K. C. E. Society's
Moolji Jaitha College
An 'Autonomous College' Affiliated to
K.B.C. North Maharashtra University, Jalgaon.
NAAC Reaccredited Grade - A (CGPA : 3.15 - 3rd Cycle)
UGC honoured "College of Excellence" (2014-2019)
DST(FIST) Assisted College

KNOWLEDGE IS POWER
ESTD. 1945

के. सी. ई. सोसायटीचे
मूळजी जेठा महाविद्यालय
क.ब.चौ. उत्तर महाराष्ट्र विद्यापीठ, जळगाव संलग्नित
'स्वायत्त महाविद्यालय'
नॅकद्वारा पुनर्मानांकित श्रेणी – 'ए' (सी.जी.पी.ए. : ३.१५ – तिसरी फेरी)
विद्यापीठ अनुदान आयोगाद्वारा घोषित 'कॉलेज ऑफ एक्सलन्स' (२०१४-२०१९)
डी.एस.टी. (फीस्ट) अंतर्गत अर्थसहाय्य प्राप्त

Date :- 01/08/2023

NOTIFICATION

Sub :- CBCS Syllabi of M. Sc. in Zoology (Sem. I & II)

Ref. :- Decision of the Academic Council at its meeting held on 26/07/2023.

The Syllabi of M. Sc. in Zoology (First and Second Semesters) as per **NATIONAL EDUCATION POLICY - 2020** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2023-24.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The office of the COE, M. J. College, Jalgaon.
3) The office of the Registrar, M. J. College, Jalgaon.

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समर्थ कॉलनी जवळ, जळगांव – ४२५ ००२. (महाराष्ट्र, भारत) । दूरध्वनी क्र. : +९१ २५७-२२३७३६३, २२३४२८१ । ई-मेलः mjcollege@kces.in । वेबसाईटः mjcollege.kces.in

Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College"

Affiliated to

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon-425001

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STRUCTURE AND SYLLABUS

M.Sc. Honours / Honours with Research (F. Y. M. Sc. Zoology)

as per NEP-2020 Guidelines

[w.e.f. Academic Year: 2023-24]

Preface

Skilled human resource is a prerequisite in higher education, and it is to be acquired through thorough knowledge of theoretical concepts and hands-on laboratory methods of the subject. The MooljiJaitha College (Autonomous) has adopted a department-specific model as per the guidelines of UGC, NEP-2020 and the Government of Maharashtra. The Board of Studies in Zoology and Biotechnology of the college has prepared the syllabus for the first-year postgraduate of Zoology. The syllabus cultivates theoretical and practical know-how of different fields of Zoology. The contents of the syllabus have been prepared to accommodate the fundamental aspects of various disciplines of Zoology and to build the foundation for various applied sectors of Zoology. Besides this, in the first-year postgraduate, the students will be enlightened with the skill related to Phylogeny, systematics identification of Invertebrates and Chordates species with advanced tools and techniques testing, which will enhance students' employability.

The overall curriculum of three / four-year covers general Zoology, taxonomy, animal physiology, quantitative biology, animal ecology, biophysics, tools and techniques in biology, Skills in Scientific Communication and Writing report , and parasitology of various branches of Zoology.Zoology is a branch of Basic Sciences that studies all aspects of animal biology. It includes a wide range of fascinating, extremely varied themes. The advancements of biological sciences necessitates that students of zoology become masters in a variety of related fields. Furthermore, the syllabus is structured to cater to Zoology's present and future needs in the research field, Industrial Sector, Environmental Sector, Entrepreneurship etc., emphasizing imparting hands-on skills. Hence, the curriculum is endowed with more experiments that shall run hand-in-hand with theory. The detailed syllabus of each paper is appended with a list of suggested readings.

Program Outcomes (PO) for M.Sc. Program:

Upon successful completion of the M.Sc. program, student will be able to:

PO No.	PO
1	Student possess an in-depth understanding of advanced theories, concepts, and methodologies in their specific field of study.
2	Student should demonstrate advanced technical skills and proficiency in utilizing specialized equipment, software, and methodologies relevant to their field of study.
3	Student should be capable of critically analyzing complex problems and synthesizing information from various sources.
4	Student should be proficient in effectively communicating scientific information to both technical and non-technical audiences. They should be able to present their experimental findings through oral presentations, scientific writing, and the use of appropriate visual aids.
5	Student should demonstrate leadership qualities and the ability to work effectively as part of a team.
6	Student should have developed advanced research skills and the ability to independently design and conduct rigorous scientific investigations. They should be able to analyze scientific literature,formulate research questions, develop research plans, collect and analyze data, draw valid conclusions and know about IPR.
7	Student should understand and adhere to ethical principles and professional standards in their field.
8	Student should recognize the importance of continuous learning and professional development. They should have the skills and motivation to stay updated with advancements in their field, engage in lifelong learning, and pursue further academic or professional opportunities.

Program Specific Outcome PSO (M.Sc. Zoology):

After completion of this course, students are expected to learn/understand the:

PO No.	PSO
1	**Understanding Invertebrate Biology and Physiology**: Students will acquire comprehensive knowledge of the classification, structure, and function of invertebrates, including their physiological processes related to locomotion, digestion, respiration, and the comparative physiology of excretion and circulation. This will include the ability to interpret evolutionary origins and phylogenetic relationships among invertebrate phyla. And gain the skill about all these from the hands-on experiments through practical.
2	**Application of Ecological and Biostatistical Principles**: Students will develop proficiency in ecological concepts, including the interaction between environment and biota, population dynamics, and the impacts of human activities on ecological systems. Additionally, they will gain expertise in biostatistics, including data management, statistical analysis, and the ethical considerations involved in research, enabling them to critically evaluate scientific studies and effectively communicate statistical findings. Also Know the molecular events, understand the membrane deformations, get knowledge about electron transport, knowledge about electrical properties of membranes and lipid membrane technology. And gain the skill about all these from the hands-on experiments through practical.
3	**Understanding Vertebrate Evolution and Anatomy**: Students will gain knowledge of the evolutionary processes that led to the development of chordates from protochordates, including the phylogenetic evolution of vertebrates. This outcome encompasses understanding the anatomical changes related to vertebrate evolution, such as the origin of jaws and their functional significance in feeding strategies and ecological adaptation. Understanding biological development, gametes, process of fertilization, morphogenesis and organogenesis, placenta and programmed cell death. And gain the skill about all these from the hands-on experiments through practical.
4	**Application of Biological Research Techniques and Communication Skills**: Students will develop proficiency in various biological research techniques, including the use of advanced instrumentation and separation techniques in biology. Additionally, they will acquire skills in scientific communication, including the ability to prepare and present research findings effectively through visual aids, written reports, and oral presentations. Understand diversity of parasites, the identification and diagnosis of parasites, the pathogenesis of parasitic infections, the epidemiology of parasitic diseases, including their geographic distribution, transmission patterns, and risk factors. And gain the skill about all these from the hands-on experiments through practical.
5	**Understanding Reproductive Biology and Genetics**: Students will develop a comprehensive understanding of the reproductive systems of different species, including the anatomy, physiology, and hormonal regulation of male and female reproductive cycles. They will also gain knowledge in genetic principles, such as Mendelian inheritance, gene expression, and the genetic basis of reproductive traits, enabling them to analyze genetic data and diagnose genetic disorders. Compare and contrast DNA replication, transcription, and translation processes. Analyze the impact of mutations in genes involved in these processes. Discuss the importance of gene regulation in cellular function and development. Explain the mechanisms by which drugs can target specific steps in gene expression. And gain the skill about all these from the hands-on experiments through practical.
6	**Fossil Analysis and Wildlife Conservation**: Students will learn to critically evaluate fossil evidence to interpret the geological history of Earth, classify fossils, and understand past animal distribution patterns. Additionally, they will develop skills in wildlife conservation, including conducting independent wildlife surveys, analyzing data on wildlife abundance and diversity, and creating management plans for the conservation of protected areas and threatened species,

	while understanding the ethical and legal aspects of wildlife management. And gain the skill about all these from the hands-on experiments through practical.
7	**Mastery of Nervous System and Sensory Function**: Students will gain practical skills and a deep understanding of the nervous system's functionality, including nerve impulse conduction, sensory coding mechanisms, and receptor functions. They will be able to conduct and interpret sensory tests, applying these skills in clinical and research settings, and will comprehend the cellular mechanisms of hormone action, enhancing their knowledge of the hypothalamo-hypophyseal system and other hormonal pathways. Analyze the potential hazards of various chemicals in our environment, dose-response relationships in assessing toxicity, assess the safety of new chemicals and drugs, by which toxicants enter the body, distribute to different organs, and exert their harmful effects. And gain the skill about all these from the hands-on experiments through practical.
8	**Proficiency in Histological and Forensic Techniques**: Students will demonstrate proficiency in histological techniques, including selecting appropriate microtome types, preparing tissue samples for microscopic examination, and performing specific staining and histochemical procedures. Additionally, they will acquire skills in forensic science, such as collecting, preserving, and analyzing biological evidence, interpreting forensic analyses to assist in investigations, and understanding the importance of maintaining the chain of custody in criminal investigations. And gain the skill about all these from the hands-on experiments through practical.

