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 :- 01/08/2024

NOTIFICATION

Sub :- CBCS Syllabi of M. Sc. in Zoology (Sem. III & IV)

Ref. :- Decision of the Academic Council at its meeting held on 27/07/2024.

The Syllabi of M. Sc. in Zoology (Third and Fourth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2023 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2024-25.

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.
1)

Near Samarth Colony, Jalgaon - 425 002. (Maharashtra, India) | Ph. : +91 257 - 2237363, 2234281 | e-mail : mjcollege@kces.in | Website : mjcollege.kces.in
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

KavayitriBahinabaiChaudhari

North Maharashtra University, Jalgaon-425001

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STRUCTURE AND SYLLABUS

M.Sc. II Zoology

Under Choice Based Credit System (CBCS)

and

as per NEP-2020 Guidelines

[w.e.f. AcademicYear:2024-25]

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.

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

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

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.

S. Y. M. Sc. Zoology Course Structure

Semester	Course Module	Credit	Hours/ week	TH/ PR	Code	Title
III	DSC	4	4	TH	ZOO-DSC-611	Animal Physiology I
	DSC	4	4	TH	ZOO-DSC-612	Palaeontology
	DSC	4	4	TH	ZOO-DSC-613	Inheritance Biology
	DSE	2	2	TH	ZOO-DSE-614(A)	Molecular Biology
	DSE	2	2	TH	ZOO-DSE-614(B)	Wildlife and Conservation Biology
	DSC	2	**4**	**PR**	ZOO-DSC-615	Practical based on ZOO-DSC-611, 612 and 613
	DSE	2	**4**	**PR**	ZOO-DSE-616(A)	Practical on Molecular Biology
	DSE	2	**4**	**PR**	ZOO-DSE-616(B)	Practical onWildlifeand Conservation Biology
	DSC	4	**8**	**RP**	ZOO-RP-617	Research Project I
IV	DSC	4	4	TH	ZOO-DSC-621	Animal Physiology II
	DSC	4	4	TH	ZOO-DSC-622	Histology and Histochemistry
	DSE	2	2	TH	ZOO-DSE-623(A)	Forensic Science
	DSE	2	2	TH	ZOO-DSE-623(B)	Toxicology
	DSC	2	**4**	**PR**	ZOO-DSC-624	Practical on Animal Physiology II
	DSC	2	**4**	**PR**	ZOO-DSC-625	Practical on Histology and Histochemistry
	DSE	2	**4**	**PR**	ZOO-DSE-626(A)	Practical on Forensic Science
	DSE	2	**4**	**PR**	ZOO-DSE-626(B)	Practical on Toxicology
	DSC	6	**12**	**RP**	ZOO-RP-627	Research Project II

DSC :Department-Specific Core course, DSE :Department-Specific elective, TH:Theory, PR: Practical

SEMESTER III

MSc II (Zoology)
Semester III
ZOO-DSC-611: Animal Physiology I

Total Hours: 60 **Credits: 4**

Course Objectives	• To comprehend the structure and function of the male and female reproductive systems. • To explain the process of spermatogenesis and oogenesis. • To distinguish between the female reproductive cycles of different mammals. • To analyze the influence of hormones on the development and function of the reproductive system, puberty, and menopause.	
Course Outcomes	After successful completion of this course, students are expected to: • Comprehend the primary and accessory organs, external genitalia, and their histological features of the male and female. • Analyze the sperm maturation and storage, and egg cell development. • Distinguish between the female reproductive cycles (estrous and menstrual) across different species. • Explain the roles and mechanisms of action of key sex hormones.	
Unit	**Topic**	**Hours**
I	**Introduction and Scope of Reproductive Physiology.** **Male Reproductive system sexual organsand Accessory glands**- Testes, secondary or accessory organs- Ducts, Rete testis, Vasa-efferentia, Epididymis, Vasa differentia and Ejaculatory duct, and Penis.Accessory glands- Seminal vesicle, Prostate gland, Cowper's gland. Spermatogenesis.	15
II	**Female Reproductive system sexual organs and Accessory glands** - Ovaries, Fallopian tube, Uterus, Vagina.Accessory glands- Mammary glands, Bartholin's glands, Skene's glands, Uterine glands. Oogenesis.	15
III	**Reproductive cycle in Female, Copulation and Fertilization:** Estrous cycle, Menstrual cycle, Hormonal and Neural control of Menstrual cycle Ejaculation, insemination, gamete transport – Sperm and Ova, sperm capacitation and activiation, entry of sperm in to the ovum, acrosomal reaction, activation of sperm, amphimixis.	15
IV	**Reproductive health** