



**SIR P. T. SARVAJANIK COLLEGE OF SCIENCE, (AUTONOMOUS)  
ATHWALINES, SURAT-395001**

**Sir P. T. Sarvajani College of Science**

**(Autonomous)**

**Affiliated to Veer Narmad South Gujarat  
University, Surat**

**Re-Accredited 'A<sup>+</sup>' with CGPA 3.35**

**SYLLABUS**

**FOR**

**SEM IV**

**Program: B.Sc.**

**Course: ZOOLOGY**

**For**

**Academic year**

**2025-26**

**(NEP-2020)**

**Effective from June 2025-26**



**SIR P. T. SARVAJANIK COLLEGE OF SCIENCE, (AUTONOMOUS)  
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**Board of Studies in Zoology  
Undergraduate and Post graduate**

	<b>Name</b>	<b>Designation</b>	<b>Institute/Industry</b>
<b>Head of the Department</b>			
1	Dr. Jaya Patel	Chairperson	Sir P. T. Sarvajanik College of Science
<b>Two experts from other than the parent University</b>			
1	Dr. Nikunj Bhatt	Associate Professor	Department of Zoology, V. P. & R. P. T. P. Science College, (Autonomous), Vallabh Vidyanagar, Anand
2	Dr. Amol Patwardhan	Assistant Professor	K. J. Somaiya College of Science and Commerce (Autonomous), Mumbai
<b>Subject Expert nominated by Vice-Chancellor</b>			
1	Dr. Krupal Patel	Assistant Professor	Department of Zoology, Govt. Arts, Commerce & Science College, Limbayat, Surat
<b>Meritorious Alumnus</b>			
1	Mr. Bhavesh Chevli	Chief of Manufacturing	Envision Scientific Pvt. Ltd Sachin-Hazira Road
<b>Experts from outside the Autonomous College, whenever special courses of studies are to be formulated, to be nominated by the Principal.</b>			
1	Dr. Arun Dholakia	Retd. Associate Professor	Department of Zoology, Sir P. T. Sarvajanik College of Science, Surat
<b>Representative from Industry/corporate sector/allied area</b>			
1	Ms. Pinal Patel	Board of Member	TINSA, Ecological Foundation Bhopal, Madhya Pradesh
<b>Faculty of the specialization</b>			
1	Dr. Jaya Patel	Associate Professor & Head	Sir P. T. Sarvajanik College of Science
2	Dr. Nitin Solanki	Assistant Professor	Sir P. T. Sarvajanik College of Science
3	Dr. Neelam Mishra	Adhyapak Sahayak	Sir P. T. Sarvajanik College of Science



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**Content**

<b>Sr. No</b>	<b>Semester</b>	<b>Course number</b>	<b>Course Code</b>	<b>Course Title</b>
<b>Core Course (CC)</b>				
1	IV	CC VIII	ZOOMJ-S4P8-2CR25	Non Chordates and Chordates III
2		CC VIII	ZOOMJ-S4PR8-2CR25	Non Chordates and Chordates III
3		CC IX	ZOOMJ-S4P9-2CR25	Biochemistry and Physiology
4		CC IX	ZOOMJ-S4PR9-2CR25	Biochemistry and Physiology
5		CC X	ZOOMJ-S4P10-4CR25	Cell Biology and Genetics-II
6		CC III	ZOOMN-S4P3-2CR25	Non Chordates, Chordates II and Tissue System
7		CC III	ZOOMN-S4PR3-2CR25	Non Chordates, Chordates II and Tissue System
8		SEC IV	ZOOSec-S4P4-2CR25	Apiculture
9		IKS II	ZOOIKS-S4P2-2CR25	Indian Knowledge System- Ancient Zoology



**Detailed B. Sc. Zoology Syllabus**

**S. Y. B. Sc. Syllabus with effect from the Academic year 2025-26**

Course No.	Course Title	Course Code	Credits	Hour	Module	Lectures per module (1 Hr)	Examination		
							Internal Marks	External Marks	Total Marks
<b>SEMESTER IV</b>									
<b>Major Courses Theory and Practical</b>									
CC VIII	Non Chordates and Chordates II	ZOOMJ-S4P8-2CR25	2	30	2	15	25	25	50
CC VIII	Non Chordates and Chordates II Practical Lab Course	ZOOMJ-S4PR8-2CR25	2	30	2	15	25	25	50
CC IX	Biochemistry and Physiology	ZOOMJ-S4P9-2CR25	2	30	2	15	25	25	50
CC IX Practical	Biochemistry and Physiology Lab Course	ZOOMJ-S4PR9-2CR25	2	30	2	15	25	25	50
CC X	Cell Biology and Genetics-II	ZOOMJ-S4P10-4CR25	4	60	4	15	50	50	100
ME CCIII	Non Chordates, Chordates II and Tissue System	ZOOMN-S4P3-2CR25	2	30	2	15	25	25	50
ME Practical	Non Chordates, Chordates II and Tissue System Practical Lab Course	ZOOMN-S4PR3-2CR25	2	30	2	15	25	25	50
SEC IV	Apiculture	ZOOSec-S4P4-2CR25	2	30	2	15	25	25	50
IKS II	Indian Knowledge System - Ancient Zoology	ZOOIKS-S4P2-2CR25	2	30	2	15	25	25	50



