



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

Reaccredited 'A+' 3.35 CGPA by NAAC, *College with Potential for Excellence*

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**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 III & IV**

**Program: M.Sc.**

**Course: ZOOLOGY**

**For**

**Academic year**

**2025-26**

**Effective from June 2025-26**



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**Content**

<b>Sr. No</b>	<b>Semester</b>	<b>Course</b>	<b>Course number</b>	<b>Course Code</b>	<b>Course Name</b>
1	III	Core Course - VII	CC VII	ZOOMSC-S3P7-4CR25	Immunology and Research Methodology
2		Core Course - VIII	CC VIII	ZOOMSC-S3P8-4CR25	Cell Biology and Cytogenetics
3		Core Course - IX	CC IX	ZOOMSC-S3P9-4CR25	Biochemistry and Bioinstrumentation
4		Elective Course-V &VI	EC-V	ZOOMSC-S3E5-4CR25	Biostatistics
			EC-VI	ZOOMSC-S3E6-4CR25	Parasitology
5		Skill Based Elective Course-III	SEC-III	ZOOMSC-S3SEC3-2CR25	Wildlife Photography
6	PRACTICAL	CCP-III	ZOOMSC-S3PR3-6CR25	Experimental Zoology	
1	IV	Dissertation/Internship	CCX	ZOOMSC-S4DP1-24CR25	Dissertation Project



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**M.Sc. Sem. III & IV Zoology Syllabus**

**Academic Year 2025-26**

**Semester - III**

Course Name	Course Code	Credits	Hours	Module	Lecture Per Module	Examination Theory		
						Internal Marks	External Marks	Total Marks
Immunology and Research Methodology	ZOOMSC-S3P7-4CR25	4	60	4	15	30	70	100
Cell Biology and Cytogenetics	ZOOMSC-S3P8-4CR25	4	60	4	15	30	70	100
Biochemistry and Bioinstrumentation	ZOOMSC-S3P9-4CR25	4	60	4	15	30	70	100
Biostatistics	ZOOMSC-S3E5-4CR25	4	60	4	15	30	70	100
Wildlife Photography	ZOOMSC-S3SEC3-2CR25	2	30	2	15	15	35	50
						Examination Practical		
Experimental Zoology	ZOOMSC-S3PR3-6CR25	6	180	3	60	60	140	200



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**Programme Outcomes**

<b>PO Number</b>	<b>PO Statement</b>
PO1	To impart basic knowledge of various branches of Zoology and to understand the unity of life with the rich diversity of organisms and their ecological and evolutionary significance.
PO2	To appreciate the complexities of biological organisation and address scientifically controversial issues in a rational way. To acquire basic skills in the observation and study of nature, biological techniques, experimental skills and scientific investigation
PO3	To assess the scope of animal biology and select particular areas for further study. To address the socio-economic challenges related to animal sciences and to facilitate students for taking up and shaping a successful career in Zoology and its related subjects
PO4	To inculcate transformational impact on the quality of education and to inspire the students to adopt scientific temper and live with scientific values.
PO5	To make the students aware of applications of Zoology and to highlight the potential of various branches to become an entrepreneur.



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**M. Sc. (Zoology) SEMESTER III**

**Course Name: Immunology and Research Methodology [CC VII]**

**Course Code: ZOOMSC-S3P7-4CR25**

**Theory [Credits -4]**

<b>Course Learning Outcome</b>		
<p>At the end of this course, Students will be able to:</p> <ul style="list-style-type: none"> <li>• Define Immunology</li> <li>• Understand Immune system</li> <li>• Explain structure and function of Immune cells</li> <li>• Define Immunity</li> <li>• Describe development and mechanism of T and B-lymphocytes</li> <li>• Understand Research methodology</li> <li>• Understand importance of literature survey</li> </ul>		
<b>Module 1</b>	<b>Immune System</b>	<b>[15L]</b>
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ul style="list-style-type: none"> <li>• Introduce detailed account of Immune system.</li> </ul>		
<p><b>Learning Outcome:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ul style="list-style-type: none"> <li>• Understand the basic concepts of haematopoiesis</li> <li>• Explain the structure and functions of cells of Immune system.</li> <li>• Differentiate and classify the various groups of antibody and antigen</li> </ul>		
<b>1.1</b>	<b>Lymphatic Immune System</b>	
	1.1.1 Overview of Immune system	
	1.1.2 Haematopoiesis and cells of Immune system	
	1.1.3 Primary and Secondary Lymphoid organs	
<b>1.2</b>	<b>Antibody and Antigen</b>	
	1.2.1 Structure of antibodies and five major classes of antibodies	
	1.2.2 Antigen receptors and MHC molecules	
	1.2.3 Antigen processing- endogenous and exogenous	
<b>Module 2</b>	<b>Innate and Adaptive Immunity</b>	<b>[15L]</b>
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ul style="list-style-type: none"> <li>• Discuss Innate Immunity.</li> </ul>		



