ST. ALOYSIUS COLLEGE(AUTONOMOUS), JABALPUR

Reaccredited 'A++ 'Grade by NAAC(CGPA:3.58/4.00)
College with Potential for Excellence by UGC
DST-FIST Supported & STAR College Scheme by DBT

Theory syllabus
Scheme A-1(For course of science Discipline having Major Practicum Component)

Part A - Introduction			
PROGRAMME : PG Diploma	Class: M.Sc.	I Year/II Semester	Session- 2025-26
Subject- Zoology			

1	Course Code	CC-21 (Paper-I)
2	Course Title	Biostatistics, Ecology & Behavioural Science
3	Course type	Core Course
4	Pre- requisite (if any)	To study this course a student must have had Subject Major Zoology in 3 year Graduation course.
5	Course Learning Outcomes (CLO)	• Understand and apply basic statistical methods in biology. • Know ecological systems and population dynamics. • Understand Indigenous Data Systems and Observational Methodologies • Explain organism-environment interactions. • Describe key concepts in animal and human behaviour. • Evaluate biological data to draw scientific conclusions • Students will becomeecological research, wildlife conservation, data analysis, environmental consultancy, and behavioural science in academia and NGOs.
6	Credit Value	06
7	Total Marks	Max. Marks: 60+40 | Min. Passing Marks: 40

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Part B- Content of the Course Total No. of Lectures- Tutorials- Practical (in hour per week) : 5 hour per week		
Unit	Topics	No. of Lectures
I	**Basic concept of Biostatistics** • Preliminary concept of development of Biostatistics (scope, statical method and experimental problem) • Central tendency, characteristic and measures with statistical problem. • Calculation of mean median and mode by different method. • Measures of variation co-variation and analysis of variance by ANOVA technique • Test method: Z- test, F-test, T-test, standard deviation(SD), standard error(SE), and experimental problem	18
II	**Graphical representation of data** • Theoretical distribution monomial and binomial • Correlation, Regression. • Tabulation statical table • Presentation of data line diagram graphs histogram per diagram pictogram cartogram • Chi square test • Probability **Indigenous Data Systems and Observational Methodologies** • Ancient Indian methods of systematic observation (e.g., in Ayurveda, Jyotisha). • Use of metrics in Ayurveda, e.g., *Nadi pariksha*, *dosha quantification*, and other semi-quantitative models.	18
III	**Ecology** • **Definition:** Ecology, landscape, habitat, ecozone, biosphere reserve and ecosystem. • **Habitat Ecology Introduction to Habitat Ecology:** Ecological concept of habitat. Ecological niche: niche overlap, niche separation. Ecology of major habitats: Grasslands (characteristics, composition, grassland ecosystem and its distribution in central India), Forests (types of forest, canopy cover, species composition in different forest types). • **Wetland Ecology Wetlands:** Wetland definition, characteristics and distribution in northeast India, Wetland formation, Ecological role of wetland as wildlife habitat with special reference to Central India. • **Forest Ecology Forest and forest environment:** Structure of forest ecosystem; Forest fragmentation, Characteristic of tropical trees; phenology of trees; forest seed dormancy and germination; regeneration of forest trees.	18
IV	**Foundations and Mechanisms of Animal Behaviour.** • Introduction to Ethology and Behavioural Science • Historical Perspectives: Tinbergen's Four Questions	

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	• Neural and Hormonal Control of Behaviour • Genetic Basis of Behaviour: Heritability and Gene-Environment Interactions • Learning and Cognition: Classical & Operant Conditioning, Habituation, Insight Learning • Communication: Signals, Modalities, Evolution of Language • Circadian Rhythms, Biological Clocks, and Navigation	18
V	**Ethology, Evolution & Applications of Behaviour** • Behavioural Ecology: Optimal Foraging Theory, Mating Systems, Territoriality. • Reproductive Strategies and Parental Care. • Altruism, Cooperation, and Kin Selection. • Social Organization in Insects, Birds, Mammals (Case Studies: Ants, Wolves, Primates). • Human-Wildlife Conflict and Behavioural Adaptation in Urban Ecology. • Applied Behavioural Science: Conservation, Captive Animal Welfare, and Etho-tourism. • Ethical and Legal Aspects in Behavioural Research (Wildlife Protection Acts, IUCN guidelines).	18