**S. Y. B. Sc. (Zoology) SEMESTER IV  
Course Name: Non Chordates and Chordates III [CC VIII]  
Course Code: ZOOMJ-S4P8-2CR25  
Theory [Credits - 02]**

<b>Course learning outcome</b>		
After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>Understand the general taxonomic rules on animal classification.</li> <li>The principles and methods of taxonomy and the general characters of phylum.</li> <li>Identify a range of invertebrate and vertebrate animals.</li> </ul>		
<b>Module 1</b>	<b>Classification up to subclass of Phyla</b>	<b>[15L]</b>
<b>Learning Objective</b>		
<ul style="list-style-type: none"> <li>To differentiate animals as per taxonomy.</li> </ul>		
<b>Learning Outcomes:</b>		
<ul style="list-style-type: none"> <li>Explain the general characteristics and classification of Mollusca, Arthropoda, Echinodermata, and Hemichordata</li> <li>Describe the external and internal morphology of representative organisms from each phylum.</li> </ul>		
1.1	Classification up to subclass of Phyla 1.1.1 Arthropoda 1.1.2 Mollusca 1.1.3 Echinodermata 1.1.4 Hemichordata	
<b>Module 2</b>	<b>Type Study: Calotes</b>	<b>15L</b>
<b>Learning Objective</b>		
Ensure acquiring the awareness on the basics of the zoology and to understand the different features and diversities of Chordates		
<b>Learning Outcomes:</b>		
<ul style="list-style-type: none"> <li>Understand the taxonomy, classification, and distinguishing characteristics of Calotes species.</li> <li>Describe the morphological and anatomical adaptations of Calotes related to its habitat and lifestyle.</li> <li>Explain the physiological processes, including digestion, respiration, and reproduction in Calotes.</li> </ul>		
2.1	External features and Digestive System with digestion process	
2.2	Respiratory system	



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2.3	Circulatory System
2.4	Urinogenital System
2.5	Brain
<b>References:</b>	
<ol style="list-style-type: none"><li>1. Living Invertebrates, 1987: Pearse, Buchsbaum, Blackwell Scientific Publication, California.</li><li>2. A Text book of Zoology Invertebrates, Vol. I 1992, 7th Edn. Parker and Haswell edited by Marshall William, C B S publishers and distributors, New Delhi.</li><li>3. Invertebrate Zoology, 1992; S. N. Prasad, Vikas Publishing House, New Delhi.</li><li>4. Life of Invertebrates, 1992; S.N. Prasad, Vikas Publishing House, New Delhi.</li><li>5. Invertebrate Zoology, 1992 4th Edn., reprint, P.S. Dhami and J. K. Dhami, R. Chand and Co., New Delhi.</li><li>6. Modern text book of Zoology, Invertebrates 10th Edn., 2009, R.L. Kotpal, Rastogi publ., Meerut.</li><li>7. Invertebrates Structure and Function, 2nd Edn. 1979, EJW Barrington, John Wiley and Sons Inc.</li><li>8. Invertebrates Zoology, 1994, 6th Edition, Ruppert, E. Edward, R. D. Barnes; Saunders college Publishing, USA.</li><li>9. Invertebrate Zoology, 1991, P.A. Meglitsch and F. R. Schram, Oxford University Press; New York.</li><li>10. Invertebrate: A New synthesis, 1988, R.S.K. Barnes, P. Calow and P.J.W., Olive Blackwell Scientific, U.K.</li><li>11. An Introduction to Protochordata, 1990, H. S. Bhamrah and Kavita Juneja, Anmol publication, New Delhi.</li><li>12. The invertebrates: Protozoa through Ctenophora Vol.I, 1959, Hyman, Libbie Henrietta, McGraw-Hill Book Co., Inc. New York.</li><li>13. A text book of Zoology, Vol.II, 1990, T. J. Parker and W. A. Haswell, Low price Publication, Delhi.</li><li>14. A text book of Zoology, Vol.II, 1990, T. J. Parker and W. A. Haswell, Low price Publication, Delhi.</li><li>15. Modern Text Book of Zoology, 1992, R. L. Kotpal, Rastogi Publication, Meerut.</li><li>16. Chordate Zoology, 1982, P. S. Dhami and J. K. Dhami, R. Chand and Co., New Delhi.</li><li>17. The life of Vertebrates, 3rd edn. 1993, J. Z. Young, Oxford University Press, USA.</li><li>18. The Phylum Chordata: Biology of Vertebrates and their Kin, 1987, H. H. Newman, Distributor Satish book enterprise, Agra.</li><li>19. A text book of Zoology, 1984, R. D. Vidyarthi, S. Chand and Co., New Delhi.</li><li>20. Comparative Anatomy of the Vertebrates, G. C. Kent, R. K Carr, 9th Edn., 2001, McGraw Hill, Boston, USA</li><li>21. Practical Zoology Invertebrates, 11th revised Edn., 2014, S. S. Lal, Rastogi publ., Meerut.</li></ol>	



