Kingdom, Their Characters and Lists of the Families and Principal Genera,</i> ISBN 978-1020027147.</li> <li>Evelyn Wells (2025). <i>Fundamentals of Animal Classification: A Beginner's Guide,</i> ISBN-979 .8313953526</li> <li>Louis Agassiz (2023). <i>On the Principles of Classification in the Animal Kingdom,</i> ISBN-978 1021394712.</li> <li>Rahul Jain (2023). <i>Kingdom Animalia Animal Classification: Quick Revision Book,</i> ISBN-978 -9358470635</li> </ol>		

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

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

**Semester- V**

**Title: Aquaculture**

**Vertical - 4  
VSC - 2 Credit**

**With effect from the  
Academic Year 2026-27**

# Title: Aquaculture

**Course Code: CHMZOOV6**

S. No.	Heading	Particulars
1	<b>Description the Course</b>	Aquaculture involves the controlled cultivation of aquatic organisms such as fish, crustaceans, molluscs, and aquatic plants. Aquaculture is one of the fastest-growing industries in India, contributing significantly to employment generation and national GDP. Economic success depends on efficient management of inputs like feed and labour in relation to market value. This vocational course is designed to equip learners with practical knowledge required to establish and manage an aquaculture farm as a profitable enterprise.
2	<b>Vertical 4</b>	Vocational Skill Course (VSC)
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> Apply scientific principles for planning, designing, and managing sustainable freshwater, brackish water, and marine aquaculture systems.</p> <p><b>CO(A)2:</b> Perform practical techniques for water quality analysis, species identification, disease diagnosis, feed management, and biosecurity in aquaculture operations.</p> <p><b>CO(A)3:</b> Evaluate the technical, economic, and environmental aspects of aquaculture for sustainable production and entrepreneurship.</p> <p><b>CO(A)4:</b> Develop entrepreneurial, managerial, and professional competencies required for establishing and operating economically viable aquaculture enterprises</p>
8	<b>Course Outcomes:</b>	<p>Upon completion of the course, the learners should be able to:</p> <p><b>CO1:</b> Select suitable aquaculture sites, culture systems, and commercially important aquatic species based on scientific and economic criteria.</p> <p><b>CO2:</b> Perform water and soil quality assessment, plankton identification, disease diagnosis, and feed evaluation using standard aquaculture techniques.</p> <p><b>CO3:</b> Apply biosecurity measures, disease prevention strategies, and sustainable farm management practices for healthy aquaculture production.</p> <p><b>CO4:</b> Analyze production efficiency using feed conversion indices, water quality parameters, and economic feasibility of aquaculture enterprises</p>
9	<b>Syllabus</b>	<ol style="list-style-type: none"> <li>1. Study of the criteria for the site selection, design and construction of aquaculture of fish and shell fish (cages, rafts, pens, raceways, dyke, inlet, and outlet construction).</li> <li>2. Study of pond design and its types (nursery, rearing, stocking).</li> <li>3. Study of various instruments and gears: Nets (drag, cast, trap), Aerators, pumps, feed dispensers, Secchi disk, pH meter, and DO meter.</li> <li>4. Estimation of water parameters: Temperature, conductivity, ammonia, nitrate, phosphate, alkalinity, and hardness.</li> <li>5. Estimation of soil parameters: Soil texture and pH.</li> <li>6. Identification of Plankton: Identification of phytoplankton – Chlorella, Scenedesmus, Navicula, Spirulina; Identification of zooplankton: Rotifers, Cladocerans, and Copepods.</li> </ol>

7. Study of the criteria for the selection of species for aquaculture. Identification of cultivable finfish and shellfish species: Indian Major Carps (Catla, Rohu, Mrigal), exotic carps (Silver Carp, Grass Carp, Common Carp), catfish (Pangasius spp), sea bass, mullet, freshwater prawn, tiger prawn, mud crab.
8. Diagnosis and prevention of common bacterial - Edwardsiellosis (Enteric Septicemia of Catfish), Streptococcosis, Aeromoniasis (Motile Aeromonas Septicemia); viral – Infectious Pancreatic Necrosis (IPN), Viral Hemorrhagic Septicemia (VHSV), White Spot Syndrome Virus (WSSV); fungal – Fusariosis, Cladosporiasis; and parasitic diseases – Gill fluke infection, Lepeophtheirus infection and Capillaria infection.
9. Disinfection protocols used in aquaculture – Types of disinfectants, disinfection protocols, disinfection of eggs and larvae, disinfection of materials and equipment, disinfection of source water and water pipelines.
10. Study of types of fish feed (natural vs. artificial) and nutritional requirements of fishes.
11. Calculation and study of Feed Conversion Ratio (FCR), Food Efficiency Ratio (FER), Protein Efficiency Ratio (PER).
12. Live feed culture – zooplankton – Artemia, Infusuria and Daphnia.
13. Preparation and submission of a feasibility report for a small to medium-scale aquaculture farm.
14. Visit to a freshwater aquaculture farm to observe practices and submission of a detailed report on the same.

**10 Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)**

**Practical Examination**

**A. Semester End External-**

**A. Total: 30 marks**

**Time: 3 hrs**

**B.**

**Skelton Paper for Practical**

S. No	Practical	Marks
Q.1	Major Experiment	10
Q.2	Minor Experiment	08
Q.3	Spotting / Identification (4 x 2.5 Marks)	10
Q.4	Journal	02
	Total	<b>30</b>

**C.**

**D. Internal Examination (20 marks)**

S. No	Assessment / Evaluation	Marks
1.	Multiple Choice Exam	10
2.	Project Submission, Presentation and Viva	10
	Total	<b>20</b>

**11**

**References:**

1. Jhingran, V.G. (1982). Fish and Fisheries of India. Hindustan Publishing Corporation India.
2. Chhapgar, B. F. (1991). Seashore life of India (Vol. 3). Oxford University Press.
3. Pillai, N. K. (1986). Introduction to Planktology. Himalaya Publication house Bombay.
4. Boyd, C. E. (1982). Water quality Management for Pond fish culture Elsevier Scientific Publishing Company.
5. APHA, AWWA, WPCF (1998). Standard methods for the Examination of Water and waste water, 20th ED.

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|---|
| <ol style="list-style-type: none"><li>6. Pillay, T.V.R. &amp; Kutty, M. N. (2005). Aquaculture- Principles and Practices. Blackwell.</li><li>7. Rath, R. K. (2000). Freshwater Aquaculture. Scientific Publ</li><li>8. Beavea, R. (1990). Handbook of the Freshwater Fishes of India. Narendra Publ. House. India,</li><li>9. Khanna, S.S. &amp; Singh, H.R. (2006). A Textbook of Fish Biology and Fisheries. Narendra Publ. House., India</li><li>10. Chandy, M. (1996). Fishes, National Book Trust India.</li></ol> |
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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

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

**Semester – VI**

**Title: Field Project**

**Vertical: 6  
FP: 2 Credits**

**Choice Based and Credit Based syllabus  
as per NEP 2020 with effect from  
the Academic Year 2026-2027**

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

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

**Semester – VI**

<b>S. No</b>	<b>Vertical</b>	<b>Code</b>	<b>Name of the Paper</b>	<b>Theory/ Practical</b>	<b>Credits</b>
1	Major	CHMZOOVI1	Classification of Chordates	Theory	2
2	Major	CHMZOOVI2	Laboratory exercise based on classification of Chordates	Practical	2
3	Major	CHMZOOVI3	Animal Physiology	Theory	2
4	Major	CHMZOOVI4	Laboratory exercise based on Animal Physiology	Practical	2
5	Major	CHMZOOVI5	Type Study-Sepia	Theory	2
6	Major	CHMZOOVI6	Laboratory exercise based on Type study	Practical	2
7	Major	CHMZOOVI7	Histology and Endocrinology	Theory	2
8	Major Elective	CHMZOOVI8	Clinical Research	Theory	2
9	Major Elective	CHMZOOVI9	Laboratory exercise based on Clinical Research	Practical	2
10	OJT	CHMZOOVI10	---	Training	4
<b>Total</b>					<b>22</b>