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Part C- Learning Resources	
	Text Books, Reference Books, Other resources
Suggested Reading	1. Biostatistics: A Foundation for Analysis in the Health Sciences by Wayne W. Daniel & Chad L. Cross 2. Sokal, R.R. & Rohlf, F.J. – Biometry: The Principles and Practice of Statistics in Biological Research 3. Khan, I.A. & Khanum, A. – Fundamentals of Biostatistics 4. Science and Technology in Ancient India – Debiprasad Chattopadhyaya 5. Statistics and Truth: Putting Chance to Work– C.R. Rao (bridges statistical thinking and ancient methodologies) 6. Odum, E.P. – Fundamentals of Ecology 7. Essentials of Ecologyby Colin R. Townsend, Michael Begon& John L. Harper 8. Smith, T.M. & Smith, R.L. – Elements of Ecology 9. Dugatkin, L.A. – Principles of Animal Behaviour 10. Manning, A. & Dawkins, M.S. – An Introduction to Animal Behaviour. 11. Principles of Biostatistics byMarcello Pagano & Kimberlee Gauvreau. 12. Animal Behaviour by Reena Mathur. 13. The Study of Animal Behaviourby Scott Freeman and John Alcock 14. Principles of Animal Behavior by Lee Alan Dugatkin 15. Introduction to Behavioural *Ecology* by Davies, Krebs, and West
Suggested equivalent online courses	1. Coursera – Biostatistics in Public Health (Johns Hopkins) 2. Online Master's in Biostatistics – Brown University 3. FutureLearn – Ecology and Wildlife Conservation 4. Biodiversity, Wildlife and Ecosystem Health (Online Learning) – University of Edinburgh 5. Postgraduate Certificate in Ecological Survey Techniques – University of Oxford 6. Coursera – Animal Behaviour and Welfare (University of Edinburgh) 7. NPTEL – Animal Behaviour (Indian case studies, includes ethograms and behavioural ecology topics.) 8. Master's in Ethology – Bircham International University 9. Advanced Ethology and Animal Welfare – Nord University

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Part D- Assessment and Evaluation		
Suggested continuous Evaluation Methods		
Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE) :40 Marks University Examination(UE) :60		
Internal Assignment Continuous Comprehensive Evaluation (CCE):40	Class Test Assignment/Presentation	Total-40
External Assignment: University Exam Section :60 Time: 03.00 Hour	Section (A): Objective type question Section (B): Short Question Section (C): Long Questions	Total-60
Any Remarks/Suggestion:		

Practical syllabus

Scheme A-1(For course of science Discipline having Major Practicum Component)

Part A - Introduction			
PROGRAMME : PG Diploma	Class: M.Sc.	I Year/II Semester	Session- 2025-26
Subject- Zoology			
1	Course Code	PC-21 (Paper-I)	
2	Course Title	Biostatistics, Ecology & Behavioural Science	
3	Course type	Core Course	
4	Pre- requisite (if any)	To study this course a student must have had Subject Major Zoology in 3 year Graduation course.	
5	Course Learning Outcomes (CLO)	• Apply statistical tools to analyze biological data. • Conduct ecological field studies and interpret results. • Observe and record behavioural patterns in organisms. • Use software/tools for statistical and ecological analysis. • Demonstrate proper data collection, analysis, and presentation techniques.	
6	Credit Value	04	
7	Total Marks	Max. Marks: 60+40	Min. Passing Marks: 40

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Part B- Content of the Course		
Total No. of Lectures- Tutorials- Practical (in hour per week) :3 hours per week L-T-P		
Unit	Topics	No. of Lectures
I	Measures of Central Tendency • Collection of biological data (field/lab data). • Calculation of mean, median, mode • Application-based problem solving. Measures of Variation • Application of ANOVA (One-way) using example datasets. Test of Significance • Performing Z-test, F-test, T-test using biological data. Graphical Representation • Construction and analysis of: o Line diagram, Bar graph, Histogram, Pie chart o Pictogram, Cartogram, Frequency polygon Distribution and Correlation • Calculation and plotting of correlation (Pearson/Spearman) using sample data. Tabulation and Chi-square • Designing of statistical tables (primary and secondary). • Chi-square test for goodness of fit and association.	25
II	Basic & Habitat Ecology • Field study on niche characteristics of selected species. • Comparative study of grassland vs. forest ecosystem composition. • Mapping and identification of habitat zones (with reference to NE India). Wetland Ecology • Field visit to a local wetland. • Assessment of wetland flora/fauna. • Study of ecological roles in nutrient cycling, wildlife habitat. Forest Ecology • Identification of tree species, phenology study. • Observation of canopy cover, forest stratification, seed dormancy. • Field survey on forest fragmentation and its impact on species diversity.	25
III	• Construction of ethograms for selected species (in lab or field) • Observation and recording of foraging or social behaviour • Design of behavioural experiments (e.g., maze learning, choice tests) • Data analysis using descriptive statistics and behaviour software (e.g., BORIS)	10