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22. Vertebrate Practical Zoology, 11th revised Edition, 2014, S. S. Lal, Rastogi publ., Meerut.
23. Practical Zoology, 2004, Vijay Laxmi Sharma, Paragon International Publishers.
24. The anatomy of Garden Lizard, 1974, S.Y. Paranjape, Pune University Publication, Pune.
25. Chordate Zoology, 2009 reprint, E. L. Jordan, S. Chand and Co., New Delhi.
26. Text book of Zoology, Vertebrates, Vol. II, T.J. Parker and W.A. Haswell, edited by Marshall and Williams, CBS Publications, New Delhi.
27. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
28. Pough H. Vertebrate life, VIII Edition, Pearson International.
29. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
30. Outline of comparative anatomy of vertebrate Kingsley J.S. Central book depot. Allahabad
31. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
32. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
33. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
34. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
- 35 JUNQEIRA'S Basic Histology Text & Atlas by Anthony L. Mescher
36. Histology: Arthiur W. Ham, M. B.
37. Vertebrate Zoology: An Experimental Field Approach-Nelson G. Hairston. Cambridge University Press, 1994
38. Chordate Zoology E.L Jordan & P. S. Verma. S. Chand
- 39 Vertebrate Zoology: An Experimental Field Approach-Nelson G. Hairston. Cambridge University Press, 1994
- 40 Text Book of Zoology - Dalela and Verma. Jay Prash Nath & co. Meeru
41. Text Book of Zoology - S.N. Prasad. Vikas Publishing House pvt. ltd. Delhi
- 42 Chordate Zoology - Agrawal and Dalela. Jay Prash Nath & co. Meerut
- 43 Text book of Zoology - R. D. Vidyarthi. S. Chand
- 44 Jiv Vignan-2 (Gujarati) – Nirav Prakashan.
- 45A Text Book of General Biology – Tomer & Singh. Rastogi Publication, Meerut
- 46 Text Book of Chordates - A. Thangamani, S. Prasanna Kumar
- 47 Prushthvanshi Praniyoane Garbhvidya - A. B. Vyas. Guj. Granthnirman Board.
- 48 Utkrushtha Aprushthvanshi Praniyo - U. M. Rawal. Guj. Granthnirman Board.
- 49 Chordate Zoology - Majupuria.
- 50 A Manual of Zoology Vol. I & II – Ekambernath Ayar. S. Vishwanathan Chennai.



**Mapping of COs and POs**

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Explain the general characteristics and classification of Mollusca, Arthropoda, Echinodermata and Hemichordata.		X				
Describe the external and internal morphology of representative organisms from each phylum.		X				

Unit	Remembering (1)	Understanding (2)	Applying (3)	Analyzing (4)	Evaluating (5)	Creating (6)	Total
I	30%	70%	-	-	-	-	100%
II	30%	50%	20%	-	-	-	100%

**S. Y. B. Sc. (Zoology) SEMESTER IV**

**Course Name: Non Chordates and Chordates III [CC VIII]**

**Course Code: ZOOMJ-S4PR8-2CR25**

**Practical [Credits - 02]**

Course Learning Outcome	
After the successful completion of the Course, the learner will be able to:	
<ul style="list-style-type: none"> <li>• Identify various animals based on morphological features of non- chordate animals.</li> <li>• Apply taxonomic tools, identification keys, and modern classification methods.</li> <li>• Comment on the modifications of common animal forms of the groups studied.</li> <li>• Conduct practical observations (Virtual) to understand internal structures</li> <li>• Study of all systems of Calotes (Virtual).</li> </ul>	
Practical Module – I (ZOOMJ-S3PR5-2CR25) [10L]	
The following practicals are to be taught / studied only with the help of charts, models, videos, photographs, permanent slides, working models etc.	
1	<b>Classification of following animals up to sub class:</b> I. Arthropoda: Peripetus, Hermit crab, Julus, Palaemon, Termite II. Mollusca: Chaetoderma, Unio, Aplysia, Sepia III. Echinodermata: Anthena, Ophiocoma, Cucumaria, Feather star
2	<b>The following practical of Calotes to be taught/studied only with the help of Charts/models/videos/photographs/permanent slides, working models, simulators etc.</b>



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		I. External characters II. Digestive system III. Respiratory system IV. Circulatory system V. Urinogenital system VI. Brain	

**Mapping of CLOs and PSOs**

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Identify various animals based on morphological features of non-chordate animals.		X				
Apply taxonomic tools, identification keys, and modern classification methods.			X			
Comment on the modifications of common animal forms of the groups studied.		X				
Conduct practical observations (Virtual) to understand internal structures and Study of all systems of Calotes (Virtual).		X				

**S. Y. B. Sc. (Zoology) SEMESTER IV**

**Course Name: Biochemistry and Physiology [CC IX]**

**Course Code: ZOOMJ-S4P9-2CR25**

**Theory [Credits - 02]**

Course learning outcome		
After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>Understand the structure and function of carbohydrates and proteins.</li> <li>Identify properties and differences between biomolecules.</li> </ul>		
<b>Module 1</b>	<b>Biochemistry</b>	<b>[15L]</b>
<b>Learning Objective</b> <ul style="list-style-type: none"> <li>Understand the basic structure, classification, and biological significance of carbohydrates, proteins and lipid.</li> </ul>		
<b>Learning Outcomes:</b> <ul style="list-style-type: none"> <li>Understand the classification and structure of carbohydrates, proteins, and lipids.</li> <li>Explain the biological functions and significance of carbohydrates, proteins, and lipids in metabolism.</li> </ul>		