**Choice Based and Credit Based syllabus  
as per NEP 2020 with effect from  
the Academic Year 2026-2027**

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

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

**Semester- VI**

**Title: Classification of Chordates**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Classification of Chordates

Course Code: CHMZOOVI1

S. No.	Heading	Particulars
1	Description of the Course	The course is designed to help learners understand the <b>taxonomy, diversity, and evolutionary relationships of chordates</b> , tracing their progression from simple protochordates to complex vertebrates. It emphasizes the <b>morphological, anatomical, and adaptive features</b> that define each major group—fishes, amphibians, reptiles, birds, and mammals—with a phylogenetic perspective. Learners will explore the <b>evolutionary significance of chordate characteristics</b> , analyze comparative anatomy across classes, and recognize the <b>functional adaptations</b> that enabled vertebrates to conquer diverse habitats. The <b>type study of Shark</b> provides an in-depth understanding of vertebrate structure, organ systems, and evolutionary specialization. This course builds conceptual clarity on how classification reflects evolutionary history and equips students with scientific reasoning to interpret <b>form, function, and phylogeny</b> within the animal kingdom.
2	Vertical	Major
3	Type	Theory
	Teaching methods	Lecture, Seminar, Group discussion, Presentation, simulations, field visits, AV mode etc.
4	Credit	02
5	Hours allotted	30 Hours
6	Marks allotted	50 Marks
7	Course Objectives:	<p><b>CO(A)1.</b> To examine the distinguishing morphological and adaptive features of major chordate groups, including fishes, amphibians, reptiles, birds, and mammals.</p> <p><b>CO(A)2.</b> To analyze the evolutionary relationships and trends from primitive chordates to advanced vertebrates through comparative study of representative organisms.</p> <p><b>CO(A)3.</b> To develop skills in identification, classification, and systematic interpretation of chordate animals based on their taxonomic and ecological characteristics.</p>
8	Course Outcomes:	<p>Upon completion of the course, learners will</p> <p><b>CO 1.</b> Explain and classify chordates up to the class level based on evolutionary and morphological features.</p> <p><b>CO 2.</b> Differentiate and compare anatomical structures and adaptive characteristics across vertebrate groups.</p> <p><b>CO 3.</b> Apply taxonomic principles to identify and differentiate representative chordates, interpret their evolutionary relationships, and communicate scientific concepts using appropriate zoological terminology.</p>

## Syllabus

### Unit I: Phylum Chordata: Group Protochordata and Group Euchordata I

**1.1 Group Protochordata:** General characters and classification upto class with distinguishing features and suitable examples of Subphylum Urochordata: Class Ascidiacea e.g. *Herdmania*, Class Thaliacea e.g. *Salpa*, Class Larvacea e.g. *Oikopleura*, Subphylum Cephalochordata: Class Leptocardii e.g. *Branchiostoma* (Amphioxus)

**1.2 Group Euchordata I:** General characters and classification upto class with distinguishing features and suitable examples of Subphylum Vertebrata: Division Agnatha: Class Ostracodermii e.g. *Cephalaspis*, Class Cyclostomata e.g. *Petromyzon* (Lamprey), Division: Gnathostomata: Superclass: Pisces: Class Chondrichthyes e.g. *Rhinobatos* (Guitar fish) Class Osteichthyes e.g. *Clarius batracus* (Cat fish)

### Unit II: Group Euchordata II

**2.1** General characters and classification upto class with distinguishing features and suitable examples of Division: Gnathostomata: Superclass Tetrapoda: Class Amphibia: General characters Examples: Limbless amphibian e.g. *Ichthyophis* (Caecilian), Tailed amphibian e.g. *Amphiuma*, Tailless amphibian e.g. *Hyla* (Tree frog) and Class Reptilia: General characters and Examples: Extinct reptile e.g. *Ichthyosaurus*, Living fossil e.g. *Sphenodon* (Tuatara), Aquatic reptile e.g. *Chelonia* (Sea turtle), Arboreal reptile e.g. *Chamaeleo* (Chamaeleon)

**2.2** General characters and classification upto class with distinguishing features and suitable examples of Division: Gnathostomata: Superclass Tetrapoda: Class Aves: General Characters and Examples: Arboreal bird e.g. *Melanerpes* (Wood pecker), Terrestrial bird e.g. *Gallus* (Fowl), Swimming bird e.g. *Phalacrocorax* (Cormorant), Flightless birds e.g. *Dromaius* (Emu) and Class Mammalia: General characters and Examples: Egg-laying mammals e.g. *Ornithorhynchus* (Duck-billed platypus), Pouched mammals e.g. *Macropus* (Kangaroo), Toothless mammals e.g. *Bradypus* (Sloth), Primates e.g. *Macaca* (Monkey)

## 10 Scheme of Examination and Assessment Pattern (Paper – 50 Marks)

**A. External Examination: Semester End External - 30 marks**

**Time: 1:00 hour**

Format of Question Paper

**Attempt all questions.**

Question	Nature of Questions	Marks
Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15
Q. 2	Attempt any three questions out of six (5 marks each) based on Unit-2	15
<b>Total</b>		<b>30</b>

**Note:** Equal Weightage is to be given to all the Units.

**B. Internal Examination: Continuous Evaluation - 20 marks**

No	Assessment / Evaluation	Marks
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes. Continuous Internal evaluation	15
2.	Overall conduct as a responsible student	05
<b>Total</b>		<b>20</b>

**11****References:**

9. Noriyuki Satoh (2016). Chordate Origins and Evolution, The Molecular Evolutionary Road to Vertebrates. Academic Press is an imprint of Elsevier, Copyright © 2016 Elsevier Inc. All rights reserved. ISBN: 978-0-12-809934-6 (Print); ISBN: 978-0-12-803006-6 (Online).
10. Lindell Bromham (2016). An Introduction to Molecular Phylogenetics and evolution. Oxford University Press. ISBN 978-0-19-873636-3.
11. Vineeta Rawat (2024). Animal Taxonomy, Behaviour and Chronobiology. ISBN-13: - 978 8196080655.
12. Eschmeyer's Catalog of Fishes: The website provides monthly updates and addenda to the core family-group names list.
13. Integrated Taxonomic Information System (ITIS): A highly comprehensive and authoritative source for the scientific names and classification of species globally. It is widely used as a standard ITIS (.gov).
14. IUCN Red List of Threatened Species: While primarily focused on conservation status, it uses a robust and current taxonomic framework for mammals, birds, reptiles, and amphibians IUCN Red List.
15. The Reptile Database: A continuously updated resource that provides the current taxonomy and geographic data for all known reptile species The Reptile Database.
16. IOC World Bird List: Maintained by the International Ornithologists' Union, this is a leading reference for the classification and nomenclature of the world's birds IOC World Bird List.
17. Mammal Diversity Database (MDD): Curated by the American Society of Mammalogists, this database reflects the most current understanding of mammal taxonomy ASM Mammal Diversity Database.