Credit distribution structure for two years/one-year PG MSc programme

Level	Sem	Major (Core) Subjects		Minor Subjects	OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)				
6.0	I	DSC-1 (4T) DSC-2 (4T) DSC-3 (4T) DSC-4 (2P)	DSE-1(2T) A/B DSE-2(2P) A/B	RM (4T)		22	First-year PG OR One year PG diploma after 3 years UG
	II	DSC-5 (4T) DSC-6 (4T) DSC-7 (4T) DSC-8 (2P)	DSE-3(2T) A/B DSE-4(2P) A/B		OJT/Int (4)	22	
	Cum. Cr.	28	8	4	4	44	
	Exit option: PG diploma (44 Credits) after three-year UG degree						
6.5	III	DSC-9 (4T) DSC-10 (4T) DSC-11 (4T) DSC-12 (2P)	DSE-5(2T) A/B DSE-6(2P) A/B	--	RP (4)	22	Second-year PG after 3 years UG OR PG degree after 4 years UG
	IV	DSC-13 (4T) DSC-14 (4T) DSC-15 (2P) DSC-16 (2P)	DSE-7(2T) A/B DSE-8 (2P) A/B	...	RP (6)	22	
	Cum. Cr.	54	16		4+10	88	
2 Years-4 Sem. PG Degree (80-88 credits) after Three Year UG Degree or 1 Year-2 Sem PG Degree (40-44 credits) after Four Year UG Degree							

Sem- Semester, **DSC**- Department Specific Course, **DSE**- Department Specific Elective, **T**- Theory, **P**- Practical, **RM**- Research Methodology, **OJT**- On Job Training, **Int**- Internship, **RP**- Research Project, **Cum. Cr.** : Cumulative Credits

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
6.0	One-year PG Diploma program after 3 Yr Degree	40	44	2	1
6.5	Two-year master's Degree program After 3-Yr UG Or PG Degree after 4- Yr UG	80	88	4	2

Examination Pattern for MSc

Theory Question Paper Pattern:

- 60 (External) +40 (Internal) for 4 credits
  - External examination will be of three hours duration
  - There shall be 5 questions, each carrying equal marks (12 marks each), while the tentative pattern of question papers shall be as follows;
  - Q1 Attempt any 3 out of 4 sub-questions; each 4 marks
  - Q 2, Q3, Q4 and Q5 Attempt any 2 out of 3 sub-question; each 6 marks.
- 30 (External) +20 (Internal) for 2 credits
  - External examination will be of 1½ hours duration
  - There shall be 3 questions Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. while the tentative pattern of question papers shall be as follows;
  - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
  - Q 2 and Q3 Attempt any 2 out of 3 sub-question; each 6 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous and Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

i. Individual Assignments
ii. Seminars/Classroom Presentations/Quizzes
iii. Group Discussions/Class Discussion/Group Assignments
iv. Case studies/Case lets
v. Participatory and Industry-Integrated Learning/Field visits
vi. Practical activities/Problem Solving Exercises
vii. Participation in Seminars/Academic Events/Symposia, etc.
viii. Mini Projects/Capstone Projects
ix. Book review/Article review/Article preparation
x. Any other academic activity
xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher can decide which units will be assessed using CCEs and which unit will be assessed

based on IAT.
The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations.
The subject teachers must communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours and shall be conducted as scheduled.
- There shall be 05 marks for journal and viva voce. A certified journal is compulsory to appear for practical examination.
- The practical examination will be of a minimum of 3 hours duration and shall be conducted as per schedule for 2 consecutive days in case of practical where incubation conditions and allied aspects are essential.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by the department as per the schedule given.
- For internal practical examination, students must produce the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and department head.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities the faculty assigns during regular practicals. For details, refer to internal theory examination guidelines.
- Finally, 40 (10+30) students' performance will be converted into 20 marks.

Exam Pattern

Theory / Practical	Credit	Internal	External
Theory	**4**	**40**	**60**
Theory	**2**	**20**	**30**
Practical	**4**	**40**	**60**

External Theory Examination (60 marks)

- External examination will be of 3 hours duration for each theory course. There shall be 5 questions, each carrying equal marks (12 marks each), while the tentative pattern of question papers shall be as follows;
- Q1 Attempt any 4 out of 5 sub-questions; every 3 marks.
- Q2, Q3, Q4 attempt any 2 out of 3 sub-questions; each 6 marks.
- Q5 Attempt any 3 out of 4 sub-questions, each 4 marks

External Practical Examination (60 marks):

- Practical examination shall be conducted by the respective department at the end of the semester. Practical examination will be of minimum 3 hours duration and shall be

conducted as per schedule. There shall be 05 marks for journal, 10 marks for *viva-voce*. Certified journal is compulsory to appear for practical examination.

Internal Theory/ Practical Examination (40 marks):

- The student's internal theory assessment by the respective teacher will be comprehensive and continuous, based on a written test/ assignment. The written test may comprise both objective and subjective questions.
- The internal practical examination should be conducted by the respective department according to the schedule given. For the internal practical examination, the student should perform at least one major and one minor experiment and complete a journal.

F. Y. M. Sc. Zoology Course Structure

Semeste	Course Module	Credit	Hours/ Week	TH/ PR	Code	Title
I	DSC	4	4	TH	ZOO-DSC-511	Phylogeny, Systematics of Invertebrates
	DSC	4	4	TH	ZOO-DSC-512	Animal Physiology
	DSC	4	4	TH	ZOO-DSC-513	Biostatistics
	DSE	2	2	TH	ZOO-DSE-514A	Animal Ecology
	DSE	2	2	TH	ZOO-DSE-514B	Biophysics
	DSC	2	**4**	**PR**	ZOO-DSC-515	Practicals Based on ZOO - 511, 512, and 513
	DSE	2	**4**	**PR**	ZOO-DSE-516A	Practicals of Animal Ecology
	DSE	2	**4**	**PR**	ZOO-DSE-516B	Practicals of Biophysics
	DSC	4	4	TH	ZOO-RM-517	Research Methodology
II	DSC	4	4	TH	ZOO-DSC-521	Phylogeny, Systematics of Chordates
	DSC	4	4	TH	ZOO-DSC-522	Tools and Techniques in Biology
	DSC	4	4	TH	ZOO-DSC-523	Developmental Biology
	DSE	2	2	TH	ZOO-DSE-524A	Skill of Scientific communication and report writing
	DSE	2	2	TH	ZOO-DSE-524B	Parasitology
	DSC	2	**4**	**PR**	ZOO-DSC-525	Practicals Based on ZOO - 521, 522, and 523
	DSE	2	**4**	**PR**	ZOO-DSE-526A	Practicals based on ZOO - 524(A)
	DSE	2	**4**	**PR**	ZOO-DSE-526B	Practicals of Parasitology
	DSC	4	**8**	**OJT**	ZOO-OJT-527	On Job Training/ Internship

SEMESTER I

F.Y.M.Sc
Semester-I
ZOO-DSC-511: Phylogeny, Systematics of Invertebrates

Total Hours: 60 **Credits: 4**

Course Objectives	• Understand the meaning and application of biological nomenclature. • To know about the structure and function of invertebrates in relation to locomotion, digestion and respiration. • To learn about the Origin of Invertebrates and Phylogenetic Relationships between Invertebrate Phyla • Understand the structural organization of invertebrates in relation to excretory, nervous and sense organ	
Course Outcomes	After successful completion of this course, students are expected to: • Acquire knowledge about and hierarchical levels of classification of invertebrates. • Understand the structure and function of invertebrates in relation to locomotion, digestion and respiration. • Interpret the origin of invertebrates and phylogenetic relationships between Invertebrate Phyla • Compare structural organization of invertebrates in relation to excretory, nervous and sense organ	
Unit	**Topic**	**Hours**
I	**Principles of Taxonomy** • Introduction to the science of taxonomy; o Rules of nomenclature. o Principles of biological classification; o The species category; o The polytypic species; o Population systematic intraspecific categories. • Methods of Biological classification: o Taxonomic identification, o Methods of taxonomic decisions on species level; o Cytotaxonomy; • Classical and modern methods- o Typological, Phenetics, Evolutionary, Phylogenetic.	15
II	**Structure and function in Invertebrates Locomotion, Nutrition, Digestion and Respiration** • LocomotioninProtozoa, Annelida, Mollusca and Arthropoda • Nutrition and Digestion in Protozoa, Annelida, Mollusca and Arthropoda • Respiration in Protozoa, Annelida, Mollusca and Arthropoda	**15**
III	**Origin of Invertebrates and Phylogenetic interrelationships between Invertebrate phyla.** • Origin of Protists. Prokaryotes and Eukaryotes • Cambrain explosion- causes and consequence • Possible theories of metazoan origin o Symmetry, Coelom and Metamerism o Evolutionary advantages o Porifera, Cnidaria Polymorphism, Ctenophora, Acoelomata, Placozoa, Mesozoa and Pseudocoelomata evolutionary relationships and adaptive modifications only • Phylogenetic of Molluscs and Arthropod • Adaptive Radiation in Molluscs and Annelids.	**15**
IV	**Comparative Structure and Functional Organization of invertebratesin relation to excretory, nervous and sense organ**	**15**