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<ul style="list-style-type: none"> <li>Differentiate between various types of carbohydrates, proteins, and lipids based on their chemical properties.</li> <li>Differentiate between various types of carbohydrates (monosaccharides, disaccharides, polysaccharides) and proteins (based on structure and function).</li> </ul>		
1.1	Carbohydrates, proteins and lipids – Structure and functions.	
1.2	Classification of carbohydrates, proteins and lipids	
<b>Module 2</b>	<b>Physiology of Digestion, absorption and assimilation in Human</b>	<b>15L</b>
<b>Learning Objective</b>		
To provide in-depth knowledge of the physiological processes involved in digestion, absorption, and assimilation.		
<b>Learning Outcomes:</b>		
<ul style="list-style-type: none"> <li>Understand the physiological processes involved in digestion, including the role of the digestive system and digestive enzymes</li> <li>Describe the mechanisms of absorption in the small intestine, including nutrient transport systems.</li> <li>Explain the process of assimilation and the role of the liver, pancreas, and other organs in metabolism.</li> </ul>		
2.1	Carbohydrates	
2.2	Proteins	
2.3	Lipid	
2.4	Nucleac acids	
2.5	Regulation of metabolism	
<b>References:</b>		
1. Guyton. A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd. /W.B. Saunders Company. 2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons. 3. Text Book of Medical Physiology – A. C. Guyton (Holt Saunders) 4. Ganong’s Review of Medical Physiology – (McGraw Hill) 5. Biochemistry – D. Das (Academic Publishers) 6. Lehninger Principle of Biochemistry – D. L. Nelson & M. M. Cox (Maxmillan)		

**Mapping of COs and POs**

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Understand the classification and structure of carbohydrates, proteins, and lipids.	X					



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Explain the biological functions and significance of carbohydrates, proteins, and lipids in metabolism.		X				
Differentiate between various types of carbohydrates, proteins, and lipids based on their chemical properties.	X		X			
Differentiate between various types of carbohydrates (monosaccharides, disaccharides, polysaccharides) and proteins (based on structure and function).			X			
Understand the physiological processes involved in digestion, including the role of the digestive system and digestive enzymes	X					
Describe the mechanisms of absorption in the small intestine, including nutrient transport systems.		X				
Explain the process of assimilation and the role of the liver, pancreas, and other organs in metabolism.		X				

Unit	Remembering (1)	Understanding (2)	Applying (3)	Analyzing (4)	Evaluating (5)	Creating (6)	Total
I	10%	50%	40%	-	-	-	100%
II	25%	75%	-	-	-	-	100%

**S. Y. B. Sc. (Zoology) SEMESTER IV  
Course Name: Biochemistry and Physiology [CC IX]  
Course Code: ZOOMJ-S4PR9-2CR25  
Practical [Credits - 02]**

<b>Course Learning Outcome</b>	
After the successful completion of the Course, the learner will be able to:	
<ul style="list-style-type: none"> <li>Identify and analyse the functional groups of biomolecules, qualitative tests will be conducted on various carbohydrate and protein solutions</li> <li>Understand digestion involves both mechanical and chemical processes that break down food into absorbable nutrients.</li> <li>Understand the atomic models of various monosaccharides, disaccharides and amino acids.</li> </ul>	
<b>Practical Module – I (ZOOMJ-S3PR5-2CR25) [10L]</b>	
The following practicals are to be taught / studied only with the help of charts, models, videos, photographs, permanent slides, working models etc.	
1	Preparation of atomic models: Monosaccharide:



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	<ul style="list-style-type: none"> <li>• Glucose</li> <li>• Galactose</li> <li>• Fructose</li> </ul> Disaccharides: <ul style="list-style-type: none"> <li>• Maltose</li> <li>• Lactose</li> <li>• Sucrose</li> </ul> Amino acid: <ul style="list-style-type: none"> <li>• Alanine</li> <li>• Aspartic acid</li> <li>• Glutamic</li> <li>• Tyrosine</li> </ul>	
2	Qualitative estimation of functional groups of carbohydrates from given solutions (Glucose, Fructose, Sucrose, Lactose).	
3	Qualitative estimation of functional groups of proteins from given solutions.	
4	To study the process of digestion (mechanical and chemical digestion).	
5	Qualitative estimation of amylase.	

**Mapping of CLOs and PSOs**

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
To identify and analyse the functional groups of carbohydrate and protein solutions		X				
To understand digestion of both mechanical and chemical processes that break down food into absorbable nutrients.	X					
To understand of biomolecules, atomic models of various monosaccharides, disaccharides, and amino acids will be constructed.	X					

**S. Y. B. Sc. (Zoology) SEMESTER IV**

**Course Name: Cell Biology and Genetics - II [CC X]**

**Course Code: ZOOMJ-S4P10-4CR25**

**Theory [Credits - 04]**

**Course learning outcome**

After successfully completing this course, students will be able to:

- Define and describe the endomembrane system.
- Sketch and explain mitochondria and elaborate its function.