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

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

**Semester- VI**

**Title: Laboratory exercises based on Classification of Chordates**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Laboratory exercises based on Classification of Chordates

**Course Code: CHMZOOVI2**

S. No	Heading	Particular
1	<b>Description of the Course</b>	This course provides hands-on study of vertebrate structure, function, and adaptations through dissections, comparative anatomy, and field observations. It covers major systems of representative chordates (fish to mammals), highlighting evolutionary trends and ecological significance. Field visits supplement laboratory learning, encouraging observation, analysis, and ethical understanding of animal life.
2	<b>Vertical</b>	Major
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To understand the anatomical organization, physiological functions, and evolutionary relationships among representative chordates.</p> <p><b>CO(A)2.</b> To develop practical skills in dissection, mounting, observation, and comparative analysis of vertebrate structures.</p> <p><b>CO(A)3.</b> To foster scientific attitude, ethical awareness, and appreciation of biodiversity and conservation through laboratory and field-based learning.</p>
8	<b>Course Outcomes:</b> By the end of the course, students will	<p><b>CO1.</b> Identify and describe major organ systems and adaptive features of representative vertebrates.</p> <p><b>CO2.</b> Perform and analyze dissections, mountings, and comparative studies with scientific accuracy and reasoning.</p> <p><b>CO3.</b> Interpret and evaluate structural, functional, and evolutionary relationships to explain vertebrate diversity and ecological adaptations.</p>
9	<b>Syllabus</b>	<p>9. Dissection of <i>Tilapia</i> or any bony fish to study its Digestive System, Heart and Aortic Arches Reproductive system and Brain.</p> <p>10. Mounting of fish scales - Cycloid &amp; Ctenoid.</p> <p>11. Study of Accessory respiratory organ and electric organ in fish.</p> <p>12. Identification of Commercial fish: Bombay duck, Mackerel, Seer fish, Silver Pomfret, Chinese Pomfret, Black Pomfret, Major Carps - Rohu, Mrigal and Catla and Exotic species- Tilapia.</p> <p>13. Study of parental care in fish, amphibian and birds.</p> <p>14. Comparative study of heart - Shark, Frog, Calotes, Pigeon and Rat.</p> <p>15. Comparative study of brain - Shark, Frog, Calotes, Pigeon and Rat.</p> <p>16. Study tour - Visit to National Parks / Sanctuaries / and such other places to observe vertebrates. 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</p>

10	<b>Scheme of Practical Examination and Assessment Pattern (Paper – 50 Marks)</b>		
	Duration: 3 hrs		Marks-30
	Sr. No.	Experiment	Marks
	Q.1	<b>Major experiment</b> Dissection of <i>Tilapia</i> or any bony fish _____ system. (Reproductive system / Heart and Aortic Arches / Brain.)	<b>10</b>
	Q.2	<b>Minor experiment</b> Dissection of <i>Tilapia</i> or any bony fish Digestive system. <b>Or</b> Mounting of fish scale	<b>06</b>
	Q.3	Identify and describe a. Accessory respiratory organ / electric organ in fish b. Commercial fish / Study of parental care Comparative study of heart / Comparative study of brain	<b>06</b>
	Q.4	Field Report Submission & Viva	<b>04</b>
	Q.5	Journal	<b>04</b>
		<b>Total</b>	<b>30</b>
	<b>Internal Practical Examination Paper pattern: Marks 20</b>		
Q1	Class Participation or evaluation through assignments, projects, creative writing, role play, presentations or quizzes. Continuous Internal evaluation	<b>15</b>	
Q2	Overall conduct as a responsible student and attentiveness	<b>05</b>	
	<b>Total</b>	<b>20</b>	
11	<p><b>References:</b></p> <ol style="list-style-type: none"> <li>Noriyuki Satoh (2016). Chordate Origins and Evolution, The Molecular Evolutionary Road to Vertebrates. Academic Press is an imprint of Elsevier, Copyright © 2016 Elsevier Inc. All rights reserved. ISBN: 978-0-12-809934-6 (Print); ISBN: 978-0-12-803006-6 (Online).</li> <li>Lindell Bromham (2016). An Introduction to Molecular Phylogenetics and evolution. Oxford University Press. ISBN 978-0-19-873636-3.</li> <li>Vineeta Rawat (2024). Animal Taxonomy, Behaviour and Chronobiology. ISBN-13: 978.8196080655</li> <li>Eschmeyer's Catalog of Fishes: The website provides monthly updates and addenda to the core family-group names list.</li> <li>FishBase: A comprehensive online information system with data on virtually all fish species, it is a crucial resource for ecologists and fisheries managers. It works in conjunction with the Catalog of Fishes for taxonomic consistency.</li> <li>Integrated Taxonomic Information System (ITIS): A highly comprehensive and authoritative source for the scientific names and classification of species globally. It is widely used as a standard ITIS (.gov).</li> <li>IUCN Red List of Threatened Species: While primarily focused on conservation status, it uses a robust and current taxonomic framework for mammals, birds, reptiles, and amphibians IUCN Red List.</li> <li>The Reptile Database: A continuously updated resource that provides the current taxonomy and geographic data for all known reptile species The Reptile Database.</li> <li>IOC World Bird List: Maintained by the International Ornithologists' Union, this is a leading reference for the classification and nomenclature of the world's birds IOC World Bird List.</li> <li>Mammal Diversity Database (MDD): Curated by the American Society of Mammalogists, this database reflects the most current understanding of mammal taxonomy ASM Mammal Diversity Database</li> </ol>		

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

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

**Semester- VI**

**Title: Animal Physiology**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

# Title: Animal Physiology

## Course Code: CHMZOOV13

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course provides an integrative understanding of comparative animal physiology, emphasizing on diverse systems and functions across invertebrates and vertebrates. The course illustrates comparative account of digestive, respiratory, and sensory systems strategies in animals. The course highlights mechanisms of control and coordination, environmental physiology, and adaptations in varying habitats and stressors. Through comparative analysis, learners will gain insight into physiological specializations such as feeding strategies, gas exchange, osmoregulation, locomotion, behaviour, and temperature regulation to maintain homeostasis and interact with their environment.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Theory
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To understand the fundamental physiological principles governing animal life, including diffusion, respiration, digestion, homeostasis, and cell signaling.</p> <p><b>CO(A)2.</b> To examine the mechanisms by which animals maintain internal balance through osmoregulation, thermoregulation, and feedback control systems.</p> <p><b>CO(A)3.</b> To analyze physiological adaptations of animals to diverse environmental conditions and stressors.</p> <p><b>CO(A)4.</b> To develop an integrated understanding of the relationship between cellular processes, organ-system functions, and overall animal survival and performance.</p>
8	<b>Course Outcomes:</b>	<p>Upon completion of this course student will</p> <p><b>CO1.</b> Explain the principles of diffusion, respiratory strategies, chemotaxis, digestion, and ligand–receptor interactions in animals.</p> <p><b>CO2.</b> Describe and interpret the mechanisms of homeostasis, feedback regulation, osmoregulation, and thermoregulation in different animal groups.</p> <p><b>CO3.</b> Compare physiological adaptations exhibited by animals in response to varying environmental conditions, habitats, and ecological challenges.</p> <p><b>CO4.</b> Analyze the physiological responses to stress and evaluate the role of regulatory mechanisms in maintaining survival, health, and functional efficiency in animals.</p>
9	<b>Syllabus</b>	<p style="text-align: center;"><b>Unit I: Animal Physiology I</b></p> <p><b>Diffusion in Living Organisms:</b> Definition and significance of diffusion, Concentration gradient and passive transport, Osmosis. Factors affecting diffusion (Temperature, Surface area, Membrane thickness, Size of molecules, Permeability of membrane, implication of- Fick's</p>

equation of diffusion, Ideal gas law, Dalton's law of partial pressure, Henry's Law, Graham's Law.)