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<ul style="list-style-type: none"> <li>Discuss adaptive Immunity</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 the mechanism of induced Innate Immunity</li> <li>Describe T- lymphocytes and B- lymphocytes</li> </ul>		
<b>2.1</b>	<b>Innate Immunity</b>	
	2.1.1 Cell of Innate Immunity	
	2.1.2 Receptors of Innate Immunity	
	2.1.3 Effector Mechanisms of Induced Innate Immunity	
<b>2.2</b>	<b>Adaptive Immunity</b>	
	2.2.1 T lymphocyte: Development, receptor complex, positive and negative selection, activation	
	2.2.2 B lymphocyte: Development, Receptor-Co-receptor complex, cell response- T depended and T independent	
<b>Module 3</b>	<b>Research Methodology</b>	<b>[15L]</b>
<b>Learning Objectives:</b> This module is intended to <ul style="list-style-type: none"> <li>Understand Research methodology</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>Learn different method and steps of Research</li> </ul>		
<b>3.1</b>	Reflection, Science and Research	
<b>3.2</b>	Basic and applied Research	
<b>3.3</b>	Essential Steps in Research	
<b>Module 4</b>	<b>Literature Survey</b>	<b>[15L]</b>
<b>Learning Objectives:</b> This module is intended to <ul style="list-style-type: none"> <li>Understand importance of literature survey .</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 the need for review of literature.</li> <li>Describe discriminative reading</li> </ul>		
<b>4.1</b>	Need for review of literature	



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<b>4.2</b>	Review process and bibliography
<b>4.3</b>	Research article reading
<b>4.4</b>	Discriminative reading
<b>4.5</b>	Working bibliography

**References:**

1. Owen, J. A., Punt, J., & Stranford, S. A. (2023). Kuby immunology (8th Edn). NewYork: WH Freeman.
2. Khanna R. (2011) Immunology. Oxford Uni. Press
3. Murphy, K., & Weaver, C. (2016). Janeway's immunobiology (9th Edition) Garland Science.
4. S.S.Lal, S. Kumar, Immunology 2<sup>nd</sup> edition
5. Immunology- a Textbook- Rao, C.V
6. Research Methodology- G.R. Basotia and K.K. Sharma.
7. Research Methodology- C.H. Chaudhary, RBSA Publication
8. Elements of Biostatistics in Health Science- W. Daniell.
9. Statistical Methods for Research: S. Singh et al (1988) Central Publishing Ludhiana.
10. Fundamental of Statistics – D. N. Enhance.
11. Statistical Methods: S.P. Gupta. S. Chand Publication
12. Fundamentals of Biostatistics- Khan and Kshanna, Ukaz Publication

Mapping of CO- PO

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• Define Immunology	√					
• Understand Immune system		√				
• Explain structure and function of Immune cells		√				
• Define Immunity	√					
• Describe development and mechanism of T and B-lymphocytes		√				
• Understand Research methodology		√				
• Understand importance of literature survey		√				



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**M. Sc. (Zoology) SEMESTER III**

**Course Name: Cell Biology and Cytogenetics [CC VIII]**

**Course Code: ZOOMSC-S3P8-4CR25**

**Theory [Credits -4]**

<b>Course Learning Outcome</b>		
<p>At the end of this course, Students will be able to:</p> <ul style="list-style-type: none"> <li>• Sketch the cytoskeleton and microtubules and describe its functions.</li> <li>• Explain the role of cytoskeleton in signal transduction mechanisms.</li> <li>• Describe the cell interactions.</li> <li>• Explain cell death, cancer and stem cells</li> <li>• Describe history and scope of cytogenetics.</li> <li>• Illustrate and compare idiogram and karyotyping.</li> <li>• Describe numerical and structural aberrations and chromosomal disorders.</li> <li>• Demonstrate lymphocyte culture method from Human blood for cytogenetic studies</li> <li>• Study various banding techniques.</li> <li>• Describe advanced cytogenic techniques.</li> <li>• Explain chromosomal changes associated with various cancers.</li> </ul>		
<b>Module 1</b>	<b>Cytoskeleton and Cell interaction</b>	<b>[15L]</b>
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ul style="list-style-type: none"> <li>• Understand the structure of cytoskeleton.</li> <li>• Discuss the role of cytoskeleton in signal transduction mechanisms.</li> <li>• Discuss the cell interactions.</li> </ul>		
<p><b>Learning Outcome:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ul style="list-style-type: none"> <li>• Sketch the cytoskeleton and microtubules and describe its functions.</li> <li>• Explain the role of cytoskeleton in signal transduction mechanisms.</li> <li>• Describe the cell interactions.</li> </ul>		
1.1	Cytoskeleton: Structure and function, Microtubules, Intermediate filaments, Role of cytoskeleton in signal transduction mechanisms, Microfilaments	
1.2	Cell interaction: Components of extra cellular matrix, cell junctions: gap junction and tight junction, adherens junction and desmosomes.	
<b>Module 2</b>	<b>Cell Death, Cancer and Stem Cells</b>	<b>[15L]</b>
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ul style="list-style-type: none"> <li>• Understand the concept and mechanism of cell death.</li> <li>• Discuss different types of cancers.</li> <li>• Understand the stem cells and their functions.</li> </ul>		