	• Excretory System ○ Structural and functional organization of excretory systems in Annelids, Arthropods, Molluscs and Echinoderms • Nervous System ○ Plan of nervous systems inAnnelids, Arthropods, Molluscs and Echinoderms • Trends in neural evolution • Sense organ ○ Photoreceptors in Annelids, Arthropods, Molluscs and Echinoderms	
Study Resources	• Barrington E.J.W.: Invertebrates, Structure and function, homes Nelson and Sons Ltd., London • Hyman L.H.: The Invertebrate Volume 1 to 8, MacGraw Hill Co. New York • Kotpal R.L.: Protozoa to Echinodermata Series, • Anderson, T. A., Invertebrate Zoology, 2001 (2nd Edn), Oxford University Press, New Delhi. • Pat, W. 2006. Invertebrate Relationships-Patterns in Animal Evolution Cambridge University Press	

F.Y.M.Sc
Semester-I
ZOO-DSC-512: Animal Physiology

Total Hours: 60 **Credits:4**

Course Objectives	• To learn comprehend the fundamental principles of physiology and the role of ions in cellular processes and their regulation • To gain knowledge of different types of muscles and their functions and to understand mechanisms of thermoregulation • Understand the principles of metabolism and the processes of respiration including gas exchange and transport. • Acquire the knowledge of the processes of circulation and the mechanisms of excretion	
Course Outcomes	After successful completion of this course, students are expected to: • Evaluate the role of ions in cellular processes and their regulation. • Apply their understanding of muscle physiology and thermoregulation to explain the adaptations of organisms to extreme temperatures. • Gain knowledge about the comparative physiological concepts of metabolism and respiration. • Able to explain the physiology of circulation and excretion.	
Unit	**Topic**	**Hours**
I	**Introduction and Water Relation and Ionic Regulation** • Importance and scopes of physiology • Branches of physiology • Role of membranes in osmotic and ionic regulation; Role of body fluid • Adaptation to marine habitat; Adaptation to brackish water habitat; Adaptation to • Fresh water habitat; Adaptation to terrestrial habitat	15
II	**Physiology of Muscles and Thermoregulation** • Types: a) Phasic muscles b) Tonic Muscles c) Striated Muscles d) Smooth muscles e) Cardiac muscles; • Chemical Composition of Muscle • Neuromuscular junction; Motor unit; Membrane excitation; • Mechanism of muscle contraction; Sliding filament theory; Control of Muscle contraction • General properties of Muscles • Single muscle twitch • Invertebrate muscle • Tetanus • Homeostasis • Classification of Animals Based on Thermoregulation • Vants Hoff law; Lethal temperature • Thermoregulatory Mechanisms	15
III	**Metabolism and Respiration** • Carbohydrate Metabolism • Lipid metabolism • Protein Metabolism • Mechanism of respiration in man • Tidal volume and Vital capacity • Respiratory pigments: a) Hemoglobin, b) Haemocyanin, c) Haemoerythrin, d) Chlorocruorin, e) Molpadin, f) Pinnaglobin, g) Vanadium, h) Echinochrome • Transport of Gases-Oxygen transportOxygen-Hb dissociation curve • Factors affecting the std dissociation curve,	15

	• Bohr effect • Exchange of gases in lungs and transport of CO2 • Chloride shift • Neural and chemical regulation of respiration.	
IV	**Circulatory System and Excretion** • Closed and open Circulatory system • Types of Circulation: a) Systemic circulation b) Pulmonary circulation • Advantages of Double Circulation; • Types of Heart: Pulsating Heart, Tubular Heart, Chambered Heart, Accessory heart • Physiological types of Hearts: Neurogenic heart and Myogenic heart • Heart Sound; Cardiac cycle; Cardiac output • ECG • Blood vessels: i) Arteries and arterioles ii) Veins and Venules, iii) Microcirculation • Types of excretory Products • Excretory organs in: Invertebrates and Vertebrates • General Structure of Nephron • Metabolism of Nitrogen • Osmoregulation in Invertebrates • Osmoregulation in Vertebrates	15
Study Resources	• Tortora, G. J., and Derrickson, B. (2006). Principle of Anatomy and Physiology, 11th, John Wiley and Sons. Inc., USA. • Hoar, W. S. (1983). General and comparative physiology (No. 591.1 H6 1983). • Chatterjee, C. C. (1992). Human physiology: Volume-I. Medical Allied Agency. • Chatterjee, C. C. (1992). Human physiology: Volume-II. Medical Allied Agency. • Goel, K. A., andSastri, K. V. (1984). A TextBook of animal physiology. RastogiPublications. • Nielsen, K. S. (1964). Animal physiology (Vol. 7). Prentice-Hall of India (Private)Limited. • Bell, G. H., Davidson, J. N., and Scarborough, H. (1959). Textbook of physiology andbiochemistry. Academic Medicine, 34(6), 621. • Withers, P. C. (1992). Comparative animal physiology. Philadelphia: SaundersCollege Pub. • Arora M. P.(2018). Animal Physiology. Himalaya Publishing House Pvt. Ltd. • Sobti, R. C. (2008). Animal physiology. Alpha Sci. International. • Jabde, P. V. (2005). Text Book Of General Physiology. Discovery Publishing House. Berry, A. K. (1981). Textbook of Biochemistry and Animal Physiology: Emkay.	

F.Y.M.Sc
Semester-I
ZOO-DSC-513: Biostatistics

Total Hours: 60 **Credits: 4**

Course Objectives	• Acquire skills in data collection, data entry, and data management techniques specific to biostatistical analysis. • Develop a solid understanding of basic statistical concepts and principles, including measures of central tendency, hypothesis testing, and confidence intervals. • Gain knowledge of different types of data and their appropriate statistical analysis methods, such as categorical data analysis, correlation, regression, and survival analysis. • Apply appropriate statistical tests and methods to analyze different types of research questions and data, such as chi-square tests, t-tests, ANOVA, regression analysis, and survival analysis.	
Course Outcomes	After successful completion of this course, students are expected to: • Proficiency in Statistical Analysis: Students will demonstrate proficiency in applying appropriate statistical analysis methods to biomedical data • Data Management Skills: Students will acquire skills in data collection, data entry, and data management techniques specific to biostatistics. • Critical Evaluation of Research: Students will develop the ability to critically evaluate research studies and assess the appropriateness of statistical methods and analysis. • Effective Communication of Statistical Results: Students will effectively communicate statistical results to both technical and non-technical audiences. • Ethical Considerations and Research Design: Students will understand the ethical considerations and standards associated with biostatistics research, including privacy protection, informed consent, and ethical use of data.	
Unit	**Topic**	**Hours**
I	**Introduction**, **Applications and uses of statistics.** o Meaning of Population, Sample and Sampling, Random sampling. Methods of collection of Data:Systematic random sampling, Stratified random Sampling – SRSWR, SRAWOR o Meaning of variable, discrete variable, continuous variable. • Data Classification: o Some important terms: frequency, relative frequency, classlimits, class-width, inclusive and exclusive method of classification. o Frequency distribution, relative frequency distribution, cumulative Frequency distribution. o Graphical representation of grouped data-Bar diagram, Histogram, frequency polygon,Ogive curves. • Problems and Exercise.	**20**
II	**Measures of central tendency and dispersion:** • Computation of Arithmetic Mean, Mode and Median (for raw data and grouped data) • Computation of Standard Deviation, Standard Error, Variance, and Coefficient of Variation (for raw data and grouped data) • Problems and Exercise.	**10**
III	**Correlation and Regression: -** • Concept of Correlation, types of correlation, scatter diagram. • Karl-Pearson's coefficient of correlation (ungrouped data) and its properties. • Concept of Regression, line arregression, regression coefficients and its properties. • Problems and Exercise.	**10**
IV	**Testing of hypothesis:** • Statistical Hypothesis, Null hypothesis, Alternative hypothesis, critical region, acceptance region, Type I error, Type II error, Level of significance, one tailed	**20**

	and two tailed tests. • Tests Based on large samples : test of significance of mean, test of significance of difference of means. • Tests based on small samples: o t-test: Testing single population mean, two population means, paired t-test. o $\chi 2$–test for testing independence of attributes, single population variance. o F-Test for testing two population variances. • Analysis of variance: o Meaning of ANOVA, one-way and two-way classification. o Problems and Exercise.	
Study Resources	• N. Gurumani (2000). An introduction to biostatistics, 2nd revised edition, MJP publishers, Chennai 600 005 • Irfan Ali Khan and Atiya Khanum (2004) - Fundamentals of biostatistics, 3rd edition, Ukaaz publication, Hyderabad • Dr. Satguru Prasad (2012) - Fundamentals of biostatistics [Biometry], Emkay publications, Delhi 110 051 • B.K.Mahajan (2016) - Methods in Biostatistics, Jaypee Brothers, Medical publishers (p) ltd. New Delhi, 110 002 • J.V.Dixit (2017) - Principles and practice of Biostatistics, M/S Banarasi Das Bhanot; seventh edition	