**Respiratory strategies in Animal-** Diffusion and Bulk flow,

**Introduction to Chemotaxis-** Definition Biological Significance and Historical Perspectives, Pfeffer's experiments on fern spermatozoids, Adler's work on bacterial chemotaxis, Chemotaxis as directed cell movement along a chemical gradient-Positive vs. negative chemotaxis, Role in feeding, immunity, development, and reproduction

**Digestion Physiology in Animals**

Comparative feeding mechanisms in invertebrates & vertebrates, Digestive enzymes in herbivores and carnivores, Gut microbiome – concept and significance

**Unit II: Anima Physiology II**

**Homeostasis:** Concept of internal balance, Homeostatic regulation in animals, Feedback mechanisms (Positive feedback, Negative feedback), Physiological examples of feedback regulation

**Ligand–Receptor Binding and Cell Signaling:** Definition of ligands and receptors, Characteristics of ligand–receptor interactions, Receptors, ligands, and signal transduction; Cell surface receptors and intracellular receptors, Hormonal signaling, Neural signaling, Secondary messengers (cAMP, Calcium ions), Physiological significance of receptor-mediated signaling

**Osmoregulation:** Definition and significance of osmoregulation, Water and salt balance in animals, Osmoregulation in aquatic animals (Freshwater animals, Marine animals), Osmoregulation in terrestrial animals, Role of kidneys, gills, nephridia, and salt glands; Hormonal control of osmoregulation

**Thermoregulation:** Heat gain and heat loss mechanisms, Thermoregulation in animals, Ectothermy and endothermy, behavioral and physiological adaptations to heat and cold, Adaptation to temperature extremes in desert, polar, aquatic, and terrestrial animals

**Stress Physiology:** Definition and importance of stress physiology, Physiological response to stress, Acute and chronic stress, Role of cortisol and adrenaline, Stress responses in different animals, Adaptation to environmental stressors (Heat, Cold, Hypoxia, Dehydration)

**10 Scheme of Examination and Assessment Pattern (Paper – 50 Marks)**

**A. External Examination: Semester End External - 30 marks** **Time: 1:00 hour**

Format of Question Paper

**Attempt all questions.**

Question	Nature of Questions	Marks
Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15
Q. 2	Attempt any three questions out of six (5 marks each) based on Unit-2	15
<b>Total</b>		<b>30</b>

**Note:** Equal Weightage is to be given to all the Units.

**B. Internal Examination: Continuous Evaluation - 20 marks**

No.	Assessment / Evaluation	Marks
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.	15
2.	Continuous Internal evaluation	05
<b>Total</b>		<b>30</b>

**11 References:**

1. Alberts, B., Heald, R., Johnson, A., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). *Molecular Biology of the Cell* (7<sup>th</sup> Edition). W. W. Norton & Company.
2. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Martin, K. C., Yaffe, M., & Amon, A. (2021). *Molecular Cell Biology* Textbook of Medical Physiology
3. Hall, J. E., & Hall, M. E. (2020). *Guyton and Hall Textbook of Medical Physiology* (14th ed.). Elsevier.
4. Hill, R. W., Wyse, G. A., & Anderson, M. (2022). *Animal Physiology* (5th ed.). Sinauer Associates is an imprint of Oxford University Press
5. Nelson, D. L., & Cox, M. M. (2021). *Lehninger Principles of Biochemistry* (8th ed.). W. H. Freeman.

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

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

**Semester- VI**

**Title: Laboratory exercises based on  
Animal Physiology**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Laboratory exercises based on Animal Physiology

Course Code: CHMZOOVI4

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This practical course provides training in experimental and observational techniques in animal physiology. Learners will perform qualitative biochemical tests, physiological experiments, and comparative anatomical studies to understand organ system functions across invertebrates and vertebrates. The course includes analysis of excretory products, respiratory and locomotory structures, heart and muscle physiology, behavioural responses, and effects of environmental factors.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Practicum
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To develop fundamental laboratory skills for investigating physiological processes such as diffusion, osmosis, thermoregulation, muscle activity, and reflex actions through practical experiments and demonstrations.</p> <p><b>CO(A)2.</b> To provide hands-on understanding of the structure and function of physiological systems, including sensory, respiratory, excretory, osmoregulatory, and nervous systems using specimens, charts, and models.</p> <p><b>CO(A)3.</b> To promote scientific inquiry, critical thinking, and analytical skills through case studies, experimental observations, and interpretation of physiological data.</p>
8	<b>Course Outcomes:</b>	<p>Upon completion of this course student will</p> <p><b>CO1.</b> Perform basic physiological experiments safely, record observations accurately, and interpret the results of laboratory investigations.</p> <p><b>CO2.</b> Identify and compare the physiological adaptations and functional organization of major organ systems in different animal groups.</p> <p><b>CO3.</b> Analyze experimental findings, relate physiological principles to real-life biological situations, and communicate scientific observations effectively using appropriate laboratory practices.</p>
9	<b>Syllabus</b>	<ol style="list-style-type: none"> <li>1. Study of diffusion and osmosis using simple demonstrations</li> <li>2. Observation of plasmolysis and deplasmolysis</li> <li>3. Study of thermoregulatory responses in animals</li> <li>4. Measurement of pulse rate before and after exercise</li> </ol>

	<ol style="list-style-type: none"> <li>5. Observation of reflex action</li> <li>6. Study of pupillary light reflex</li> <li>7. Weber's test for hearing lateralization</li> <li>8. Demonstration of ligand–receptor signaling using charts/models</li> <li>9. Study of osmoregulatory organs in different animals</li> <li>10. Comparative study of respiratory and excretory organs in animals</li> <li>11. Case study on stress response in humans and animals</li> <li>12. Observation of sensory receptors through charts/models.</li> <li>13. Assessment of Muscle Fatigue using Finger-Tapping Test.</li> </ol>																					
<b>10</b>	<b>A. External Practical examination skeleton Paper pattern</b> <b>Marks: 30</b> <span style="float: right;"><b>Time: 3 hrs</b></span>																					
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">No</th> <th style="width: 80%;">Practical</th> <th style="width: 10%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q1</td> <td>Major question</td> <td style="text-align: center;">07</td> </tr> <tr> <td>Q2</td> <td>Minor Question</td> <td style="text-align: center;">05</td> </tr> <tr> <td>Q3</td> <td>Solve the given problem/interpret the pathological report.</td> <td style="text-align: center;">04</td> </tr> <tr> <td>Q4</td> <td>Identify &amp; describe (3×3)</td> <td style="text-align: center;">09</td> </tr> <tr> <td>Q5</td> <td>Journal (03) &amp; viva (02)</td> <td style="text-align: center;">05</td> </tr> <tr> <td colspan="2" style="text-align: center;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table>	No	Practical	Marks	Q1	Major question	07	Q2	Minor Question	05	Q3	Solve the given problem/interpret the pathological report.	04	Q4	Identify & describe (3×3)	09	Q5	Journal (03) & viva (02)	05	<b>Total</b>		<b>30</b>
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	<b>Total</b>		<b>30</b>																			
	<b>B. Internal Practical Examination Paper pattern: Marks 20</b>																					
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**11** **References:**