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<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 cell death and its types.</li> <li>• Define cancer and describe its various types.</li> <li>• Describe stem cells and its applications.</li> </ul>		
2.1	Cell death, apoptosis, necrosis, terminal differentiation and cell aging	
2.2	Cancer, metastasis and angiogenesis.	
2.3	Stem cells- Types and applications	
<b>Module 3</b>	<b>Introduction to Cytogenetics</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Discuss history and scope of cytogenetics.</li> <li>• Understand and compare idiogram and karyotyping.</li> <li>• Understand numerical and structural aberrations and chromosomal disorders.</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>• Describe history and scope of cytogenetics.</li> <li>• Illustrate idiogram and karyotyping.</li> <li>• Describe numerical and structural aberrations and chromosomal disorders.</li> </ul>		
3.1	History and development of Human Cytogenetics	
3.2	Centromere and kinetochore, telomere and its maintenance	
3.3	Idiogram, Karyotyping and Cytogenetic nomenclature	
3.4	Numerical and structural aberrations and chromosomal disorders.	
<b>Module 4</b>	<b>Cytogenetic Techniques</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Understand the lymphocyte culture method from human blood.</li> <li>• Discuss classical genetics using various banding techniques.</li> <li>• Understand advanced cytogenetics.</li> <li>• Understand cancer cytogenetics.</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>• Demonstrate lymphocyte culture method from Human blood for cytogenetic studies</li> <li>• Illustrate various banding techniques.</li> <li>• Describe advanced cytogenetic techniques.</li> <li>• Explain chromosomal changes associated with various cancers.</li> </ul>		
4.1	Lymphocyte culture method from Human blood for cytogenetic studies: Sample	



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	collection, culture, and harvesting of cells for chromosome analysis, slide preparation and solid staining
<b>4.2</b>	Classical cytogenetics: Banding Techniques- G-banding, C-banding, R-banding, Q-banding, NOR banding, Sister Chromatic Exchanges (SEC), Karyotyping analysis and diagnostic syndromes, Genetics of fetal wastage.
<b>4.3</b>	Advanced cytogenetics: Fluorescence in Situ Hybridization (FISH), Comparative Genomic Hybridization (CGH) and other advanced techniques.
<b>4.4</b>	Cancer cytogenetics: Chromosomal changes (translocations, deletions, amplifications) associated with various cancers

**References:**

1. Cell and Molecular Biology. Concepts and Experiments, Gerald Karp. John Wileyand Sons, Inc. New York.
2. Essentials of Cell and Molecular Biology. De Robertis E. D. P. and De Robertis E.M. F.
3. Becker’s World of the cell.- Jeff Hardin and Gregory Bertoni.
4. A manual of laboratory experiences in cell biology.- Gasque, C.E.
5. Techniques in microscopy and cell biology.- Sharma, V. K.
6. An International System of Human Cytogenetic Nomenclature, Shaffer, L.G., Slovak, M.L., Campbell, L.J., ISCN 2016
7. The Principles of Clinical Cytogenetics, Gersen, Steven L. and Keagle, Martha B., 2nd ed, 2005
8. Cancer Cytogenetics Heim, S and Mitelman, F.
9. An International System for Human Cytogenomic Nomenclature (2020). Harper, J. Preimplantation Genetic Diagnosis. 2009. ISCN 2020. Editors: Jean McGowan-Jordan, Ros J Hastings, Susan Moore.
10. Chromosome Abnormalities and Genetic Counseling Gardner, RJM and Sutherland, GR., 3rd ed.
11. The Association of Genetic Technologists Cytogenetics Laboratory Manual Barch, M.J., Knutsen, T., Spurbeck, J.L.
12. Cytology and genetics - Kar, Dipak Kumar Sen, Sumitra
13. Cytogenetics - Sinha, Sunita Sinha, U
14. Glossary of genetics and cytogenetics: Classical and molecular - Green, M.; Michaelis, A.; Rieger, R
15. Cytology and Genetics – Johri, B M.: Kar, D K; Sen
16. Genetics and cytogenetics – Chakraborty Soumendra
17. Introduction to molecular cytogenetics – Stuart Elizabeth
18. Principles of clinical Cytogenetics – Gersen Steven L
19. Cytogenetics - Gupta, P K

Mapping CO\_PO

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
<ul style="list-style-type: none"> <li>• Sketch the cytoskeleton and microtubules and describe its functions.</li> </ul>	√	√	√			