Part C- Learning Resources	
Text Books, Reference Books, Other resources	
Suggested Reading	1. Sokal, R.R. & Rohlf, F.J. – Biometry: The Principles and Practice of Statistics in Biological Research 2. Practical Statistics for Field Biology by Jim Fowler, Lou Cohen & Phil Jarvis 3. Using R for Biostatistics by Thomas W. MacFarland & Jan M. Yates 4. Khan, I.A. & Khanum, A. – Fundamentals of Biostatistics 5. Odum, E.P. – Fundamentals of Ecology 6. Field and Laboratory Methods for General Ecology by James E. Brower et al. 7. Smith, T.M. & Smith, R.L. – Elements of Ecology 8. Dugatkin, L.A. – Principles of Animal Behaviour 9. Manning, A. & Dawkins, M.S. – An Introduction to Animal Behaviour. 10. Biostatistics: A Practical Guide to Design, Analysis, and Reporting By Rupert G. Miller 11. Field and Laboratory Exercises in Animal Behaviourby: Edward Price or Michael D. Breed. 12. Exploring Animal Behaviour in Laboratory and Field by Bonnie Ploger & Ken Yasukawa.
Suggested equivalent online courses	1. Graduate Certificate in Applied Biostatistics – Georgia State University (USA) 2. Coursera – Biostatistics in Public Health (Johns Hopkins) 3. Applied Ecology MSc – University of Gloucestershire (UK) 4. FutureLearn – Ecology and Wildlife Conservation 5. Coursera – Animal Behaviour and Welfare (University of Edinburgh) 6. NPTEL – Animal Behaviour 7. Ethology Course – Ethology Institute (Global)

Part D- Assessment and Evaluation			
Suggested continuous Evaluation Methods			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction/ Quiz	15	Viva/Voce on Practical	10
Attendance	05	Practical Record File	10
Assignment(Charts/ Model/Seminar/Rural Service/Technology Dissemination/ report of the Excursion/Lab Visit/Survey/Industrial Visit	20	Table Work/Experiments • Spotting • Two Experiment	20 20
TOTAL	40	Total	60
Any Remarks/Suggestion:			

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Theory syllabus
Scheme A-1(For course of science Discipline having Major Practicum Component)

Part A – Introduction			
PROGRAMME : PG Diploma	Class: M.Sc.	I Year/II Semester	Session- 2025-26
Subject- Zoology			

1	Course Code	CC-22 (Paper- II)
2	Course Title	Tool & Techniques, Biophysics And Bioinformatics
3	Course type	Core Course
4	Pre- requisite (if any)	To study this course a student must have had Subject Major Zoology in 3 year Graduation course.
5	Course Learning Outcomes (CLO)	• To understand the structure and function of microscope. • To know the different principles of working of microscope. • To understand the different cytological lab techniques. • Know about Panchamahabhutas& Biophysical States of Matteraccording to ancient text. • To know about the different systematic pathways of biomolecules. • To have an idea of new branches of Zoology their importance. • Prepares students for careers inlaboratory research, biomedical instrumentation, computational biology, and data-driven life science research in academia and industry.
6	Credit Value	06
7	Total Marks	Max. Marks: 60+40 | Min. Passing Marks: 40

Part B- Content of the Course

Total No. of Lectures- Tutorials- Practical (in hour per week) : 5 hours per week