- c. Choudhary, K. (2025). *Animal physiology*. IFAS Publications.
- d. Arora, M. P. (2017). *Animal physiology* (7th ed.). Himalaya Publishing House.
- e. Singh, H. R., & Kumar, N. (2021). *Animal physiology and biochemistry*. Vishal Publishing.
- f. Hill, R. W., Wyse, G. A., & Anderson, M. (2016). *Animal physiology* (4th ed.). Oxford University Press.
- g. Moyes, C. D., & Schulte, P. M. (2016). *Principles of animal physiology* (3rd ed.). Pearson Education.
- h. Irwin, W. S., & Eddy, F. B. (2012). *Environmental physiology of animals* (2nd ed.). Wiley-Blackwell.
- i. Randall, D., Burggren, W., & French, K. (2002). *Eckert animal physiology: Mechanisms and adaptations* (5th ed.). W. H. Freeman
- j. R. Eckert & D. Randall (1982): "Animal Physiology: 2nd Ed." W. H. Freeman & Co.
- k. C. Ladd Prosser Ed. (1991): "Environmental & Metabolic Animal Physiology" "Comparative Animal Physiology" 4th Ed. Wiley — Liss Publ.
- l. Withers, P.C. (1983): "Comparative Animal Physiology" International Ed. Saunders College Publishing.
- m. K. Schmidt – Niel (1983): "Animal Physiology: Adaptation & Environmental" 3rd Ed. Cambridge Univ. Press.

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

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

**Title: Type Study – Cuttlefish (Sepia) and Shark  
(Scoliodon)**

**Vertical - 1  
Major Subject – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Type Study – Cuttlefish (*Sepia*) and Shark (*Scoliodon*)

Course Code: CHMZOOV15

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course provides a comparative study of <i>Sepia</i> (cuttlefish) and Shark ( <i>Scoliodon</i> ), focusing on their classification, habit and habitat, distribution, and ecological roles. The course provides description of external morphology, locomotion, and economic importance, along with detailed study of major systems, digestive, respiratory, circulatory, excretory, nervous, sensory, and reproductive structures of cuttlefish and shark.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Theory
	<b>Teaching methods</b>	Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies and Phylogenetic Mapping, Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	The course is designed to acquaint learners to, <b>CO(A)1.</b> To acquaint learners to habit, habitat, distribution, general characters, and classification of <i>Sepia</i> and <i>Scoliodon</i> . <b>CO(A)2.</b> To acquaint learners with structural and functional organization of major systems. <b>CO(A)3.</b> To enable the learner to evaluate ecological and economic importance of <i>Sepia</i> and <i>Scoliodon</i> , emphasizing their role in marine ecosystems, fisheries, and conservation.
8	<b>Course Outcomes:</b>	Upon completion of the course, learners will: <b>CO 1</b> Classify <i>Sepia</i> and Shark within their respective phyla and explain their adaptations to aquatic environments. <b>CO 2</b> Analyze the anatomy and physiology of organ systems in <i>Sepia</i> and <i>Scoliodon</i> . <b>CO 3</b> Evaluate the ecological significance and economic uses of <i>Sepia</i> and <i>Scoliodon</i> .
9	<b>Syllabus</b>	
	<b>Unit I: Type study: Cuttlefish (<i>Sepia</i>)</b>	
	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	
	<b>Unit II: Type study: Shark (<i>Scoliodon</i>)</b>	
	General characters and classification, Habit and habitat, External characters and economic importance Digestive system, Respiratory system, Circulatory system, Excretory system, Nervous system and Sense organs, Reproductive system, copulation, fertilization and	

	development and Endoskeleton of shark: Axial - Skull and vertebral column and Appendicular - Pelvic and pectoral fins, pelvic and pectoral girdle.	
<b>10</b>	<b>Scheme of Examination and Assessment Pattern (Paper – 50 Marks)</b>	
	<b>G. External Examination: Semester End External - 30 marks</b>	<b>Time: 1:00 hour</b>
	Format of Question Paper	
	<b>Attempt all questions.</b>	
	<b>Question</b>	<b>Nature of Questions</b>
	Q1	Attempt any three questions out of six (5 marks each) based on Unit-1
	Q. 2	Attempt any three questions out of six (5 marks each) based on Unit-2
		<b>Total</b>
	<b>30</b>	
	<b>Note:</b> Equal Weightage is to be given to all the Units.	
	<b>H. Internal Examination: Continuous Evaluation - 20 marks</b>	
		<b>Assessment / Evaluation</b>
	<b>Marks</b>	
	1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes. Continuous Internal evaluation
		15
	2.	Overall conduct as a responsible student and attentiveness
		05
	<b>Total</b>	<b>20</b>
<b>11</b>	<b>References:</b>	
	1. Modern text book of Zoology - Vertebrates; Professor R.L. Kotpal; Rastogipublication; Third Edition 2012.	
	2. Vertebrate Zoology for Degree students; V. K. Agarwal; S. Chand Publication; 2012.	
	3. Chordate Zoology Volume II, Prof. N. Arumogam. Saras Publication.	
	4. Chordate Anatomy Mohan P. Arora, Himalaya Publishing House, First edition.	
	5. The life of Vertebrates; J.Z. Young; ELBS - Oxford University Press; Third edition, 2006 Textbook of chordate Zoology, Vol. II, G.S. Sandhu, H. Bhaskar; Campus Book	
	6. International, First edition, 2005.	
	7. Introduction to Zoology - Vol II: K. K. Chaki, G. Kundu and S. Sarkar, New Crystal Book Agency.	
	8. Chordate Zoology by E. L. Jordan and P. S. Verma, edition,2009, Chand publications. Chordate Zoology by P. S. Verma, edition,2009, Chand publications.	
	9. Modern Textbook of Zoology Vertebrates by R.L. Kotpal, edition Jan 2015, Rastogi publications.	
	10. Practical Zoology: Vertebrate, by S. S. Lal, 2015.	

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

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

**Semester- VI**

**Title: Laboratory exercises based on Type Study  
– Cuttlefish (Sepia) and Shark (Scoliodon)**

**Vertical - 1  
Major - 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Laboratory exercises based on Type Study – Cuttlefish (*Sepia*) and Shark (*Scoliodon*)

**Course Code: CHMZOOVI6**

S. No.	Heading	Particulars
1	<b>Description the Course</b>	This course provides hands-on study of vertebrate structure, function, and adaptations through dissections, comparative anatomy, and field observations. The practical component reinforces theoretical knowledge through hands-on study and dissection in both <i>Sepia</i> and Shark. Field visits supplement laboratory learning, encouraging observation, analysis, and ethical understanding of animal life.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1</b> To understand the anatomical organization, physiological functions, and evolutionary relationships among representative chordates.</p> <p><b>CO(A)2</b> To develop practical skills in dissection, mounting, observation, and comparative analysis of vertebrate structures.</p> <p><b>CO(A)3</b> To foster scientific attitude, ethical awareness, and appreciation of biodiversity and conservation through laboratory and field-based learning.</p>
8	<b>Course Outcomes:</b>	<p>By the end of the course, students will</p> <p><b>CO1.</b> Identify and describe major organ systems and adaptive features of representative vertebrates.</p> <p><b>CO2.</b> Perform and analyze dissections, mountings, and comparative studies with scientific accuracy and reasoning.</p> <p><b>CO3.</b> Interpret and evaluate structural, functional, and evolutionary relationships to explain vertebrate diversity and ecological adaptations.</p>
9	<b>List of Practical</b>	<ol style="list-style-type: none"> <li>1. Dissection of <i>Sepia</i> to study its Digestive System, Reproductive System and Nervous System</li> <li>2. Temporary mounting of Jaws, Radula, Statocyst, and Spermatophore in <i>Sepia</i></li> <li>3. Dissection of <i>Scoliodon</i> to study its Digestive System, Reproductive System, Brain, Cranial Nerves [V, VII, IX &amp; X] and Heart and Aortic Arches. Mounting of Placoid scales.</li> <li>4. Study tour - Local fish market. 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</li> </ol>