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• Explain the role of cytoskeleton in signal transduction mechanisms.		√				
• Define and describe the cell interactions.	√	√				
• Define cell death, cancer and stem cells	√					
• Describe history and scope of cytogenetics.		√				
• Compare idiogram and karyotyping.	√		√			
• Describe numerical and structural aberrations and chromosomal disorders.		√				
• Describe lymphocyte culture method from Human blood for cytogenetic studies		√				
• Explain various banding techniques.		√				
• Describe advanced cytogenetic techniques.		√				
• Explain chromosomal changes associated with various cancers.		√				



**M. Sc. (Zoology) SEMESTER III**

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

**Course Code: ZOOMSC-S3P9-4CR25**

**Theory [Credits -4]**

<b>Course Learning Outcome</b>	
At the end of this course, students will be able to:	
<ul style="list-style-type: none"><li>• Students will learn the nature and importance of enzymes in living systems.</li><li>• Students will understand the mechanisms of enzyme action, kinetics of enzyme catalyzed reactions and clinical importance of enzyme inhibitors</li><li>• The course will introduce students to the applications of enzymes in research and medicine as well as in industry, which will bolster their foray into industrial and biomedical research.</li><li>• Working of Colorimetry and Spectrophotometer.</li><li>• Application of Colorimetry and Spectrophotometer</li><li>• Limitations of Colorimetry and Spectrophotometer</li><li>• Application of enzyme immobilization</li><li>• Demonstration of biosensor.</li></ul>	
<b>Module 1</b>	<b>Introduction to Enzymes [15L]</b>
<b>Learning Objectives:</b>	
This module is intended to	
<ul style="list-style-type: none"><li>• Understand the action of enzyme activity.</li><li>• Analyse Michaelis-Menten Kinetics</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 the nature and importance of enzymes in living systems.</li><li>• Understand the mechanisms of enzyme action, kinetics of enzyme catalysed reactions and clinical importance of enzyme inhibitors</li><li>• Describe applications of enzymes in research and medicine as well as in industry</li></ul>	
<b>1.1</b>	Introduction to biocatalysis, Difference between chemical and biological catalysis.
<b>1.2</b>	IUBMB classification of enzymes.
<b>1.3</b>	Characteristic features of enzymes.
<b>1.4</b>	Introduction to the principles of activation energy, transition state, Active site
<b>1.5</b>	Outline of mechanism of enzyme action – lock and key model, induced fit model.
<b>1.6</b>	Factors affecting the rate of chemical reactions – substrate concentration, pH, temperature,
<b>1.7</b>	Activators and inhibitors (competitive and non-competitive types).
<b>1.8</b>	Relationship between initial velocity and substrate concentration, steady state



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	kinetics, equilibrium constant - Non substrate reactions.	
<b>1.9</b>	Michaelis-Menten equation,	
<b>1.10</b>	Lineweaver Burk plot,	
<b>1.11</b>	Km and Vmax calculation by graph	
<b>Module 2</b>	<b>Applications of Enzymes</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>Understand and analyse Enzyme Immobilization</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>Solve challenges in Enzyme Immobilization</li> </ul>		
<b>2.1</b>	<b>Immobilization of Enzyme</b>	
	2.1.1 Strategies of Enzyme Immobilization	
	2.1.2 Limitations of Enzyme Immobilization	
	2.1.3 Applications of Immobilized Enzymes	
<b>2.2</b>	<b>Industrial Application of Enzymes</b>	
	2.2.1 Food Industry	
	2.2.2 Beverage Industry	
	2.2.3 Medical and Pharmaceutical Industries	
<b>Module 3</b>	<b>Colorimetry and Spectrophotometer</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>Detail about Colorimetry and Spectrophotometer</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 working principle of Colorimetry and Spectrophotometer.</li> <li>Describe application of Colorimetry and Spectrophotometer</li> <li>Discuss limitations of Colorimetry and Spectrophotometer</li> </ul>		
<b>3.1</b>	<b>Photometry, Colorimetry and Spectrophotometry</b>	
	3.1.1. Colorimeter and Spectrophotometer	
	3.1.2 Working, principle & application of Colorimeter	
	3.1.3 Working, principle & application of Spectrophotometer	
<b>3.2</b>	<b>Spectrophotometric Analysis</b>	
	3.2.1 Proportionality	
	3.2.2 Graphing Method	
	3.2.3 Beer's Law Equation Method	
	3.2.4 Biological Applications of UV-Visible Spectrophotometers	