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<ul style="list-style-type: none"> <li>• Describe the semiautonomous nature of mitochondria.</li> <li>• Explain the structure, origin, occurrence and function of eukaryotic ribosomes.</li> <li>• Describe structure, origin, occurrence and function of peroxisomes.</li> <li>• Understand and explain exceptions to Mendelian inheritance.</li> <li>• Explain Chromosome theory of inheritance.</li> <li>• Describe Pedigree analysis.</li> <li>• Illustrate autosomal dominant and autosomal recessive, X-linked dominant, and X-linked recessive.</li> <li>• Explain multiple alleles and polygenic inheritance</li> <li>• Understand the concept of pleiotropy.</li> </ul>		
<b>Module 1</b>	<b>Endomembrane system</b>	<b>[07L]</b>
<b>Learning Objective</b>		
<ul style="list-style-type: none"> <li>• Understand the cell organelles</li> </ul>		
<b>Learning Outcomes:</b>		
<ul style="list-style-type: none"> <li>• Define and describe the endomembrane system</li> </ul>		
1.1	Endoplasmic reticulum: Structure, types, occurrence and function.	
1.2	Golgi complex: Structure, Origin, Occurrence, Function	
1.3	Lysosome: Structure, Origin, Occurrence and Function.	
<b>Module 2</b>	<b>Mitochondria, Ribosomes and Peroxisomes</b>	<b>[15L]</b>
<b>Learning Objective</b>		
Cell organelle		
<b>Learning Outcomes:</b>		
<ul style="list-style-type: none"> <li>• Sketch and explain mitochondria and elaborate its function.</li> <li>• Describe the semiautonomous nature of mitochondria.</li> <li>• Explain the structure, origin, occurrence and function of eukaryotic ribosomes.</li> <li>• Describe structure, origin, occurrence and function of peroxisomes.</li> </ul>		
2.1	Mitochondria: Origin, occurrence, structure and functions, semi-autonomous nature of mitochondria	
2.2	Ribosomes: Structure, origin, occurrence and function of eukaryotic ribosomes	
2.3	Peroxisomes: Structure, origin, occurrence and function.	
<b>Module 3</b>	<b>Exceptions to Mendelian Inheritance</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Understand Mendelian inheritance</li> </ul>		
<b>Learning Outcome:</b>		



After the successful completion of the module, the learner will be able to		
<ul style="list-style-type: none"> <li>• Understand and explain exceptions to Mendelian inheritance.</li> <li>• Explain Chromosome theory of inheritance.</li> <li>• Describe Pedigree analysis.</li> <li>• Illustrate autosomal dominant and autosomal recessive, X-linked dominant and X-linked recessive.</li> </ul>		
3.1	Exceptions to Mendelian Inheritance: Incomplete dominance, Codominance, Lethal alleles, Epistasis - Recessive, Double recessive, dominant and double dominant.	
3.2	Chromosome theory of inheritance.	
3.3	Pedigree analysis - Autosomal dominant and autosomal recessive, X-linked dominant, and X-linked recessive	
<b>Module 4</b>	<b>Multiple alleles and Polygenic inheritance</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Define and explain alleles</li> </ul>		
<b>Learning Outcome:</b>		
After the successful completion of the module, the learner will be able to		
<ul style="list-style-type: none"> <li>• Explain multiple alleles and polygenic inheritance</li> <li>• Understand the concept of pleiotropy.</li> </ul>		
4.1	Concept of multiple alleles, Coat colour in rabbit, ABO and Rh blood group systems	
4.2	Polygenic inheritance with reference to skin colour and eye colour in man.	
4.3	Concept of pleiotropy	
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. Cell and Molecular Biology. Concepts and Experiments, Gerald Karp. John Wiley and Sons, Inc. New York.</li> <li>2. Essentials of Cell and Molecular Biology. De Robertis E. D. P. and De Robertis E.M. F.</li> <li>3. Inside the Living Cell, J. A. V. Buttler</li> <li>4. Cell Function, L. L. Langley</li> <li>5. Cytology, P. S. Verma and V. K. Agarwal</li> <li>6. Introductory Cytology, Veer Bala Rastogi</li> <li>7. General Genetics, Adrian M. SRB Ray, D. Owen</li> <li>8. Genetics, P. K. Gupta</li> <li>9. Genetics, P. S. Verma and V. K. Agarwal</li> <li>10. Human Heredity, C. O. Carter</li> <li>11. Genetics, Edgar Altenburg</li> <li>12. Heredity, David M. Bonner</li> </ol>		



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13. Janin vidya (Gujarati), Dr. B. S. Vaidya

**Mapping of COs and POs**

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Define and describe the endomembrane system.	X					
Sketch and explain mitochondria and elaborate its function.			X			
Describe the semiautonomous nature of mitochondria.		X				
Differentiate between various types of carbohydrates (monosaccharides, disaccharides, polysacchar) Explain the structure, origin, occurrence and function of eukaryotic ribosomes.			X			
Describe structure, origin, occurrence and function of peroxisomes.		X				
Understand and explain exceptions to Mendelian inheritance.	X					
Explain Chromosome theory of inheritance.		X				
Describe Pedigree analysis.		X				
Illustrate autosomal dominant and autosomal recessive, X-linked dominant, and X-linked recessive.		X				
Explain multiple alleles and polygenic inheritance		X				
Understand the concept of pleiotropy (ides) and proteins (based on structure and function).	X					