<b>10</b>	<b>Scheme of Practical Examination and Assessment Pattern (50 Marks)</b>		
	<b>External Practical Examination: Semester End External-</b>		
	<b>30 marks</b>		<b>Time: 3 hrs</b>
	<b>Skelton Paper for Practical</b>		
	<b>No</b>	<b>Practical</b>	<b>Marks</b>
	Q.1	<b>Major experiment</b> Dissection of <i>Sepia</i> _____ system. (Reproductive system / Nervous system) <p style="text-align: center;"><b>Or</b></p> Dissection of <i>Scoliodon</i> _____ system. (Heart and Aortic Arches / Reproductive system / Cranial Nerves [V, VII, IX & X])	<b>12</b>
	Q.2	<b>Minor experiment</b> Dissection of <i>Sepia</i> Digestive system. <p style="text-align: center;"><b>Or</b></p> Dissection of <i>Scoliodon</i> _____ system. (Digestive / Cranial Nerves [V& X or VII & IX] or Brain)	<b>07</b>
	Q.3	<b>Minor experiment</b> Mounting or Temporary slide preparation of: Jaws & Radula / Statocyst / Spermatophores <p style="text-align: center;"><b>Or</b></p> Mounting or Temporary slide preparation of: Placoid scales	<b>07</b>
	Q.4	Journal	<b>04</b>
	<b>Total</b>		<b>30</b>
<b>Internal Examination (20 marks)</b>			
<b>S. No</b>	<b>Assessment / Evaluation</b>	<b>Marks</b>	
1.	Class Participation or evaluation through assignments, projects, creative writing, role play, presentations or quizzes. Continuous Internal evaluation	<b>15</b>	
2.	Overall conduct as a responsible student and attentiveness	<b>05</b>	
<b>Total</b>		<b>20</b>	
<b>11</b>	<b>References:</b> 11. Ekambaranatha Ayyar, K. N., & Ananthkrishnan, T. N. (1992). Manual of Zoology: Invertebrates (Practical). Madras: S. Viswanathan (Printers & Publishers). 12. Ekambaranatha Ayyar, K. N., & Ananthkrishnan, T. N. (1992). Manual of Zoology: Vertebrates (Practical). Madras: S. Viswanathan (Printers & Publishers). 13. Kotpal, R. L. (2012). Practical Zoology: Invertebrates. New Delhi: Rastogi Publications. 14. Kotpal, R. L. (2012). Practical Zoology: Vertebrates. New Delhi: Rastogi Publications. 15. Agarwal, V. K. (2016). Practical Zoology for Degree Learners. New Delhi: S. Chand & Company Ltd.		

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

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

**Title: Histology and Endocrinology**

**Vertical - 1  
Major- 2 Credits**

**With effect from the  
Academic Year 2026-27**

# Title: Histology and Endocrinology

Course Code: CHMZOOVI7

Sr. No.	Heading	Particulars
1	<b>Description</b> <b>Course:</b>	This course introduces the fundamental principles of histology and endocrinology. The course covers histology of major organ systems, and staining techniques used in research and diagnostics. The endocrinology component covers hormone types, mechanisms of action, feedback regulation, and disorders of major endocrine glands. Emphasis is placed on integrating structural knowledge with physiological functions and clinical relevance, providing a strong foundation for studies in zoology, biomedical sciences, and health-related fields.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>  <b>Teaching methods</b>	Theory  Interactive Lectures, ICT-enabled Teaching, Specimen- and Model-Based Learning, Group Discussions, Field Exposure and Observation, Case Studies. Use of Learning Management System (LMS)
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	The course is designed to acquaint learners to the <b>CO(A)1.</b> Microscopic structure, organization, and functions of animal tissues and organ systems. <b>CO(A)2.</b> Principles of endocrine regulation, hormone action, and feedback mechanisms. <b>CO(A)3.</b> Histological techniques and their applications in biomedical research and diagnostics.
8	<b>Course Outcomes:</b>	On completion of the course the learner will <b>CO1</b> Identify and describe the histology of tissues and major organ systems. <b>CO2</b> Understand endocrine gland functions, hormonal regulation, and associated disorders. <b>CO3</b> Apply basic histological and endocrinological knowledge to interpret normal and pathological conditions.
9.	<b>Syllabus</b>	<p><b>Unit I Histology</b></p> <p><b>Introduction to Histology</b></p> <ul style="list-style-type: none"> <li>• Definition, scope and importance</li> <li>• Animal tissue – Types, structure and their function – epithelial, muscular, connective and nervous.</li> <li>• Relevance in Zoology and diagnostics.</li> </ul> <p><b>Histology of Organ Systems</b></p> <ul style="list-style-type: none"> <li>• Integumentary System — V.S. of skin (Epidermis, Dermis, Hypodermis) and Associated structures (Hair, Sebaceous and Sweat glands, Skin receptors)</li> <li>• Digestive System — V.S. of Tooth and T.S. of Tongue. General histological organization of the digestive tract: mucosa, submucosa, muscularis externa, and serosa.</li> <li>• Histology of oesophagus, stomach, duodenum, ileum, rectum, and accessory glands —</li> </ul>

liver, pancreas, and salivary glands

## Unit II Endocrinology

### Introduction to Endocrinology

- Definition, scope, and importance
- Overview, characteristics of endocrine glands
- Hormones: types, mechanisms (peptide vs steroid)
- Feedback regulation (positive and negative)

### Hypothalamus, Pituitary Gland and Pineal body

- Hypothalamic releasing and inhibiting hormones
- Anterior and posterior pituitary – structure and hormones
- Hormones of pineal body
- Disorders: dwarfism, gigantism, acromegaly, diabetes insipidus

### Thyroid and Parathyroid Glands

- Structure and hormones (T3, T4, calcitonin, PTH)
- Regulation of calcium metabolism
- Disorders: hyper/hypothyroidism, goitre, tetany

### Adrenal Gland

- Adrenal cortex: mineralocorticoids, glucocorticoids, adrenal androgens – DHEA
- Adrenal medulla: adrenaline (epinephrine), nor-adrenaline (nor-epinephrine) and dopamine
- Stress response
- Disorders: Addison's disease, Cushing's syndrome

### Pancreas and Glucose Homeostasis

- Islets of Langerhans: cell types – alpha, beta, delta and pp
- Hormones of pancreas – insulin, glucagon, somatostatin, pancreatic polypeptide, amylin.
- Diabetes mellitus

**Other endocrine organs** – Thymus, gastrointestinal tract, heart, placenta, kidneys, adipose tissue.

## 10 Scheme of Examination and Assessment Pattern (Paper – 50 Marks)

**A. External Examination: Semester End External - 30 marks**

**Time: 1:00 hour**

Format of Question Paper

**Attempt all questions.**

Question	Nature of Questions	Marks
Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15
Q. 2	Attempt any three questions out of six (5 marks each) based on Unit-2	15
<b>Total</b>		<b>30</b>