F.Y.M.Sc
Semester-I
ZOO-DSE-514(A): Animal Ecology

Total Hours: 30 **Credits: 2**

Course Objectives	• To learn the basic concepts and scope of ecology • To gain knowledge of interaction between environment and biota. • Understand the values of community characteristics and different types of ecosystems. • Understand the knowledge about environmental ethics and how to control pollution	
Course Outcomes	After successful completion of this course, students are expected to: • Aware about the basic concepts and scope of ecology • Acquire the knowledge of interaction between environment and biota. • Gain knowledge about characteristics of population and its dynamics and different types of ecosystems. • Understanding of ecological systems can help society to know the consequences of human activity withenvironment ethics	
Unit	**Topic**	**Hours**
I	**Introduction, history and scope of Ecology;** • Life supporting properties of water; • Physical factors: temperature, light, pH and salinity, thermal stratification, • Factors influencing light penetration in water; • Concept of limiting factors and laws governing these factors.	7
II	**Unitary and Modular populations, Unique and group attributes of population:** • Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal; • Exponential and logistic growth, equation and patterns, r and K strategies, • Population regulation: density-dependent and independent factors; • Ecological niche; Gause's Principle with laboratory and field examples.	8
III	**Community characteristics** • Dominance, diversity, species richness, abundance, stratification • Ecotone and edge effect; • Types of interaction: o Inter and intra-specific • Ecological succession • Types of ecosystem with detailed account of pond, desert and forest ecosystems • Detritus and grazing food chains, food web, energy flow through ecosystem; Ecological pyramids and Ecological efficiencies; • Biogeochemical cycles: C, N, P and S cycles.	8
IV	**Environmental ethics;** • Natural resources: Mineral, water and forest, their significance and conservation • Types of biodiversity, Hotspots, benefit and threat of conservation strategies • Application of ecology in wild life management, Conservation of biological diversity: o National parks, Sanctuaries, Biosphere reserve. • Pollution: Air, water and noise pollution and their control	7
Study Resources	• Benton, A.H. and Werner, W.E 1976. Field Biology and Ecology. Tata McGraw Hill, New Delhi. Boitani, L and T.K.Fuller2000.Research Techniques in Animal Ecology. Columbia University Press, USA. • Daniel, C.D 2010.Environmental Science.(8thedn.).Jones and Bartlett Publishers. Misra, S P and Pandey S. N.2009. Essential Environmental Studies. AneBooksPvt. Ltd. Odum, E P. 2017.Fundamentals of Ecology, India edition. • Peter Stilling, 2012. Ecology: Global Insights and Investigations. The McGraw-Hill	

	companies, New York. • Peter, H.R., Berg, L.R., and Hassenzahl, D.M. 2008. Environment. (5thedn.).John Wiley Publishers. Pianka, E. R. 1981. Competition and Niche Theory in "Theoretical Ecology". (2ndedn.).In: May, R.M. (Ed.). Blackwell, London. • Rana,S.V.S. 2009.Essentials of Ecology and Environmental Science.(4thedn.). PHI learning Pvt. Ltd., New Delhi • Simons, I.G. 1981. Ecology of Natural Resources. Edwin-Arnold Ltd., London. • Robert Leo Smith and Thomas M Smith 2001. Ecology and Field biology (6th Edition), New York.

F.Y.M.Sc
Semester-I
ZOO-DSE-514 (B): Biophysics

Total Hours: 30 **Credits: 2**

Course Objectives	• To understand cell-cell communication strategies of chemical signaling • To understand the principles and working mechanisms of different instruments. • To learn transport system with non-electrolytes and electrolytes. • To get acquainted with electrical properties of membranes and lipid membrane technology	
Course Outcomes	After successful completion of this course, students are expected to: • Know the molecular events involved during sperm-ovum interaction. • Understand the membrane deformations • Get knowledge about electron transport and oxidative phosporylation: • Acquired knowledge about electrical properties of membranes and lipid membrane technology	
Unit	**Topic**	**Hours**
I	**Cell-Cell Communication Strategies of chemical signaling** • Endocrine, paracrine and synaptic. • Signaling mediated by intracellular receptors: mechanism of transduction by cell surface receptor protein • Role of calmodulin • Calcium and cyclic nucleotides phosphoinositol cycle • Sodium proton exchanger • Molecular events involved during sperm-ovum (egg) interaction • Implications and the mechanisms of sperm-zone interaction • Factors influencing sperm –ovum (egg) recognition and binding • Morphological intercellular connections in different types of cell and tissues	8
II	**Physics of Membrane** • Membrane deformations: o Bending, sharing shape fluctuation o Differential geometry of membranes o Elastic properties o Elastic constants o Charge-induced microstructures and domain. o Hysteresis of domains formation o Lateral phase separation o Critical concentrations fluctuation selective lipid protein interactions o Membrane melting.	7
III	**Membrane transport** • Transport system with non-electrolytes and electrolytes. o Transport with chemical reaction system: Primary and secondary active transport. o Transports of molecules by simple and facilitated diffusion o Transport by flux coupling. o Transport by phosphotransferase system o Transport by vesicle formation o Ionophores o Epithelial transport • **Electron Transport and oxidative phosporylation:** o Reduction potential and free energy changes in redox reaction o Organization of electron transport chain o Chemiosmotic Coupling o Proton gradient drive and synthesis of ATP o P/O ratio for oxidative phosporylation	8

	○ Cytosolic NADH electron feeding into electron transfer.	
IV	**Electrical properties of membranes and Lipid Membrane Technology** ○ Cell surface charge ○ Resting membrane potential ○ Action potential ○ Properties of action potential ○ Nernst equation ○ Goldman equation ○ Voltage clamp ○ Na+, K+ conductance ○ Membrane impedance and capacitance ○ Transmembrane potential ○ Zeta, stern and total electrochemical potential ○ Chemical synapse ○ Post synaptic potential • **Liposomes:** ○ small and large unilamellar and multilamellar vesicles ○ Planner lipid bilayer ○ Application of liposomes in biology and medicine.	7
Study Resources	• A. D.; Frankenhaeu Butler, J. A. V. (Ed); Noble, D. (Ed); Naftalin, L.; Bangham (1968) • Advances in Biophysics, Vol 18. Progress In Biophysics And Molecular Biology, Volume 18. • Biochemistry by Strayer • Biophysical Aspects of Transmembrane signaling, Sandor D (2005), Springer • Biophysics, Hopp, Lohman, Mark and Ziegler • Biophysics, Vasant Pattabhi, Gautam (2002), Narosa • Biomembrane structure and Function, Chapman Introduction to Biological Membrane, Jain R K • Introduction to Biological Membrane, D Chapman • Molecular and Cellular Biology, D Roberties. • Molecular and Cellular Biophysics, Meyer B Jackson (2006) Cambridge) • Molecular and Cellular Biophysics, Meyer B Jackson (2006), Cambridge). • Molecular Biology , D Roberties, 8th Ed. SAE • Molecular Biology of the Cell, Bruce Albert, Alexander Jhonson et al (2002). • Taylor and Francis Group. • Molecular Cell Biology, Lodish • Text Book of Physiology, Guyton and Hall, 11th Ed. 2006 • The Cell Molecular Approach, G Cooper and R Hausman (2007) ASM Press	