Unit	Remembering (1)	Understanding (2)	Applying (3)	Analyzing (4)	Evaluating (5)	Creating (6)	Total
I	30%	70%	-	-	-	-	100%
II	50%	50%	-	-	-	-	100%
III	35%	65%	-	-	-	-	100%
IV	30%	70%	-	-	-	-	100%

**S. Y. B. Sc. (Zoology) SEMESTER IV**

**Course Name: Non Chordates, Chordates II, Microscopy and Tissue System [CC III]**

**Course Code: ZOOMN-S4P3-2CR25**

**Theory [Credits - 02]**

**Course learning outcome**



After successfully completing this course, students will be able to:

- Understand the general taxonomic rules on animal classification,
- Understand the principles and methods of taxonomy and the general characters of phylum Protozoa
- Understand the Protozoan parasites of human.
- Classify the phylum Porifera & Coelenterata using examples
- Understand the canal system of Porifera and polymorphism in Coelenterates.
- Classify phylum Helminthes & Annelida and metamerism in Annelids and parasitic adaptations of Helminthes
- Understand the taxonomy, classification, and distinguishing characteristics of Calotes species.
- Describe the morphological and anatomical adaptations of Calotes related to its habitat and lifestyle.
- Explain the physiological processes including digestion, respiration and reproduction in Calotes.
- Differentiate simple and compound microscope
- Different parts of microscope and their function.
- Describe location & function of tissues.
- Draw the structures of various tissues and label them.
- Sketch and label the microscopic details of tissues
- Differentiate between different types of microscopes.

<b>Module 1</b>	<b>Classification up to subclass of Phyla</b>	<b>[07L]</b>
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**Learning Objective**

- Understand the taxonomy, classification, and distinguishing characteristics of Calotes species.
- Understand the general taxonomic rules on animal classification,

**Learning Outcomes:**

- Understand the general taxonomic rules on animal classification,
- The principles and methods of taxonomy and the general characters of phylum
- Explain the physiological processes, including digestion, respiration, and reproduction in Calotes.

1.1	1.1.1 Protozoa 1.1.2 Porifera 1.1.3 Coelenterata 1.1.4 Platyhelminthes 1.1.5 Aschelminthes 1.1.6 Annelida
1.2	<b>Type Study: Calotes</b> 1.2.1 External features and Digestive System with digestion process 1.2.2 Respiratory system



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	1.2.3 Circulatory System 1.2.4 Urinogenital System 1.2.5 Brain	
<b>Module 2</b>	<b>Microscopy and Tissue system</b>	<b>[15L]</b>
<b>Learning Objective</b>		
<ul style="list-style-type: none"> <li>• Explain the fundamental tissues in details</li> <li>• Illustrate the working of microscopes</li> </ul>		
<b>Learning Outcomes:</b>		
<ul style="list-style-type: none"> <li>• Differentiate Simple and Compound microscope</li> <li>• Different parts of microscope and their function.</li> <li>• Describe location &amp; function of tissues.</li> <li>• Draw the structures of various tissues and label them</li> <li>• Sketch and label the microscopic details of tissues</li> <li>• Differentiate between types of Microscopes, their structure and working</li> </ul>		
1.1	<b>Microscopy:</b> 1.1.1 History of microscope (Simple and Compound microscope) 1.1.2 Structural Parts 1.1.3 Optical Parts 1.1.4 Focusing System 1.1.5 Practical Applications and Techniques 1.1.6 Resolution vs. Magnification 1.1.7 Difference between Simple and Compound microscope	<b>[7L]</b>
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. Bamji, M.S., K. Krishnaswamy &amp; G.N.V. Brahmam (2009) Textbook of Human Nutrition (3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi</li> <li>2. Swaminathan (1995) Food &amp; Nutrition (Vol I, Second Edition) The Bangalore Printing &amp; Publishing Co Ltd., Bangalore</li> <li>3. Vijaya Khader (2000) Food, nutrition &amp; health, Kalyan Publishers, New Delhi</li> <li>4. Srilakshmi, B., (2010) Food Science, (5th Edition) New Age International Ltd., New Delhi</li> <li>5. S.S. Lal, S. Kumar, Immunology 2nd edition</li> </ol>		

**Mapping of COs and POs**

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Understand the general taxonomic rules on animal classification, The principles and methods of taxonomy and the general characters of phylum	X					
Protozoa and understand the protozoan's parasites of human.	X					



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Classify the phylum Porifera & Coelenterata using examples		X				
Understand the canal system of sponges and Polymorphism in Coelenterates.	X					
Phylum helminthes & Annelida with taxonomic keys, and a basic idea of metamerism in Annelids and parasitic adaptations of helminthes.	X					
Understand the taxonomy, classification, and distinguishing characteristics of Calotes species.	X					
Describe the morphological and anatomical adaptations of Calotes related to its habitat and lifestyle.		X				
Explain the physiological processes, including digestion, respiration, and reproduction in Calotes.		X				
Differentiate Simple and Compound microscope	X		X			
Different parts of microscope and their function.	X		X			
Describe location & function of tissues.		X				
Draw the structures of various tissues and label them			X			
Sketch and label the microscopic details of tissues			X			
Differentiate between types of Microscopes, their structure and working		X	X			