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Module 4	Biosensor	[15L]
<b>Learning Objectives:</b> This module is intended to <ul style="list-style-type: none"><li>• Understand working of Biosensor.</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>• Discuss history of Biosensor</li><li>• Understand working principle of Biosensor</li><li>• Understand application in different field of science</li></ul>		
4.1	Definition and History	
4.2	Components of Biosensors	
4.3	Types of Biosensor	
4.4	Applications of Biosensor	
<b>References:</b> <ol style="list-style-type: none"><li>1. Fundamentals of Enzymology: The cell and molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis Stevens, Oxford University Press, USA</li><li>2. Principles of Enzyme Technology by M.Y. Khan and Farha Khan PHI Learning Private Limited</li><li>3. Enzyme Mechanism by P.K Sivaraj Kumar, RBSA Publishers</li><li>4. Enzymes in Industry: Production And Applications by Aehle W (2007) John Wiley &amp; Sons Inc</li><li>5. Enzymes: Biotechnology, Clinical Chemistry (second Edition) by Trevor Palmer, Philip Bonner Horwood Publishing Limited</li><li>6. Lehninger, Principles of Biochemistry David L.Nelson Michael M.Cox, W.H.Freeman.</li><li>7. Biochemistry Donald Voet, Judith G. Voet Publisher: John Wiley &amp; Sons Inc</li><li>8. Enzymology Dixon and Webb, Academic Inc publishers, Newyork.</li><li>9. Biochemical Tests Principles and Protocols by Anil Kumar, Sarika Garg and Neha Garg Viva Books</li><li>10 Bioinstrumentation by L VeeraKumari MJP Publishers</li></ol>		



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**Mapping CO\_PO**

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Students will learn the nature and importance of enzymes in living systems	√	√				
Students will understand the mechanisms of enzyme action, kinetics of enzyme catalyzed reactions and clinical importance of enzyme inhibitors	√		√	√		
The course will introduce students to the applications of enzymes in research and medicine as well as in industry, which will bolster their foray into industrial and biomedical research.		√		√		
Working of Colorimetry and Spectrophotometer.	√	√				
Application of Colorimetry and Spectrophotometer.		√	√			
Limitations of Colorimetry and Spectrophotometer	√					
Application of enzyme immobilization		√				
Demonstration of biosensor		√				



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**M. Sc. (Zoology) SEMESTER III  
Course Name: Biostatistics [EC V]  
Course Code: ZOOMSC-S3E5-4CR25  
Theory [Credits -4]**

<b>Course Learning Outcome</b>		
<p>At the end of this course, Students will be able to:</p> <ul style="list-style-type: none"> <li>• Define Biostatistics</li> <li>• Understand sampling methods and calculation</li> <li>• Explain mean, median, mode</li> <li>• Describe standard deviation</li> <li>• Understand correlation analysis</li> <li>• Understands regression analysis and hypothesis</li> <li>• Describe chi-square and t-test and ANOVA</li> <li>• Analysis sample and calculate mean, deviation, and mode</li> </ul>		
<b>Module 1</b>	<b>Measures of Central Value and Dispersion</b>	<b>[15L]</b>
<p><b>Learning Objectives:</b> This module is intended to</p> <ul style="list-style-type: none"> <li>• Understand mean, median, mode</li> <li>• Understand standard deviation</li> </ul>		
<p><b>Learning Outcome:</b> After the successful completion of the module, the learner will be able to</p> <ul style="list-style-type: none"> <li>• Differentiate Mean and Median</li> <li>• Analyze the sample and found standard deviation</li> <li>• Describe Range and Mean deviation</li> </ul>		
<b>1.1</b>	Arithmetic Mean, Median Mode, Mean	
<b>1.2</b>	Range, Mean Deviation	
<b>1.3</b>	Standard Deviation	
<b>Module 2</b>	<b>Correlation Analysis</b>	<b>[15L]</b>
<p><b>Learning Objectives:</b> This module is intended to</p> <ul style="list-style-type: none"> <li>• Understand correlation analysis</li> </ul>		
<p><b>Learning Outcome:</b> After the successful completion of the module, the learner will be able to</p> <ul style="list-style-type: none"> <li>• Understand types of correlation</li> <li>• Understand Karl's Pearson's coefficient</li> <li>• Describe Coefficient of determination Rank correlation</li> </ul>		



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2.1	Types of correlation	
2.2	Scatter diagram method, Karl Pearson's coefficient of correlation	
2.3	Coefficient of determination Rank correlation	
<b>Module 3</b>	<b>Regression analysis Statistical Inference-Tests of hypotheses</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Explain hypotheses</li> <li>• Understand regression analysis</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 tests of hypothesis</li> <li>• Describe Regression equations</li> <li>• Explain standard error of sample</li> </ul>		
3.1	Introduction Regression lines	
3.2	Regression Equations, Hypothesis testing	
3.3	Standard error and sampling distribution	
3.4	Tests of significance for large samples and small samples	
<b>Module 4</b>	<b>Chi-square Test, T-Test and Analysis of variance</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Understand type of tests</li> <li>• Explain analysis of variance</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 chi-square test</li> <li>• Explain t-test sampling</li> <li>• Describe analysis of variance (ANOVA)</li> </ul>		
4.1	Chi-square: Define, distribution, Yates' Corrections	
4.2	Small Sample Test: t – test for (Single) Population Mean	
4.3	Population means (Unpaired t-test), t – test for difference between two population means (Paired t-test) Z- test	
4.4	Analysis of variance: One-Way Classification and Two-Way classification Model	
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. Gupta S.P., Statistical Methods (2023) Sultan Chand &amp; sons 46<sup>th</sup> edition</li> <li>2. Biostatistics: A Foundation For Analysis in the Health Sciences by Daniel, Wayne (Seventh Edition), Wiley India Pub.</li> </ol>		