**Note:** Equal Weightage is to be given to all the Units.

<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>		
	<b>Assessment / Evaluation</b>	<b>Marks</b>
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.	10
2.	Overall conduct as a responsible student and attentiveness	05
<b>Total</b>		<b>20</b>
<b>11</b>	<b>References:</b>	
	<p>10. Suvarna, S. K., Layton, C., and Bancroft, J. D. (2018). Bancroft's Theory and Practice of Histological Techniques (8th ed.). Elsevier.</p> <p>11. Junqueira, L. C., and Carneiro, J. (2017). Junqueira's Basic Histology: Text and Atlas (15th ed.). McGraw-Hill.</p> <p>12. Ross, M. H., and Pawlina, W. (2020). Histology: A Text and Atlas with Correlated Cell and Molecular Biology (8th ed.). Wolters Kluwer.</p> <p>13. Gartner, L. P., and Hiatt, J. L. (2014). Color Textbook of Histology (4th ed.). Elsevier.</p> <p>14. Young, B., O'Dowd, G., and Woodford, P. (2014). Wheater's Functional Histology: A Text and Colour Atlas (6th ed.). Elsevier.</p> <p>15. Nussey, S., and Whitehead, S. (2001). Endocrinology: An integrated approach. BIOS Scientific Publishers.</p> <p>16. Melmed, S., Polonsky, K. S., Larsen, P. R., Kronenberg, H. M., and Auchus, P. W. (2029). Williams textbook of endocrinology (15th ed.). Elsevier.</p> <p>17. Wass, J. A. H., Stewart, P. M., Shalet, S. M., and Grossman, A. B. (Eds.). (2022). Oxford textbook of endocrinology and diabetes (3rd ed.). Oxford University Press.</p> <p>18. Holt, R. I. G., Hanley, N. A., Choudhury, S., and Sonksen, P. H. (2021). Essential endocrinology and diabetes (7th ed.). Wiley-Blackwell.</p> <p>19. Kleine, B., and Rossmanith, W. G. (2016). Hormones and the endocrine system: Textbook of endocrinology. Springer.</p> <p>20. Strauss, J. F., III, and Barbieri, R. L. (2019). Yen and Jaffe's reproductive endocrinology: Physiology, pathophysiology, and clinical management (8th ed.). Elsevier.</p> <p>21. Agarwal, V. K. (2020). Endocrinology. S. Chand Publishing.</p>	

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

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

**Semester- VI**

**Title: Clinical research**

**Vertical - 1  
Major Elective – 2 Credit**

**With effect from the  
Academic Year 2026-27**

# Title: Clinical research

Course Code: CHMZOOV18

1	<b>Description of the Course</b>	This course provides a comprehensive introduction to clinical research and clinical trials, covering the journey from discovery to market. Learners will be acquainted with the fundamentals of medical diagnostics, clinical trial design, phases, and operational workflows. Emphasis is placed on ethical principles, regulatory frameworks, and stakeholder roles in India and globally. The course introduces clinical data management, basic biostatistics, safety monitoring, and adverse event reporting. Learners also gain exposure to scientific writing, trial documentation, compliance requirements, and emerging models such as virtual and decentralized trials. The program prepares learners for entry-level roles and career pathways in clinical research, pharmaceuticals, and academia.
2	<b>Vertical</b>	Major- Mandatory elective
3	<b>Type</b>	Practicum
4	<b>Credit</b>	2
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To build foundational knowledge of clinical research principles, ethical frameworks, regulatory guidelines, and the role of stakeholders in clinical trial processes.</p> <p><b>CO(A)2.</b> To develop a practical understanding of clinical trial design, clinical operations, drug safety monitoring, clinical data management, and scientific communication.</p> <p><b>CO(A)3.</b> To prepare learners for professional roles in clinical research by imparting applied skills in documentation, compliance, and career development pathways.</p>
8	<b>Course Outcomes:</b>	<p>On completion of the course the learner will</p> <p><b>CO 1.</b> Explain the basic clinical research process, trial phases, ethical principles, and regulatory framework and requirements in the global and Indian context.</p> <p><b>CO 2.</b> Apply knowledge of clinical trial design, clinical data management, adverse event reporting/analysis, and scientific writing to simulated or real-world clinical research scenarios.</p> <p><b>CO 3.</b> Demonstrate professional competencies in documentation, compliance, communication, and career preparedness for roles in CROs, pharma/biotech/vaccine/MedTech, or academic research</p>
9	<b>Syllabus</b>	<p><b>Unit II Foundations of Clinical Research</b></p> <p><b>Basics of Clinical Research</b></p> <p>Definition and concepts, Evolution (Global and India), Importance in healthcare, drug, development and public health, Growth, challenges, initiatives</p> <p><b>Overview of Clinical Research Process and Stakeholders</b></p> <p>From discovery to market, Stakeholders: Sponsors (Innovators), CROs, ECs, Drug Safety,</p>

Regulators, Investigators

### **Clinical Trial Design and Phases**

Observational vs Interventional, Trial phases (Pre-clinical to Phase IV), Study design concepts (randomization, blinding, controls, crossover, parallel), Intro to virtual / decentralized clinical trials

### **Ethics and Regulatory Guidelines**

Core ethical principles, informed consent, Confidentiality and data privacy (GDPR, HIPAA) National and international guidelines (ICMR, GCP, Schedule Y, Helsinki) Regulatory frameworks (ICH-GCP, CDSCO, DCGI, USFDA, EMA)

### **Roles and Responsibilities in Clinical Research**

PI, CRC, CRA, Data, Analysis, Writer roles, Role of participants and team conduct Medical Terminology and Documentation, Trial docs, GDP, ALCOA+ basics

### **Unit II Clinical Data Management and Reporting**

#### **Clinical Data Management, Biostatistics and Statistical Programming**

Data sources, eDC basics, Introduction to statistics (central tendencies: mean, mode and median; t-test; Chi-square test; ANOVA) and visualization [R, Statistical Analysis System (SAS)]

#### **Safety Monitoring and Adverse Event Reporting**

AE / SAE concepts and classifications, Reporting timelines and Vigilance basics, (Pharmacovigilance, Cosmeto-vigilance, Meterio-vigilance and Neutra-vigilance)

#### **Communication and Scientific Writing**

Clinical Study Reports, abstracts, posters, Registries (CTRI, ClinicalTrials.gov), Communicating with regulators, patients, public

#### **Advanced Documentation and Compliance**

Source data verification, audit trails, 21 CFR Part 11, data integrity

#### **Professional Development and Careers**

Required certifications, conflict of interest, Career pathways in CR (CROs, Pharma, Academia) Knowledge Process Outsourcing (KPO) for clinical research

<b>10</b>	<b>Scheme of Examination and Assessment Pattern (Paper – 50 Marks)</b>		
<b>A. External Examination: Semester End External - 30 marks</b>		<b>Time: 1:00 hour</b>	
Format of Question Paper			
<b>Attempt all questions.</b>			
<b>Question</b>	<b>Nature of Questions</b>	<b>Marks</b>	
Q1	Attempt any three questions out of six (5 marks each) based on Unit-1	15	
Q. 2	Attempt any three questions out of six (5 marks each) based on Unit-2	15	
Q3	Attempt any two questions out of four (5 marks each) based on Unit-2	10	
<b>Total</b>			<b>30</b>
<b>Note:</b> Equal Weightage is to be given to all the Units.			
<b>B. Internal Examination: Continuous Evaluation - 20 marks</b>			
	<b>Assessment / Evaluation</b>	<b>Marks</b>	
1.	Class Test (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Puzzles) or evaluation through assignments, projects, creative writing, role play, presentations or quizzes.	15	
2.	Continuous Internal evaluation	05	
<b>Total</b>			<b>20</b>
<b>11</b>	<b>References:</b> <ol style="list-style-type: none"> <li>1. Principles and Practice of Clinical Research – John I. Gallin, Frederick P. Ognibene, Laura Lee Johnson.</li> <li>2. Fundamentals of Clinical Trials – Lawrence M. Friedman, Curt D. Furberg, David L. DeMets.</li> <li>3. Design and Analysis of Clinical Trials: Concepts and Methodologies – Shein-Chung Chow, Jen-Pei Liu.</li> <li>4. Practical Guide to Clinical Data Management – Susanne Prokscha.</li> <li>5. Fundamentals of Biostatistics – Bernard Rosner.</li> <li>6. Pharmacovigilance: Principles and Practice – Ronald D. Mann, Elizabeth B. Andrews.</li> <li>7. ClinicalTrials.gov – Database of global clinical trials.</li> <li>8. WHO International Clinical Trials Registry Platform (ICTRP).</li> <li>9. CTRI (Clinical Trials Registry of India).</li> <li>10. TransCelerate BioPharma – Resources on clinical trial efficiencies and innovation.</li> <li>11. Society for Clinical Data Management (SCDM) – Data management and digital transformation best practices.</li> <li>12. DIA (Drug Information Association) – Training modules and regulatory updates.</li> </ol>		