Unit	Topics	No. of Lectures
I	• **Basic principles of microscopy:** Types of microscopes and their biological applications, Bright-field, microscope, numerical aperture, limit of resolution, types of objectives, ocular and stage micrometers, Dark-field, Phase-contrast, Differential interference contrast, Fluorescence, Confocal, Atomic force, Transmission and scanning electron microscopy • **Centrifugation:** Basic principle, Types of rotors, Clinical, high speed and ultracentrifuge.	18
II	• **Electrophoresis:** Agarose- and polyacrylamide gel, Two-dimensional, Isoelectrofocussing • **Spectroscopy:** Beer-Lambert's law, molar extinction coefficient and calculation, Spectroscopy, Colorimeter and UV-Vis, Spectrophotometer, CD, Fluorescence, NMR, Spectrofluorometry • **Chromatography:** Paper and thin layer chromatography, Column chromatography, Gel filtration, Ion-exchange, HPLC, FPLC, MALDI (TOF), Affinity purification	18
III	• **Panchamahabhutas& Biophysical States of Matter:** Earth (solid), Water (liquid), Fire (thermal/energy), Air (gaseous), Ether (space): traditional descriptors of physical and physiological states. • **Bioenergetics:** Laws of thermodynamics, Concept of free energy, Standard free energy, ATP as energy currency and its hydrolysis. • **Water:** Hydrogen bonding and structure of water molecule, Ionization of water, Concept of pH,pK and pOH, Colligative properties. • **Carbohydrates:** Classification and structure, glycosaminoglycans and proteoglycans, Glycolysis, TCA cycle, Electron transport system.	16
IV	• **Amino acids:** Structure, Classification, Zwitter ionic properties and titration curves. • **Proteins:** Various levels of structural organization of proteins, Peptide bonds, disulphide and other types of cross-links, α-helix and other helices, Helix-coil transition, parallel and anti-parallel β-pleated sheets, Ramachandran plot and its significance • **Lipids:** Simple and complex lipids, Glycerophospholipids, Sphingolipids, Gangliosides, Eicosanoids and prostaglandins • **Cholesterol:** Structure and biosynthesis. • **Nucleic acids and Nucleotides:** Biosynthesis of purines and pyrimidines, de novo and Salvage pathway, various confirmations of nucleotides.	20
V	**Bioinformatics and Molecular Biology Techniques:** • Introduction and scope of Bioinformatics, Data bases Nucleic acid sequences Genomes, Protein sequence and structures. • Access to molecular biology data bases Entrez Sequence retrieval system (SRS) Protein identification resource (PIR). • Sequence alignments and phylogenetic trees Southern and northern blotting, Western blotting, ELISA, PCR, FACS. • In situ hybridization, FISH, RISH, Immunostaining, Microarray, , FACS, • DNA protein Interaction methods, EMSA, South Western, Protein-protein interaction methods, Pull down assay, Far western Blot, FRET-FREM, Yeast two hybrid system.	18

Part C- Learning Resources	
Text Books, Reference Books, Other resources	
Suggested Reading	1. Principles and Techniques of Biochemistry and Molecular Biology ByKeith Wilson & John Walker. 2. Techniques in Molecular Biology" By: John M. Walker 3. Biotechniques Theory and Practice – *R. K. Sharma* Biophysical Chemistry By Upadhyay, Upadhyay & Nath. 4. Biophysical Techniques by Iain Campbell 5. Fundamentals of Biophysics by Andrey B. Rubin 6. Biophysics: An Introduction By Rodney Cotterill 7. Essentials of Biophysics – P. Narayanan 8. Principles of Biophysics – Dr. R.N. Roy 9. Biophysics – *Vasantha Pattabhi & N. Gautham* 10. Panchamahabhuta and Physiology in Ayurveda" – Dr. Subhash Ranade 11. Elements of Indian Cosmology and Biophysics" – IGNCA papers 12. Fundamentals of Bioinformatics" By Dan E. Krane & Michael L. Raymer 13. Introduction to Bioinformatics by Arthur M. Lesk 14. Bioinformatics: Sequence and Genome Analysis by David W. Mount 15. Essential Bioinformaticsby Jin Xiong 16. Bioinformatics: Principles and Applications – *Ghosh & Mallick* 17. Fundamentals of Bioinformatics – *Krane & Raymer* 18. Tools and Techniques in Biosciences (Set of 2 Volumes) byDr. Binay Kumar Singh, Dr. Sangeeta Mashi, Dr. Vandana Ram
Suggested equivalent online courses	1. MIT OpenCourseWare – Experimental Biology 2. Postgraduate Certificate in Biophysics – TECH United States 3. Free Online Courses – Biophysical Society 4. NPTEL – Techniques in Biolog 5. Bioinformatics Graduate Certificate – Harvard Extension School 6. Coursera – Introduction to Biophysics *(by École normale supérieure)* 7. EMBL-EBI Training – Bioinformatics Tools 8. NCBI Tutorials – Sequence Analysis Tools 9. Bioinformatics: Algorithms and Applications – Swayam

Part D- Assessment and Evaluation		
Suggested continuous Evaluation Methods		
Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE) : 40 Marks University Examination(UE) : 60		
Internal Assignment Continuous Comprehensive Evaluation (CCE):40	Class Test Assignment/Presentation	Total-40
External Assignment: University Exam Section :60 Time: 03.00 Hour	Section (A): Objective type question Section (B): Short Question Section (C): Long Questions	Total-60
Any Remarks/Suggestion:		