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3. Introduction to Biostatistics- A textbook of biometry by Banerjee, Pranabkumar
4. Basic Biostatistics and its application by Datta, Animesh K
5. Basic Biostatistics by Kumar Suresh, Veeri Satya

Mapping CO\_PO

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• Define Biostatistics	√					
• Understand sampling methods and calculation		√				
• Explain mean, median, mode		√				
• Describe standard deviation		√				
• Understand correlation analysis		√				
• Understands regression analysis and hypothesis		√				
• Describe chi-square and t-test and ANOVA		√				



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**M. Sc. (Zoology) SEMESTER III  
Course Name: Parasitology [EC VI]  
Course Code: ZOOMSC-S3E6-4CR25  
Theory [Credits -4]**

<b>Course Learning Outcome</b>		
At the end of this course, Students will be able to:		
<ul style="list-style-type: none"> <li>• Define parasitology</li> <li>• Understand parasite action</li> <li>• Explain life cycle of different parasites</li> <li>• Differentiate effect of parasite according to their action</li> <li>• Describe technique use in parasitology</li> </ul>		
<b>Module 1</b>	<b>Introduction of Parasitology</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Introduction about Parasitology</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 strategies of parasite control</li> <li>• Explain life cycle and development of different parasite</li> </ul>		
<b>1.1</b>	History of parasitology	
<b>1.2</b>	Chemical control strategies in relation to parasite control	
<b>1.3</b>	Control of Haemosporidian diseases in exotic livestock	
<b>1.4</b>	Life-cycles of parasites	
<b>1.5</b>	Alternation of generation Development of parasites in tissue systems Economic importance of taxonomic study of parasites	
<b>Module 2</b>	<b>Parasitic Protozoa</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Understand protozoan parasite</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 parasitic behaviour of malaria parasite</li> <li>• Explain the pathogenicity and treatment of malaria parasite</li> <li>• Describe host parasite relation</li> </ul>		
<b>2.1</b>	<b>The discovery of the malarial parasites in man and mosquito</b>	



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	<b>Host-parasite relations</b>	
	Parasitological and clinical periods Pathogenesis Epidemiology Treatment Prevention	
<b>Module 3</b>	<b>Parasitic Helminthes</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Understand types of helminthes parasites</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 life cycle of helminths parasite</li> <li>• Understand pathogenicity and treatment</li> </ul>		
3.1	Types of helminthes parasite	
3.2	Periodicity	
3.3	Life-cycle	
3.4	Pathogenicity	
3.5	Epidemiology	
3.6	Treatment	
<b>Module 4</b>	<b>Techniques for Parasitology Studies</b>	<b>[15L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"> <li>• Understand examination technique of parasite studies</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 examination of blood film</li> <li>• Understand different type of examination technique for various parasites</li> </ul>		
4.1	Stain and examination of blood film	
4.2	Examination of stool for protozoa & helminthic infections	
4.3	Baermann's method for concentration of helminthic larvae	
4.4	Analysis of biopsy and post-mortem material for detection of parasites	
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. Parasitology, K. D. Chatterjee</li> <li>2. A Textbook of Parasitology, P. R. Yadav</li> <li>3. Parasitology, B. Dasgupta</li> </ol>		



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Mapping CO\_PO

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• Define parasitology	√					
• Understand parasite action		√				
• Explain life cycle of different parasites		√				
• Discuss effect of parasite according to their action		√				
• Describe technique use in parasitology		√				



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**M. Sc. (Zoology) SEMESTER III  
Course Name: Wildlife Photography [SEC III]  
Course Code: ZOOMSC-S3SEC3-2CR25  
Theory [Credits -2]**

<b>Course Learning Outcome</b>		
<p>After the successful completion of the Course, the learner will be able to:</p> <ul style="list-style-type: none"> <li>• Know types of camera and its usage</li> <li>• Explain different camera lenses and its usages</li> <li>• Use of camera and know camera settings</li> <li>• Create opportunities to work as photographer</li> </ul>		
<b>Module 1</b>	<b>Camera and its Components</b>	<b>[15L]</b>
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ul style="list-style-type: none"> <li>• Use of camera and know camera settings</li> <li>• Create opportunities to work as wildlife photographer</li> </ul>		
<p><b>Learning Outcome:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ul style="list-style-type: none"> <li>• Know types of camera and its usage</li> <li>• Explain different camera lenses and its usages</li> <li>• Use of camera and know camera settings like Light, Shutter speed, Aperture and ISO</li> </ul>		
1.1	Photography history and importance	
1.2	Types of camera and its usage and basic keys	
1.3	Different camera lenses and its usages	
1.4	Settings of Light, Shutter speed, Aperture and ISO	
1.5	Accessories like Filters, Tripod and Cards	
<b>Module 2</b>	<b>Field Work</b>	<b>[15L]</b>
<p><b>Learning Objectives:</b></p> <ul style="list-style-type: none"> <li>• Apply camera method practically in field</li> </ul>		
<p><b>Learning Outcome:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ul style="list-style-type: none"> <li>• Know types of camera and its usage</li> <li>• Explain different camera lenses and its usages</li> <li>• Take natural photographs</li> <li>• Know basic image editing</li> </ul>		
<b>2.1</b>	To study types of camera with the help of photographs	