Unit	Remembering (1)	Understanding (2)	Applying (3)	Analyzing (4)	Evaluating (5)	Creating (6)	Total
I	20%	60%	20%	-	-	-	100%
II	10%	50%	40%	-	-	-	100%

**S. Y. B. Sc. (Zoology) SEMESTER IV**  
**Course Name: Non Chordates, Chordates II, Microscopy and Tissue System [CC III]**  
**Course Code: ZOOMN-S4PR3-2CR25**  
**Practical [Credits - 02]**

**Course learning outcome**

After successfully completing this course, students will be able to:

- Understand the general taxonomic rules on animal classification,
- Understand the principles and methods of taxonomy and the general characters of phylum Protozoa
- Understand the Protozoan parasites of human.
- Classify the phylum Porifera & Coelenterata using examples



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- Understand the canal system of Porifera and polymorphism in Coelenterates.
- Classify phylum Helminthes & Annelida and metamerism in Annelids and parasitic adaptations of Helminthes
- Understand the taxonomy, classification, and distinguishing characteristics of Calotes species.
- Describe the morphological and anatomical adaptations of Calotes related to its habitat and lifestyle.
- Explain the physiological processes including digestion, respiration and reproduction in Calotes.
- Differentiate simple and compound microscope
- Different parts of microscope and their function.
- Describe location & function of tissues.
- Draw the structures of various tissues and label them.
- Sketch and label the microscopic details of tissues
- Differentiate between different types of microscopes.

<b>Practical Module (ZOOMN-S3PR3-2CR25)</b>		<b>[10L]</b>
<p>The following practical are to be taught / studied only with the help of charts, models, videos, photographs, permanent slides, working models etc.</p>		
<b>1</b>	<p><b>Classification of following animals up to sub class:</b>            I. Protozoa: Trypanosoma, Monocystis, Vorticella            II. Porifera: Grantia, Euplectella, Spongilla            III. Cnidaria: Hydra, Cyanea, Gorgonia            IV. Helminthes: Planaria, Taenia, Ascaris            V. Annelida: Aphrodite, Tubifex, Hirudomedicinalis</p>	
<b>2</b>	<p><b>The following practical of Calotes to be taught/studied only with the help of Charts/models/videos/photographs/permanent slides, working models, simulators etc.</b>            VII. External characters            VIII. Digestive system            IX. Respiratory system            X. Circulatory system            XI. Urinogenital system            XII. Brain</p>	
<b>3</b>	<p>To Study different parts of microscope (Simple &amp; Compound Microscope)</p>	
<b>4</b>	<p>Determination of ABO Blood group &amp; Blood Clotting</p>	
<b>5</b>	<p>Estimation of haemoglobin using Sahli's haemoglobinometer</p>	
<b>6</b>	<p>Types of various tissues (Slide/ photograph)</p>	



**Mapping of COs and POs**

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Understand the general taxonomic rules on animal classification, The principles and methods of taxonomy and the general characters of phylum	X					
Protozoa and understand the protozoan's parasites of human.	X					
Classify the phylum Porifera & Coelenterata using examples		X				
Understand the canal system of sponges and Polymorphism in Coelenterates.	X					
Phylum helminthes & Annelida with taxonomic keys, and a basic idea of metamerism in Annelids and parasitic adaptations of helminthes.	X					
Understand the taxonomy, classification, and distinguishing characteristics of Calotes species.	X					
Describe the morphological and anatomical adaptations of Calotes related to its habitat and lifestyle.		X				
Explain the physiological processes, including digestion, respiration, and reproduction in Calotes.		X				
Differentiate Simple and Compound microscope	X		X			
Different parts of microscope and their function.	X		X			
Describe location & function of tissues.		X				
Draw the structures of various tissues and label them			X			
Sketch and label the microscopic details of tissues			X			
Differentiate between types of Microscopes, their structure and working		X	X			

**S. Y. B. Sc. (Zoology) SEMESTER IV  
Course Name: Apiculture [SEC]  
Course Code: ZOOS-SEC-S4P4-2CR25  
Practical [Credits - 02]**

**Course learning outcome**

After successfully completing this course, students will be able to:

- Understand the biology, behaviour and life cycle of honey bees.
- Identify different species of honey bees and their role in pollination and biodiversity.
- Explain beekeeping equipment, hive management and seasonal care.



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- Demonstrate skills in honey extraction, processing and value-added bee products.
- Evaluate the economic and ecological importance of apiculture in agriculture.

<b>Module 1</b>	<b>Practical</b>	<b>[10L]</b>
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**Learning Objective**

Introduction, construction of bee-hive and management of Apiculture.

**Learning Outcomes:**

- Understand the biology, behaviour and life cycle of honey bees.
- Identify different species of honey bees and their role in pollination and biodiversity.
- Explain beekeeping equipment, hive management and seasonal care.
- Demonstrate skills in honey extraction, processing, and value-added bee products.
- Evaluate the economic and ecological importance of apiculture in agriculture.