F.Y.M.Sc
Semester-I
ZOO-DSC-515: Practicals of based on ZOO - 511, 512, and 513

Total Hours: 60 **Credits:2**

Course Objectives	• Understand the classification of different invertebrate forms • Learn aspects of the internal body organization using relevant conventions, terminology. • To learn about various methods for anatomical, and behavioural adaptations of organisms living in different habitats • To study comprehend the fundamental principles of physiology	
Course Outcomes	After successful completion of this course, students are expected to: • Acquire knowledge about classification of different invertebrate forms • Learn about taxonomy in identification of species and internal organization of invertebrate • Able to identify common species available in and around their region. • Understand about the comparative physiological process on metabolism	
Sr. No.	**Topic Particular**	**Hours**
1	Classification of Invertebrates of differentphylum up to Class (Annelida to Echinodermata -one example from each Class)	4
2	Composition assessment of taxonomical diversity or biodiversity of invertebrates in habitat from different ecosystems	4
3	Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem. (E)	4
4	Comparative study of Invertebrates in relation locomotion, digestion, respiration, excretion and nervous sytem (Annelida to Echinodermata -one example from each phylum)	4
5	Field visit to Zoological park/museum.	4
6	Study of adaption in brackish, fresh, marine water and terrestrial habitat.	4
7	Study of different types of muscles.	4
8	Isolation of Haemoglobin. (E)	4
9	Determination of oxygen consumption of any suitable animal. (E)	4
10	Determination of GFR. (E)	4
11	Construction of frequency distribution and its graphical representation-Bar diagram, Histogram, Pi diagram,Frequency curve, Frequency polygon, Ogives. (E)	4
12	Computation of Arithmetic Mean, Mode, and Median(ungrouped and grouped data).	4
13	Computation of Standard Deviation, Variance, andCoefficient of Variation (ungrouped and grouped data).	4
14	Correlation and Regression (ungrouped data).	4
15	Problems on Large sample tests, Small sample tests, $\chi 2$ – test,F-Test and ANOVA	4
Study Resources	• Ruppert and Barnes, R. D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition. • Barnes, R. S. K., Calow, P., Olive, P. J. W., Golding, D. W. and Spicer, J. I. (2002).The Invertebrates: A New Synthesis, III Edition, Blackwell Science • Hall B.K. and Hallgrimsson B.(2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc. • Chatterjee, C. C. (1992). Human physiology: Volume-I. Medical Allied Agency. • Chatterjee, C. C. (1992). Human physiology: Volume-II. Medical Allied	

	Agency. • Goel, K. A., andSastri, K. V. (1984). A TextBook of animal physiology. Rastogi publications. • Nielsen, K. S. (1964). Animal physiology (Vol. 7). Prentice-Hall of India (Private)Limited. • Bell, G. H., Davidson, J. N., and Scarborough, H. (1959). Textbook of physiology and biochemistry. Academic Medicine, 34(6), 621. • Gurumani N. (2000) - An introduction to biostatistics, 2nd revised edition, MJP publishers, Chennai 600 005 • Irfan Ali Khan and Atiya Khanum (2004) - Fundamentals of biostatistics, 3rd edition, Ukaaz publication, Hyderabad • Satguru Prasad (2012) - Fundamentals of biostatistics [Biometry], Emkay publications, Delhi 110 051 • B.K.Mahajan (2016) - Methods in Biostatistics, Jaypee Brothers, Medical publishers (p) ltd. New Delhi, 110 002 • Dixit J.V. (2017) - Principles and practice of Biostatistics, M/S Banarasi Das Bhanot; seventh edition

F.Y.M.Sc
Semester-I
ZOO-DSE-516(A):Practicals of Animal Ecology

Total Hours:60 **Credits:2**

Course Objectives	• Understand the basic concepts of ecology, different types of ecosystems, outline community organization and its structure. • Learn aspects of the internal body organization using relevant conventions, terminology. • To learn about various methods for anatomical, and behavioural adaptations of organisms living in different habitats	
Course Outcomes	After successful completion of this course, students are expected to: • Understand classification of different invertebrate forms • Acquire knowledge about taxonomy in identification of species and internal organization of invertebrate • Able to identify common species available in and around their region.	
Sr. No.	**Topic Particular**	**Hours**
1	Identification and interpretation of aquatic and terrestrial food chains and food webs	4
2	Study of sandy fauna and their adaptation.	4
3	Study of muddy fauna and their adaptation.	4
4	Study of rocky fauna and their adaptation.	4
5	Study of deep sea fauna and their adaptation.	4
6	Study of freshwater fauna and their adaptation.	4
7	Study of ecosystem in a glass trough.	4
8	Calculation of Water Quality Index (WQI) using 9 parameters	4
9	Estimation of BOD in water samples. (E)	4
10	Estimation of COD in water samples. (E)	4
11	Estimation of total alkalinity of water. (E)	4
12	Study of animal community structure by quadrate method (Field or Simulation).	4
13	Determination of density, frequency and abundance of species by quadrat method. (E)	4
14	Effect of pollutants on primary productivity.	4
15	Visit to any one ecosystem.	4
Study Resources	• Anderson, D.T (Ed) 1988: Invertebrate Zoology, Oxford University Press. • Colinvaux, P. A. (1993). Introduction to Ecology. II Edition. Wiley, John and Sons,Inc. • Krebs, C. J. (2001). Ecology: The Experimental Analysis of Distribution andAbundance, 6th Edition, ©2009, Pearson • Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole • Robert Leo Smith Ecology and field biology Harper and Row publisher • Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press • Sharma P.D. (2002) Ecology and Environment, Himalaya Publication	

F.Y.M.Sc
Semester-I
ZOO-DSE-516(B): Practicals of Biophysics

Total Hours:60 **Credits:2**

Course Objectives	• Gain proficiency in using different types of microscopes, including bright field, phase contrast, fluorescent, and polarization microscopes. • Develop skills in identifying and classifying gram-positive and gram-negative organisms, and observing cellular processes such as growth, viability, and division. • Understand and perform techniques to observe and analyze cell death, DNA-protein interactions, and fluorescence properties. • Acquire practical knowledge in studying blood cell counts, thermal denaturation of biomolecules, and mutarotation of glucose and amino acids.	
Course Outcomes	After successful completion of this course, students are expected to: • Demonstrate the ability to operate and distinguish between bright field, phase contrast, fluorescent, and polarization microscopes for various biological applications. • Classify microorganisms as gram-positive or gram-negative, and effectively use colony forming assays and dye exclusion methods to assess cell growth, viability, and division. • Observe and interpret the effects of physical and chemical agents on cell death, and study DNA-protein interactions using fluorimetry and other techniques. • Perform accurate blood cell counts (RBC, WBC, DLC), analyze thermal denaturation of DNA and proteins, and understand the principles of fluorescence sensitivity, quenching, and mutarotation of biomolecules. Additionally, demonstrate competence in identifying C-terminal and N-terminal amino acids and preparing detailed reports from scientific institute visits.	
Sr. No.	**Topic**	**Hours**
1	Microscopy: Familiarization with bright field, phase contrast, fluorescent, polarization microscopes.	4
2	Classification of gram –ve and +ve ogananisms.	4
3	Observe cell growth/ survival by colony forming assay.	4
4	Estimation of cell viability by dye exclusion and colony formation assay. (E)	4
5	Observe cell death by physical and chemical agents.	4
6	Observe cell division by Mitosis and Meiosis. (E)	4
7	Study of RBCs, WBC and DLC count. (E)	4
8	Study of thermal denaturation of DNA and protein. (E)	4
9	Mutarotation of glucose and amino acids.	4
10	Study of DNA-Protein interaction using fluourimetry.	4
11	Study of fluorescence sensitivity and quenching.	4
12	Absorption spectra of Hb, DNA, RNA etc.	4
13	Study of interaction of acridene orange with DNA.	4
14	Identification of C-terminal and N terminal amino acid.	4
15	Visit to scientific institute.	4
Study Resources	• KeshavTrehan (1990) Biotechnology. Wiley Estern Limited, Bangalore. • T. Poddar, S. Mukhopadhyay, S. K. Das- An Advanced Laboratory Manual Of Zoology, MACMILLAN. • Keith Wilson, John Walker Principles and Techniques of PracticalBiochemistry (Wilson, Principles and Techniques of Practical Biochemistry	

F.Y.M.Sc
Semester-I
ZOO-RM-517: Research Methodology

Total Hours: 60 **Credits: 4**

Course Objectives	• Do close textual analysis of literary works • Do critical analysis and interpretation • Acquire significant knowledge on various aspects related to scientific paper writing and paper presentation skills. • Acquire significant knowledge on various aspects related to IPR and its regulations.	
Course Outcomes	After successful completion of this course, students are expected to: • Understood how do to the literature survey about a particular scientific problem. • Understood the digital sources available for the literature collection. • Understood the methods of doing scientific research and how to write scientific papers. • Learned about the data analysis and presentation skills.	
Unit	**Topic**	**Hours**
I	**Foundations of Research** • Meaning, Objectives, Motivation • Research Methods vs Methodology • Types of Research o Analytical vs Descriptive o Quantitative vs Qualitative o Basic vs Applied o Conceptual vs Empirical Research **Steps in the Scientific Method** o Identification of research problem, o Formulation of research hypothesis, o Testing the hypothesis using experiments or surveys	15
II	**Research Design** • Meaning of research design, • Need of research design, • Features of good design, • Important concepts of research design o Observation and facts o Prediction and explanation o Development of Model • Developing a research plan by using o Problem identification o Experimentation o Determining experimental and sample design	15
III	**Literature review** • Importance of literature review in defining a problem • Literature review o Primary and secondary sources o reviews, treatise, monographs-patents, web as a source, searching the web o Critical literature review o Identifying gap areas from literature review o Development of working hypothesis **Data collection and Analysis** • Observation and Collection of Data, • Methods of data collection. • Sampling Methods,	15