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<b>2.2</b>	To study different types of camera lenses and its usages
<b>2.3</b>	Field photography by Mobile or Camera (Only Five natural photographs)
<b>2.4</b>	Basic image editing - Crop, Resize, White and color balance etc.

**References:**

1. John Freeman Practical Photography
2. Michael Busselle, The Encyclopaedia of photography
3. Saurabh Desai, Visual poetries
4. John Hedgecoe, The art of colour photography

**Mapping CO\_PO**

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• Know types of camera and its usage	√	√				
• Explain different camera lenses and its usages	√	√				
• Use of camera and know camera settings			√	√		
• Create opportunities to work as photographer			√			



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**M. Sc. (Zoology) SEMESTER III  
Course Name: Experimental Zoology [CCP III]  
Course code: ZOOMSC-S3PR3-6CR25  
Practical [Credits -6]**

<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>• Develop practical knowledge related to immune system and cell biology.</li><li>• Use different type of bioinstrumentation</li></ul>		
<b>Course Name</b>	<b>Immunology and Research Methodology</b>	<b>[3L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"><li>• Introduce learner to detailed account of Immune system.</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 the basic concepts of haematopoiesis and</li><li>• Explain the structure and functions of cells of immune system.</li><li>• Differentiate and classify the various groups of antibody and antigen</li></ul>		
<ol style="list-style-type: none"><li>1. ELISA test for antigen and antibody</li><li>2. RIA test for antigen and antibody</li><li>3. Demonstration of hemeopoesis and diifentiation of blood cell</li><li>4. COVID 19 antigen test</li><li>5. Write up of review article</li></ol>		
<b>Course Name</b>	<b>Cell biology and Cytogenetics</b>	<b>[3L]</b>
<b>Learning Objectives:</b>		
This module is intended to		
<ul style="list-style-type: none"><li>• Introduce learner to detailed account of cell biology and cytogenetics.</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>• Sketch the structure of microtubules, intermediate filaments and microfilaments through photos/charts</li><li>• Describe various cell junctions through photos/charts</li><li>• Describe the stem cells through photos/charts.</li><li>• Explain different types of cancers through photos/charts/models.</li><li>• Demonstrate lymphocyte culture from human blood.</li><li>• Compare karyotyping and idiogram of human chromosomes.</li><li>• Perform various banding techniques.</li><li>• Describe advanced cytogenetic techniques- FISH, CGH, SKY, PRINS and aCGH</li></ul>		



- Identify chromosomal changes associated with various cancers

1. To study the structure of microtubules, intermediate filaments and microfilaments through photos/charts
2. To study various cell junctions through photos/charts
3. To study stem cells through photos/charts.
4. To study different types of cancers through photos/charts/models.
5. Demonstration of lymphocyte culture from human blood.
6. To study karyotyping and idiogram of human chromosomes.
7. To perform various banding techniques.
8. To study advanced cytogenetic techniques- FISH, CGH, SKY, PRINS and aCGH
9. Identification of chromosomal changes associated with various cancers.

### **Course Learning Outcome**

After the successful completion of the Course, the learner will be able to:

- Perform Enzyme assay

### **Course Name**

**Biochemistry and Bioinstrumentation**

**[3L]**

### **Learning Objectives:**

This module is intended to

- Different methods of enzyme immobilization

### **Learning Outcome:**

After the successful completion of the module, the learner will be able to

- Determine activity and specific activity of an enzyme.
- Determination of  $K_m$  and  $V_{max}$  of an enzyme using Lineweaver-Burk plot
- Solving problems on enzyme kinetics.