**Practicals:**

1. To study different species of honeybee used in apiculture.
2. To study different caste of honeybee.
3. To study life history of honeybee.
4. To study economic importance of honey and wax.
5. To study structure of honey comb/bee hive.

**References:**

1. Economic Zoology: G.S. Shukla & V.B. Upadhyay, Rastogi Publication, Meerut.
2. <https://www.fao.org/3/i3531e/i3531604.pdf>

**Mapping of COs and POs**

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Understand the biology, behaviour and life cycle of honey bees.	X					
Identify different species of honey bees and their role in pollination and biodiversity.		X				
Explain beekeeping equipment, hive management and seasonal care.		X				
Demonstrate skills in honey extraction, processing, and value-added bee products.		X				
Evaluate the economic and ecological importance of apiculture in agriculture.			X			



**S. Y. B. Sc. (Zoology) SEMESTER IV**

**Course Code : ZOOIKS-S4P2-2CR25**

**Course Name: Indian Knowledge System – Ancient Zoology  
Theory [Credits - 02]**

Course learning outcome		
After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>• Know Animals and its by-product uses in ancient India</li> <li>• Explain Indian traditional methods for agriculture pest control</li> <li>• Know and explain The Sacred animals of Hinduism               <ul style="list-style-type: none"> <li>• Describe The significance of animals in Hinduism</li> </ul> </li> </ul>		
<b>Module 1</b>	<b>Animals and its by-product uses in ancient India</b>	<b>[15L]</b>
<b>Learning Objective</b>		
<ul style="list-style-type: none"> <li>• Animal as therapy</li> </ul>		
<b>Learning Outcomes:</b>		
<ul style="list-style-type: none"> <li>• Know Animals and its by-product uses in ancient India</li> <li>• Explain Indian traditional methods for agriculture pest control</li> </ul>		
1	1.1 As therapy - Leech and Magoot 1.2 By products – Honey, Cow dung, Natural dyes from plants and insects 1.3 Insect as food 1.4 Indian traditional method for agriculture pest control	
<b>Module 2</b>	<b>Biodiversity in ancient India</b>	<b>[15L]</b>
<b>Learning Objective</b>		
<ul style="list-style-type: none"> <li>• The significance of animals in Hinduism</li> </ul>		
<b>Learning Outcomes:</b>		
<ul style="list-style-type: none"> <li>• Know and explain The Sacred animals of Hinduism</li> <li>• Describe The significance of animals in Hinduism</li> </ul>		
2.1	2.1.1 The Sacred animals of Hinduism: Elephant, Horse, Cow, Bull, Tiger, Monkey, Snake, Buffalo, Dog, Rat, Lion, Cat, Peacock 2.1.2 Hindu Gods / Goddesses and their amazing animal vehicle Elephant, Horse, Bull, Tiger, Male Buffalo, Mouse, Lion, Peacock, Owl, Swan, Crow, Donkey, Eagle 2.1.3 The significance of animals in Hinduism: Spiritual nature of animals Classification of beings The value of interdependence The virtue of service to animals Symbolic importance	<b>[15L]</b>



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	Relationship with God Animals incarnations of God	
<b>References:</b>		
1. Cow Dung For Food Security And Survival of Race By SachdevaDasa Human		
2. Natural Dyeing Processes Of India (Standard Edition) By: B.C. Mohanty, K.V. Chandramouli and H.D.Naik		
3. Handbook on Natural Dyes for Industrial Applications (Extraction of Dyestuff from Flowers, Leaves, Vegetables) 2nd Revised Edition By Dr. Padma S Vankar		
4. Traditional Pest Control Methods: Old-style Ways of Controlling Your Insect Enemies by DueepJyot Singh (Author), John Davidson (Author), Mendon Cottage Books (Author)		
5. Home Remedies Honey by Dr. Rajiv Sharma (Author)		
6. Leech therapy in ayurveda By Dr.M.BhaskarRao (Author), Dr.Hemanth Kumar Kushwaha (Author)		
7. Leech Therapy in Traditional Medicine: Hirudotherapy by Syed I. Hasan (Author), TanwirAlam (Author)		
8. Animal Husbandry and Allied Technologies in Ancient India - Joglekar P. P.		
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15. <a href="https://www.hinduwebsite.com/hinduism/h_animals.asp">https://www.hinduwebsite.com/hinduism/h_animals.asp</a> .		
16. <a href="https://www.hinduwebsite.com/hinduism/essays/animals.asp">https://www.hinduwebsite.com/hinduism/essays/animals.asp</a>		

**Mapping of COs and POs**

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Know Animals and its by-product uses in ancient India	X					
Explain Indian traditional methods for agriculture pest Control		X				
Know and explain The Sacred animals of Hinduism		X				
Describe The significance of animals in Hinduism	X	X				
Know Animals and its by-product uses in ancient India	X					



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Explain Indian traditional methods for agriculture pest Control		X				
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Unit	Remembering (1)	Understanding (2)	Applying (3)	Analyzing (4)	Evaluating (5)	Creating (6)	Total
I	50%	50%	-	-	-	-	100%
II	40%	60%	-	-	-	-	100%