	• Data Processing and analysis Stratergies	
IV	**Ethical Issues** • Intellectual property Rights, • Commercialization, • Copy Right, • Royalty, • Patent law, • Plagiarism, • Citation, • Impact factor • h-index paper • Acknowledgement	15
Study Resources	• Graziano, A. M., and Raulin, M. L. (1993). Research methods: A process of inquiry. HarperCollins College Publishers. • Walliman, N. (2011). Research theory, Research methods: the basics.Taylor and Francis, London, New York • Wadehra, B. L. (2006). Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications: Including Semiconductor Integrated Circuits and Layout-design; Protection of Plant Varieties and TRIPS. Universal Law Publishing Company. • Kothari, C. R. (2009). Research methodology: new age international 2nd edition. • Coley, S. M., andScheinberg, C. A. (2008). Proposal writing: effective grantsmanship. Sage. • Anthony, M, Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon. • Walliman, N. 2011. Research Methods- The Basics. Taylor and Francis, London, New York.	

SEMESTER II

F.Y.M.Sc
Semester-II
ZOO-DSC-521: Phylogeny, Systematics of Chordates

Total Hours: 60 **Credits: 4**

Course Objectives	• To learn the evolution of chordates from protochordates. • To know about the origin of fishes and amphibians evolved from pisces. • To learn about the anatomy of vertebrates in perception to phylogenetic evolution • Understand the development of vertebral column in various tetrapods	
Course Outcomes	After successful completion of this course, students are expected to: • Identify the evolution of chordates from protochordates. • Understand the anatomy of vertebrates in perception to phylogenetic evolution • Acquire the phylogenetic relationships of each vertebrate between the conquest of land by reptiles • Interpret the functional and evolutionary significance of origin of jawin relation to feeding.	
Unit	**Topic**	**Hours**
I	**Introduction** • Concept of Protochordata, Cephalochordata and Urochordata; Ostracoderms: • Silurian and Devonian Ostracoderms. Evolutionary Position of Ostracoderms. • Placoderms: Origin of Jaws- Placoderms as ancient experiments in the evolution of the jawed vertebrates. • Structural peculiarities of Cyclostomes	15
II	**Overview of fish phylogeny-** • Chondrichthyes: Fossil history of Chondrichthyes • Tendencies in Elasmobranch evolution • Actinopterygii: Origin and evolution • Adaptive radiation of bony fishes • Structural and Functional adaptations of fishes • Evolution of modern Amphibians, diversity, distribution, status and threats • Adaptive radiation in Amphibia • Crossopterigians- A blueprint	**15**
III	**Origin of Reptiles, Aves and Mammals Reptiles –** • Evolution of Reptilia. • Saurischian and Ornithischian Dinosaurs • Rhynocephalia- Adaptive radiation of Reptiles. • Conquest of land by Seymouria and related forms • Skull of reptiles and its importance in biosystematics. • Mesozoic world of reptiles and extinction. • Origin of birds: Fossil History of Birds. • Palate in birds. Birds as glorified reptiles. • Class Mammalia: Prototheria, Metatheria and Eutheria. • Phylogeny of Mammalian orders. • Adaptive radiation in mammals. • Evolution of man-relation of man with other primates, fossilrecord of man's ancestry, • Sphenodon as a living fossil.	**15**
IV	**Development, structure and functions of vertebrate integumentary system and its derivatives** • Origin and evolution of paired fins and limbs. • Respiratory system:	**15**

	○ Characters of respiratory tissue, external and internal respiration. • Evolution of aortic arches and portal systems. • Blood circulation in various vertebrates groups. ○ Heart and circulation in foetal and neonatal mammals. • Evolution of portal systems. • Special senses: Vomero-nasal organs in reptiles, electroreception in fish. • Comparative anatomy of brain and spinal cord (CNS), peripheral and autonomous nervous system and lateral line system. • Comparative account of electroreception.	
Study Resources	• Colbert, E. H. 1969 Evolution of Vertebrates John Wiley and Sons Inc, New York • Hobart M. Smith, 1960.Evolution of Chordate Structure, Holt, Rinehart and Winston Inc. New York. • Holstead, 1969, The pattern of Vertebrate evolution, Freeman and Co. San Francisco. USA. • Hyman L.H.: The vertebrate, MacGraw Hill Co. New York • Kotpal R.L.: Vertevbrates	

F.Y.M.Sc
Semester-II
ZOO-DSC-522: Tools and Technique in Biology

Total Hours: 60 **Credits: 4**

Course Objectives	• To understand different tools and techniques applicable in biological research including various types of microscopes centrifuges, electrophoresis, chromatography etc. • To understand the principles and working mechanisms of different instruments • To learn media preparation and sterilization method • To get acquainted with Cytological and histological techniques	
Course Outcomes	After successful completion of this course, students are expected to: • Know the different tools and techniques used in biological research. • Know the uses of instruments. • Get knowledge about separation technique in biology • Develop skills of advanced instrumentation.	
Unit	**Topic**	**Hours**
I	**Principle, and applications of following instruments** • Microscope: Light, phase contrast, interference, fluorescence, polarization, Inverted and electron microscopy. • Principles and Uses of Balances • ESR and NMR spectrometers.	15
II	**Principle, and applications of following instruments** • UV-Vis spectrophotometer, • Colorimeter • Fluorimeter • Electrophoresis: o Principle o types and applications of agrose gel electrophoresis o SDS and PAGE electrophoresis • Radioactivity: Radioisotopes, half life units, Geiger Muller counter, gamma counter and scintillation, safety guidelines	15
III	**Centrifuge** • Basic principle, type analytical and preparative centrifuges, different density gradient centrifuge and analytical with its application • Incubator, hot air oven and autoclave: Principle, instrument and its application. • pH meter: Principle types, types of electrodes and application. • Freezers, coolers, platelet agitators, cryo thawing baths. • Cell culture techniques o Design and functioning of tissue culture laboratory o Cell proliferation measurement o Cell viability testing o Culture media preparation and cell harvesting methods	15
IV	**Separation techniques in biology** • Molecular separation by chromatography • Precipitation. • Organelles separation by centrifugation • Cell separation by flow cytometry • Density gradient centrifugation • Unit gravity centrifugation • Affinity adsorption • Anchorage base techniques. • Immunological techniques based on antigen-antibody interaction – Principle and applications. • Biosensors.	15

Study Resources	• Plummer, L: Practical Biochemistry Tata McGraw-Hill. • Bullock, J. D., Kristiansen (1987) B.- Basic Biotechnology academic press, New York. • Prave, P. Faust, V., Sitting, W andSukatsch, D.A.-(1987) Fundamental ofBiotechnology, VCL Publishers, New York. • Spier, R. E. and Griffins, J.B.(1985) - Animal Cell Biotechnology, Vol. IandII,AcademicPress,Orlande. • KeshavTrehan (1990) Biotechnology. Wiley Estern Limited, Bangalore. • D. B. Tembhare- Techniques in Life Sciences, Himalaya Publishing House. • T. Poddar, S. Mukhopadhyay, S. K. Das- An Advanced Laboratory Manual Of Zoology, MACMILLAN. • Keith Wilson, John Walker Principles and Techniques of PracticalBiochemistry (Wilson, Principles and Techniques of Practical Biochemistry