1. Extraction of enzyme
2. Assay to determine activity and specific activity of an enzyme.
3. Progress curve for an enzyme.
4. Effect of pH on enzyme activity.
5. Effect of temperature on enzyme activity.
6. Determination of  $K_m$  and  $V_{max}$  of an enzyme using Lineweaver-Burk plot.
7. Immobilization of enzyme (any two techniques)
8. Specificity, Stability and reusability of immobilized enzyme
9. Demonstration of formation of biosensor



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Mapping CO\_PO

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Determine activity and specific activity of an enzyme.			√			
Determination of Km and Vmax of an enzyme using Lineweaver-Burk plot			√			
Solving problems on enzyme kinetics.				√		
Different methods of enzyme immobilization		√	√			
Define immunology	√					
Understand immune system		√				
Explain structure and function of immune cells		√				
Define immunity	√					
Describe development and mechanism of T and B-lymphocytes		√				
Understand Research methodology		√				
Understand importance of literature survey		√				
Sketch the cytoskeleton and microtubules and describe its functions.	√	√	√			
Explain the role of cytoskeleton in signal transduction mechanisms.		√				
Define and describe the cell interactions.	√	√				
Define cell death, cancer and stem cells	√					
Describe history and scope of cytogenetics.		√				
Compare idiogram and karyotyping.	√		√			
Describe numerical and structural aberrations and chromosomal disorders.		√				
Describe lymphocyte culture method from Human blood for cytogenetic studies		√				
Explain various banding techniques.		√				
Describe advanced cytogenetic techniques.		√				
Explain chromosomal changes associated with various cancers.		√				



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**M. Sc. (Zoology) SEMESTER IV**

**COURSE TITLE: Dissertation Project**

**COURSE CODE: ZOOMSC-S4DP1-24CR25 [CREDITS - 24]**

<b>Course Learning Outcomes</b>	
After the successful completion of the course, learners will be able to	
<ul style="list-style-type: none"><li>• Apply research methodologies to design, execute and analyze a zoology-based project, demonstrating problem-solving and critical thinking skills.</li><li>• Analyze experimental or theoretical data using advanced zoology concepts.</li><li>• Develop a comprehensive project report that effectively communicates research findings, methodologies and interpretations.</li><li>• Present research outcomes clearly and confidently through oral and written presentations, demonstrating depth of understanding and scientific rigor.</li></ul>	
<b>Dissertation Project</b>	<b>[48 hrs per week]</b>
<b>Learning Objectives:</b>	
This course is intended to	
<ul style="list-style-type: none"><li>• Introduce the students to research methodologies and analytical techniques to investigate complex zoology problems and develop independent research skills</li><li>• Demonstrate the ability to analyse data, interpret results and effectively communicate scientific findings through reports and presentations.</li></ul>	
<b>Learning Outcomes:</b>	
After the successful completion of the course, learners will be able to	
<ul style="list-style-type: none"><li>• Apply research methodologies to design, execute and analyze a zoology-based project, demonstrating problem-solving and critical thinking skills.</li><li>• Analyze experimental or theoretical data using advanced zoology concepts.</li><li>• Develop a comprehensive project report that effectively communicates research findings, methodologies and interpretations.</li><li>• Present research outcomes clearly and confidently through oral and written presentations, demonstrating depth of understanding and scientific rigor.</li></ul>	
<b>Guidelines:</b>	
<ul style="list-style-type: none"><li>• Every student shall work on a project under a faculty member of the department.</li><li>• Project work may be carried out within the department or in other department or from other institution institutions (e.g. Research Organizations, Industries, etc.) (if required).</li><li>• Allotment of the supervisors shall be done by the Department.</li><li>• The supervisor shall act as the instructor for this course on project and make continuous assessment every 30 days based on the understanding/ literature survey, experimental/</li></ul>	



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<p>theoretical formulation, performance, interpretation of results and writing of Report.</p> <ul style="list-style-type: none"> <li>• End-semester evaluation will be based on evaluation of report, presentation and viva voce examination of the candidate at the end of the semester by a panel of examiners.</li> <li>• In case, if a student fails to complete the project work at other institutions (e.g. Research Organizations, Industries, etc.), then other institution has to intimate the college 45 days prior to the date of submission of report. In such cases, student has to complete the equivalent course work* in the department.</li> </ul>
<p><b>Note:</b></p> <ul style="list-style-type: none"> <li>➤ Students have to submit the copies of the report in due time (declared by the Department).</li> <li>➤ Student has to prepare a PowerPoint presentation comprising all his/her project work (e.g. problem statement, literature review, data collection, results and discussion, etc.) (wherever applicable). The duration of the presentation shall be 30 minutes (maximum).</li> <li>➤ Student's report and PowerPoint presentation shall be evaluated by a panel of examiners decided by the Department Officials.</li> </ul> <p>*Equivalent courses can be defined by the respective supervisor at the home institute, for example such students may be asked to write a review article and write a brief research proposal in the subject/domain in which student has or hasn't already studied previously.</p>

**Mapping of CLOs and PSOs**

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Apply research methodologies to design, execute and analyze a zoology-based project, demonstrating problem-solving and critical thinking skills.	√	√	√			
Analyze experimental or theoretical data using advanced zoology concepts.	√	√			√	
Develop a comprehensive project report that effectively communicates research findings, methodologies and interpretations.			√	√	√	√
Present research outcomes clearly and confidently through oral and written presentations, demonstrating depth of understanding and scientific rigor.			√	√	√	√