**Smt. Chandibai Himathmal Mansukhani College  
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**Third Year B. Sc.  
(Zoology)**

**Semester- VI**

**Title: Laboratory Exercise in Clinical Research**

**Vertical - 1  
Major Elective – 2 Credit**

**With effect from the  
Academic Year 2026-27**

## Title: Laboratory exercise in Clinical research

**Code: CHMZOOV19**

<b>1</b>	<b>Description of the Course</b>	This practical course provides hands-on training in clinical research operations and regulatory practices. Learners engage in protocol review, informed consent form drafting, and ethical dilemma discussions to understand trial conduct. Simulated trial management exercises cover feasibility assessment, delegation logs, documentation, and handling protocol deviations. Learners gain exposure to electronic data capture systems, data entry, cleaning, query resolution, and basic biostatistical analysis using mock datasets. Practical sessions include adverse event reporting with MedDRA coding, audit and inspection role-plays, and industry visits to CROs and clinical operations units, bridging theoretical knowledge with real-world clinical research practice.
<b>2</b>	<b>Vertical</b>	Major -Elective
<b>3</b>	<b>Type</b>	Practicum
<b>4</b>	<b>Credit</b>	2
<b>5</b>	<b>Hours allotted</b>	60 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks
<b>7</b>	<b>Course Objectives:</b>	<p><b>CO(A)1.</b> To provide practical exposure to clinical trial processes, including protocol interpretation, documentation, data management, and safety reporting.</p> <p><b>CO(A)2.</b> To develop applied skills in ethical compliance, trial monitoring, and interaction with clinical research stakeholders (CROs, pharma units, ethics committees).</p>
<b>8</b>	<b>Course Outcomes:</b>	<p>On completion of the course the learner will</p> <p><b>CO-1-</b> Demonstrate competence in drafting, managing, and interpreting essential clinical trial documents (protocols, ICFs, CRFs, TMFs) and using digital trial tools (EDC systems).</p> <p><b>CO-2-</b> Analyze trial-related scenarios (protocol deviations, AE/SAE cases, audits) and apply corrective actions in alignment with regulatory and ethical standards.</p> <p><b>CO3.</b> Prepare and interpret essential clinical research documents, communicate scientific findings effectively, and demonstrate professional awareness of compliance requirements, data integrity, and career opportunities in clinical research, pharmacovigilance, and related industries</p>
<b>9</b>	<b>Syllabus</b>	
	<ol style="list-style-type: none"> <li>2 Protocol review and interpretation.</li> <li>3 ICF drafting and ethical dilemma discussion.</li> <li>4 Trial management simulation (delegation logs, feasibility checklist).</li> <li>5 Document drafting (CRF, Source Doc, TMF checklist).</li> <li>6 Examples: protocol deviations and corrective actions.</li> <li>7 EDC system overview (REDCap/OpenClinica).</li> <li>8 Data management workshop: entry, cleaning, queries.</li> <li>9 Biostatistics workshop (mock dataset analysis)</li> </ol>	

	<p>10 Calculate the mean, mode, median, and standard deviation.</p> <p>11 AE/SAE reporting simulation (forms and MedDRA coding).</p> <p>12 Audit and inspection role-play.</p> <p>13. Industry Visit – CRO / Ethics Committee interaction (protocol and ICF process) / Industry Visit — Pharma / CRO Clinical Operations Unit (data, safety, reporting).</p> <ul style="list-style-type: none"> <li>• in CR (CROs, Pharma, Academia)</li> <li>• Knowledge Process Outsourcing (KPO) for clinical research</li> </ul>																																				
<b>10</b>	<p><b>External Practical Examination Skeleton Paper pattern</b></p> <p><b>Marks: 30</b> <span style="float: right;"><b>Time: 3 hrs</b></span></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S.No.</th> <th style="width: 70%;">Experiment</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q.1.</td> <td>Identify spots ‘a’ to ‘e’ as per instructions (5 identifications x 2)</td> <td style="text-align: center;">10</td> </tr> <tr> <td>Q.2.</td> <td>Major Experiment</td> <td style="text-align: center;">7</td> </tr> <tr> <td>Q.3.</td> <td>Minor Experiment</td> <td style="text-align: center;">5</td> </tr> <tr> <td>Q.4.</td> <td>Report</td> <td style="text-align: center;">4</td> </tr> <tr> <td>Q.5</td> <td>Certified Journal and Viva-voce</td> <td style="text-align: center;">4</td> </tr> <tr> <td colspan="2" style="text-align: center;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3" style="text-align: center;"><b>Internal Practical Examination Paper pattern: Marks 20</b></th> </tr> <tr> <th style="width: 10%;">S. No</th> <th style="width: 70%;">Nature of evaluation/ Assesment</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Q1</td> <td>Minor experiment / Industrial visit / Assignment / Project</td> <td style="text-align: center;">15</td> </tr> <tr> <td>Q2</td> <td>Social awareness activity using AI tools, Attendance</td> <td style="text-align: center;">05</td> </tr> <tr> <td colspan="2" style="text-align: center;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>	S.No.	Experiment	Marks	Q.1.	Identify spots ‘a’ to ‘e’ as per instructions (5 identifications x 2)	10	Q.2.	Major Experiment	7	Q.3.	Minor Experiment	5	Q.4.	Report	4	Q.5	Certified Journal and Viva-voce	4	<b>Total</b>		<b>30</b>	<b>Internal Practical Examination Paper pattern: Marks 20</b>			S. No	Nature of evaluation/ Assesment	Marks	Q1	Minor experiment / Industrial visit / Assignment / Project	15	Q2	Social awareness activity using AI tools, Attendance	05	<b>Total</b>		<b>20</b>
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**Third Year B. Sc.  
(Zoology)**




**Semester- VI**

**Title: On Job Training**

**Vertical - 6  
OJT – 4 Credit**

**With effect from the  
Academic Year 2026-27**

## Syllabus Committee:

S. No	Name of the Faculty	Designation and College	Signature
1.	Dr. Shashibhal Pandey	Professor & Head, Dept of Zoology 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 BoS Chairperson: Dr. Shashibhal Pandey**



**Name & Signature of the Dean: Dr. Neena Anand**



**Name & Signature of the Principal: Dr. Manju Lalwani Pathak**



**PRINCIPAL**  
Smt. CHANDIBAI HIMATHMAL  
MANSUKHANI COLLEGE  
ULHASNAGAR-421 003.