F.Y.M.Sc
Semester-II
ZOO-DSC-523: Developmental Biology

Total Hours: 60 **Credits: 4**

Course Objectives	• To understand the basic concepts of development. • To comprehend the processes of gametogenesis, fertilization and early development. • To understand the concepts of morphogenesis and organogenesis. • To understand the structure and function of the placenta.	
Course Outcomes	After successful completion of this course, students are expected to: • Develop a fundamental understanding of the principles involved in biological development. • Explore the formation of gametes, process of fertilization. • Understand the concepts of morphogenesis and organogenesis in animal development. • Describe the development and formation of the placenta and the molecular mechanisms and signaling pathways involved in programmed cell death.	
Unit	**Topic**	**Hours**
I	**Basic concepts of development** • Potency, commitment, specification, induction, competence, determination anddifferentiation; morphogenetic gradients; cell fate and cell lineages; stem cells;genomic equivalence and the cytoplasmic determinants; imprinting; mutants andtransgenics in analysis of development. **Gametogenesis** • Spermatogenesis and Ogenesis.	**15**
II	**Fertilization and early development** • Cell surface molecules in sperm-egg recognition in animals. • Embryo sac development; zygote formation. • Cleavage. • Blastula formation. • Gastrulation and formation of germ layers in animals. • Embryogenesis.	**15**
III	**Morphogenesis and organogenesis in animals** • Cell aggregation and differentiation in *Dictyostelium*. • Axes and pattern formation in *Drosophila*, amphibia and chick. • Organogenesis – vulva formation in *Caenorhabditis elegans*, Eye lens induction, limb development • Differentiation of neurons, • Post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination	**15**
IV	**Placenta and Programmed cell death, aging, senescence, Regeneration** • Definition and functions of placenta, • Types of placenta in Mammals – o With reference to morphological peculiarities – i] Deciduate, ii] Indeciduate and iii] Contra-deciduate placenta. o With reference to the foetal and maternal tissue involved – i] Diffuse, ii]Cotyledonary, iii] Zonary and iv] Decidual; o With reference to histological peculiarities –	**15**

	i] Epithelio-chorial ii] Syndesmo-chorial iii] Endothelio-chorial iv] Haemo-chorial, v] Hemo-endothelial placenta. • Apoptosis, Senescence, Theories of aging - Programmed theories (ex.Programmed senescence theory, Telomeric theory,) and Error theories (ex. Free radical theory) • Regeneration	
Study Resources	• Gilbert Scott:Developmental Biology 2020 (12th Edition) Sinauer Associates, an imprint of Oxford University Press • Lewis Wolpert, Cheryll Tickle, Alfonso Martinez Arias: Principles of Development, 2019 (6th Edition), Oxford University Press • Boris I. Balinsky: An Introduction to Embryology 1981 (5th Edition) Saunders College Publishing • N.J. Berrill: Developmental Biology 1971 McGraw-Hill • C.H. Waddington: An Introduction to Modern Genetics 1939 Allen and Unwin	

F.Y.M.Sc
Semester-II
ZOO-DSE-524(A): Skill of Scientific communication and report writing

Total Hours: 30 **Credits: 2**

Course Objectives	• Understand the techniques to improve communication • Identify the general communication principles for oral and presentation skill • To learn and practise how to write a research report • Get knowledge about use of visual aid for effective presentation	
Course Outcomes	After successful completion of this course, students are expected to: • Develop a fundamental techniques of communication skill • Acqurie principles of scientific communication for oral and presentation skill • To inculcate scientific temper through communication for development through write a research report • Interpret use of visual aid for effective presentation by PPT and Poster	
Unit	**Topic**	**Hours**
I	**Nature and scope of communication:** • Theory, concept and meaningof communication, • Objectives of communication, effective communication, • Global communication • Techniques to improve communication: o Speaking (phonetics), o Writing communication –definition characteristics, objectives, structure of communication effective written communication, o Reading, reading skills, techniques of improving retention, with reading strategy o Listening: definition, personal characters and effective listening, introduction to modern communication media	**8**
II	**Conferencing**– • Introduction, importance techniques, media • Oral communication: o effective communication, o characteristics of verbal or oral communication, o speaking skill and group discussion • Presentation skill: o planning, audience, purpose, time subject pattern o preparing drafting talk o practicing o presentation to different group	**7**
III	**Writing a research report:** o Purpose of writing research report of dissertation and thesis, o Style and structure of research report, o Preliminary section, main body of the report, - o Introduction, review of literature, methods of study, results and analysis of data, summary, suggestion and conclusion of data, reference section, • General precautions, editing and correction, final evaluation of research report • IMMRAD pattern of research report	**8**
IV	**Use of visual aid for effective presentation** • Synopsis, summary, abstract, tables, graphs, power point presentation • Poster presentation: title, author, affiliation, introduction material and methods, results, summary selection of appropriate Font size, table, figure etc.	**7**
Study Resources	• Dr. Nageshwar Rao and Dr. Rajendra P. Das: Communication Skills, Himalaya Publishing House 2005	

	• Margerson, J.E.: The Art of effective communication, Excel Books New Delhi • Richard, W. Clark and Barbara, L. Clinton: Effective Speech Communication, MacMillan, Mac Graw Hill, New York, 1999 • N. Gurumani, Research Methodology for biological sciences, MJP publishers, Chennai • Gopen, G.D. and Swan J..A. The Science of Writing, American Scientist, 1990 • Hall, G.M. How to write a paper, By Word publication, 1996

F.Y.M.Sc
Semester-II
ZOO-DSE-524(B): Parasitology

Total Hours: 30 **Credits: 2**

Course Objectives	• Develop a fundamental understanding of the concepts and principles of parasitology, including the classification, life cycles, and morphology of parasites. • Acquire knowledge and skills to identify different types of parasites, including protozoa, helminths, and arthropods, based on their morphological features, life stages, and diagnostic techniques. • Learn about the classification systems used in parasitology and understand the characteristics that distinguish different parasite groups. • Learn to recognize and interpret the clinical manifestations associated with common parasitic infections, including gastrointestinal, respiratory, and vector-borne diseases.	
Course Outcomes	After successful completion of this course, students are expected to: • Students will demonstrate knowledge of the diversity of parasites, including protozoa, helminths, and arthropods, and their classification based on morphological features, life cycles, and diagnostic techniques. • Students will develop skills in the identification and diagnosis of parasites using laboratory techniques such as microscopy, serology, molecular assays, and immunodiagnostic tests. • Students will gain an understanding of the pathogenesis of parasitic infections and the mechanisms by which parasites cause disease in their hosts. • Students will acquire knowledge of the epidemiology of parasitic diseases, including their geographic distribution, transmission patterns, and risk factors.	
Unit	**Topic**	**Hours**
I	**Introduction, scope and importance of Parasitology** • Definition: host, parasite, vector, Animal association, Intraspecific, Interspecific, Mutualism, Commensalism, Parasitism **Types of parasites** • According to habitat, Ecto parasites, Endo parasites- Gut, Haemo, Tissue and Lymph parasites, Degree of Parasitism- Temporary, permanent, facultative and obligatory	8
II	• **Types of hosts** • Definitive, intermediate, paratenic, reservoir and accidental host, Mosquitoes as a Vector in the transmission of diseases- Malaria, Dengue fever, Elephantiasis, Yellow fever Chikungunia and control of mosquitoes., Host specificity- Definition and characters, Hyper infestation, hyper parasitism and parasite mix. • Parasitic adaptations • Structural, Physiological	**7**
III	**Effects of parasites on Hosts** • Mechanical, Nutritional, Obstructive and Biological (Sacculina) **Host reactions to parasites** • Resistance, Compatibility, Immunity, Cellular reactions, Tissue reactions	**7**
IV	**Study of the following parasites** with reference to Systematic position, Habits, Habitat, Morphology, life cycle, pathogenicity, prevention and control measures • *Plasmodium vivax, Fasciola hepatica, Wuchereria bancrofti, Peduculus humanis*	**8**
Study Resources	• Chatterjee K. D. (1969) –Parasitology (Protozoology and Helminthology) • Cheng T.C. (1964) - The Biology of animal parasites, Saunders International Student Edition. • Dawes B. (1946) - The Invertebrates Vol II, McGraw Hill, New York. • Daly, H. V., J. T. Doyen and P.R. Ehrilch (1981) "Introduction to Insect Biology and Diversity" International Student Edn. McGraw- Hill, Kogakusha, Japan.	