Practical syllabus

Scheme A-I(For course of science Discipline having Major Practicum Component)

Part A - Introduction			
PROGRAMME : PG Diploma	Class: M.Sc.	I Year/II Semester	Session- 2025-26
Subject- Zoology			
1	Course Code	PC-22 (Paper-II)	
2	Course Title	Tool & Techniques, Biophysics And Bioinformatics.	
3	Course type	Core Course	
4	Pre- requisite (if any)	To study this course a student must have had Subject Major Zoology in 3 year Graduation course.	
5	Course Learning Outcomes (CLO)	• Identify and operate basic laboratory instruments (e.g., centrifuge, spectrophotometer, pH meter, microscope). • Demonstrate aseptic techniques for microbial culture and handling. • Understand nucleic acid handling techniques, including DNA extraction, PCR, and gel electrophoresis. • Understand the physical principles behind biological structures and processes. • Perform experiments to assess protein folding, enzyme kinetics, and diffusion processes. • Knowthermodynamic and kinetic data from biological systems.	
6	Credit Value	04	
7	Total Marks	Max. Marks: 60+40	Min. Passing Marks: 40

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Part B- Content of the Course		
Total No. of Lectures- Tutorials- Practical (in hour per week) : 3 hour per week L-T-P		
	Topics	No. of Lectures
I	• DNA Isolation from Plant or Animal Tissue • Agarose Gel Electrophoresis for DNA Fragment Separation • Protein Estimation using Bradford or Lowry Method • Spectrophotometric Analysis of Nucleic Acids or Proteins • pH Measurement and Buffer Preparation • Microscopy – Cell Staining and Observation (e.g., onion cells, cheek cells) • Centrifugation – Separation of Cellular Components • SDS-PAGE for Protein Analysis • Chromatography Techniques: Paper, Thin, Column, or Ion Exchange	25
II	• Determination of Absorption Spectrum of Biomolecules • Viscosity Measurement of Biological Fluids • Beer-Lambert Law Verification using UV-Vis Spectrophotometer • Thermal Denaturation of DNA (Melting Curve Analysis) • Enzyme Kinetics: Michaelis-Menten Curve and Km Determination.	15
III	• Retrieval of DNA/Protein Sequences from NCBI/UniProt • BLAST Analysis for Gene/Protein Identification • Gene Structure Analysis using Ensembl Genome Browser • Protein Structure Visualization using PyMOL or UCSF Chimera • Phylogenetic Tree Construction using MEGA Software • Motif and Domain Analysis using InterProScan • 3D Protein Structure Retrieval and Analysis from PDB	20

Part C- Learning Resources	
Text Books, Reference Books, Other resources	
Suggested Reading	1. Principles and Techniques of Biochemistry and Molecular Biology By: Keith Wilson & John Walker. 2. Molecular Biology Techniques: A Classroom Laboratory Manual– *Heather Miller, D. Scott Witherow, Sue Carson* 3. Biophysical and Biochemical Techniques By: Upadhyay, Upadhyay & Nath. 4. Biophysics: Tools and Techniques By C. Syamal Roy. 5. A Laboratory Course in BiophysicsR.R. Yadav. 6. Bioinformatics: Methods and Applications By S.C. Rastogi (includes practical problem-solving exercises) 7. Bioinformatics: A Practical Guide to the Analysis of Genes Proteins and Authors: Andreas D. Baxevanis& B.F. Francis Ouellette 8. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 9. Techniques in Biophysical Chemistry by R. Rajagopalan 10. Practical Bioinformatics by Michael Agostino 11. Bioinformatics with Python Cookbook by Tiago Antao
Suggested equivalent online courses	1. Bioinformatics Tools & Techniques – Udemy 2. Foundations of Bioinformatics – UC San Diego 3. Bioinformatics Graduate Certificate – Harvard Extension School 4. MIT OpenCourseWare – Experimental Biology 5. NPTEL – Techniques in Biology 6. NPTEL – Introduction to Molecular Biophysics 7. edX – Biophysical Chemistry (Kyoto University) 8. Coursera – Bioinformatics Specialization (UC San Diego)

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Part D- Assessment and Evaluation			
Suggested continuous Evaluation Methods			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction/ Quiz	15	Viva/Voce on Practical	10
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Assignment(Charts/ Model/Seminar/Rural Service/Technology Dissemination/ report of the Excursion/Lab Visit/Survey/Industrial Visit	20	Table Work/Experiments • Spotting • Two Experiment	20 20
TOTAL	40	Total	60

Any Remarks/Suggestion:

23/05/25