F.Y.M.Sc
Semester-II
ZOO-DSC-525: Practicals based on ZOO - 521, 522, and 523

Total Hours: 60 **Credits: 2**

Course Objectives	• To learn the classification of different chordates forms • To familiarize with the various types of instrument used in zoology laboratory • To understand the various types of eggs and placenta found in different organisms. • To understand the morphogenetic movements that occur during the development of frogs and process of regeneration in Planaria	
Course Outcomes	After successful completion of this course, students are expected to: • Understand the evolutionary relationships and taxonomic classification of animals • Acquire knowledge about how to handle instruments safely • Demonstrate an understanding of the processes of cleavage, blastula formation, and gastrulation in different organisms. • Apply appropriate techniques for preparation of permanent slides of chick embryos at different developmental stages.	
Sr. No.	**Topic Particular**	**Hours**
1	Classification of Chordates of different phylum up to Class (Protochorataa to Mammals-one example from each Class)	4
2	Composition assessment of taxonomical diversity or biodiversity of vertebrates in habitat from different ecosystems	4
3	Construction of taxonomic tree from the character in vertebrate animal groups.	4
4	Comparative study of chordates in relation to Structure of Heart and Brain (Pisces to Mammals-one example from each class)	4
5	Field visit to Zoological park/museum	4
6	Calibration of pH meter.	4
7	Study of Compound and Phase Contrast microscopy.	4
8	Cell fractionation by using density gradient centrifuge (any suitable gradient)	4
9	Test Cell viability and Counting.	4
10	Determination of Molecular Weight of DNA by electrophoresis	4
11	Study of different types of eggs and placenta.	4
12	Study of cleavages, blastula and gastrula of - Amphioxus, frog, birds and mammals	4
13	Study of morphogenetic movements during frog development.	4
14	Regeneration in Planaria.	4
15	Permanent preparation of chick embryo.	4
Study Resources	• Verma, P.S. 2000 (10th edn).A Manual of Practical Zoology: Chordates, S.Chand publications. • Shahla Yasmin, Reshma Sinha and Sumeet Ranjan (2022).Practical Zoology, Today's and Tomorrows Printers and Publisher. • Kotpal R.L.: Practical Zoology • Freifelder D. (1983), Physical Biochemistry, Application to Biochemistry and Molecular Biology, W.H. Freeman and Company, San Fransisco. • Wilson, K. and Walker, J. (2005) Principles and Techniques of Practical Biochemistry Cambridge University Press. • Holmeand, D. and Peck, H. (1998) Analytical Biochemistry. Longman • Scopes, R. (1982) Protein Purification - Principles and Practices. Springer Verlag.	

	• Pattabhi V and Gautham N. (2002) Biophysics, Kluwer Academic Publishers. • Narayanan P. (2016) Essentials of Biophysics, New Age International Pvt Ltd. • Volkenshtein, (2012) M.V. General Biophysics Academic Press, Inc. • Daniel, M. (2012) Basic Biophysics for biologists Agrobios. • Van, Holde, Johnson, K. E., Cutis, W. and Shing Ho, P. (2006) Principles of physical biochemistry, Pearson education Pvt. Ltd. • Gilbert Scott: Developmental Biology. • Wolpert: Principle of Development. • Balinsky: Developmental Biology. • Berril: Developmental Biology. • Waddington: Developmental Biology.

F.Y.M.Sc
Semester-II
ZOO-DSE-526(A): Practicals based on ZOO - 524(A)

Total Hours: 60 **Credits: 2**

Course Objectives	• Develop the ability to prepare and follow detailed experimental protocols, including principles, requirements, procedures, observations, tables, and inferences. • Cultivate skills in critically analyzing research articles, focusing on their structure, content, and presentation. • Enhance proficiency in scientific writing, including designing titles, framing abstracts, preparing references, and interpreting data. • Improve communication skills through effective reading, writing, and oral presentation of scientific information.	
Course Outcomes	After successful completion of this course, students are expected to: • Demonstrate the ability to create comprehensive experimental protocols, clearly detailing each component necessary for reproducible scientific experiments. • Critically analyze and summarize research articles, identifying key sections such as titles, abstracts, materials and methods, results, and discussions, and effectively interpret tables and graphs. • Skillfully design titles, write abstracts, and select keywords, as well as prepare accurate references and citations from various scientific sources. • Effectively communicate scientific information through written and oral formats, including drafting letters, proposals, and short communication articles, and participate in group discussions and presentations.	
Sr. No.	**Topic Particular**	**Hours**
1	Prepare a protocol of any experiment (Give- i) Principle, ii) Requirement, iii) Procedure, iv) Observation, v) Tables and vi) Inference	4
2	A close study of research article published in any of the foreign research journals with reference to i)Title, ii) Abstract, iii) Introduction, iv) Materials and Methods, v) Observations/ result, vi) Tables/ Graphs (Histograms, Bar graph) and its interpretation, vii) Discussion, viii) Study Resources and x) Summary	4
3	Title designing, framing abstract and keywords	4
4	Preparation of References by finding references from journals, books and databases and Citation – styles of citation	4
5	Preparation of Tables and Graphs from the given hypothetical data	4
6	Interpretation of data from the given hypothetical data	4
7	Communication skill – narration of any scientific news from any science report (sequence of facts, results, conclusions) and group discussion	4
8	Effective reading – read a passage (Pay attention to stress, pause, rhythms and style)	4
9	Paragraph writing – characteristics of good paragraphs, study of some good paragraphs having some scientific information. Find out difficult words and know their meanings. Underline the key sentences. Give abstract of the passage. Suggest suitable title to the passage	4
10	Effective writing communication skill: Drafting a letter for procurement of animals	4
11	Preparation of draft for purchasing of chemicals	4
12	Preparation of Scientific proposal for financial assistance for research project for Government agencies,	4

13	Using NCBI resources find out nucleotide database of any one gene	4
14	Preparation of short communication articles sending a research paper to editor for publication	4
15	Visit to the research laboratory/Institute	4
Study Resources	• Nageshwar Rao and Rajendra P. Das. (2005). Communication Skills, Himalaya Publishing House • Margerson, J.E.: The Art of effective communication, Excel Books New Delhi • Richard, W. Clark and Barbara, L. Clinton (1999). Effective Speech Communication, MacMillan, Mac Graw Hill, New York, • N. Gurumani, Research Methodology for biological sciences, MJP publishers, Chennai • Gopen, G.D. and Swan J.A. (1990). The Science of Writing, American Scientist. • Hall, G.M. (1996). How to write a paper, By Word publication,	

F.Y.M.Sc
Semester-II

ZOO-DSE-526(B): Practical of Parasitology

TotalHours: 60 **Credits:2**

Course Objectives	• Develop a fundamental understanding of the concepts and principles of parasitology, including the classification, life cycles, and morphology of parasites. • Acquire knowledge and skills to identify different types of parasites, including protozoa, helminths, and arthropods, based on their morphological features, life stages, and diagnostic techniques. • Learn to recognize and interpret the clinical manifestations associated with common parasitic infections, including gastrointestinal, respiratory, and vector-borne diseases. • Develop practical skills in specimen collection, processing, and analysis for the detection and identification of parasites.	
Course Outcomes	After successful completion of this course, students are expected to: • Demonstrate knowledge of the diversity of parasites, including protozoa, helminths, and arthropods, and their classification based on morphological features, life cycles, and diagnostic techniques. • Develop skills in the identification and diagnosis of parasites using laboratory techniques such as microscopy, serology, molecular assays, and immunodiagnostic tests. • Gain an understanding of the pathogenesis of parasitic infections and the mechanisms by which parasites cause disease in their hosts. • Acquire knowledge of the epidemiology of parasitic diseases, including their geographic distribution, transmission patterns, and risk factors.	
Sr. No.	**Topic Particular**	**Hours**
1	Study of Animal association – Intraspecific, Interspecific, Mutualism, Commensalism, Parasitism	4
2	Study of types of parasites-Ecto and endo parasites	4
3	Study of types of hosts	4
4	Study of Parasitic adaptations	4
5	Study of effects of parasites on Hosts	4
6	Prepration of Malarial parasite slide	4
7	Study of life cycle and preventive measures of *Plasmodium vivax.*	4
8	Study of life cycle and preventive measures of *Fasciola hepatica*.	4
9	Study of life cycle and preventive measures of *Wuchereria bancrofti,*	4
10	Study of life cycle and preventive measures of *Peduculus humanis*	4
11	Study of larval forms of Cestodes, Trematodes and Nematodes	4
12	Demonstration of endoparasites from the fish/ chick/ goat/ sheep intestine (any one)	4
13	Study of Host reactions to parasites	4
14	Study of rectal parasites from cockroaches / any suitable animal	4
15	Study of insects vectors:housefly and mosquito	4
Study Resources	• Chatterjee K. D. (1969). Parasitology (Protozoology and Helminthology) • Cheng T.C. (1964). The Biology of animal parasites, Saunders International Student Edition. • Dawes B. (1946). The Invertebrates Vol II, McGraw Hill, New York. • Daly, H. V., J. T. Doyen and P.R. Ehrilch (1981). Introduction to Insect Biology and Diversity, International Student Edn. McGraw- Hill, Kogakusha, Japan.	

MSc I (Zoology)
Semester I
ZOO-OJT-527: Internship / On Job Training

Hours: 120 **Credits: 4**

Course objectives	• To provide the students with actual work experience • To make aware prescribe standards and guidelines at work • To develop the employability of participating student • To avail an opportunities to eventually acquire job experiences
Course outcomes	After successful completion of this course, students are expected to: • Get actual work experience with office and virtual exposure to various management styles, technical, industrial, and proceduralsystems • Acquaintthe knowledge related to working hours, work protocols and guidelines • Understand the roles and responsibilities of employee as well as team work • Justify job experiences that match their potentials, skills, and competencies

Internship

An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills.

On the job training

On the job training is a form of training provided at the workplace. During the training, employees are familiarized with the working environment they will become part of. Employees also get a hands-on experience using machinery, equipment, tools, materials, etc.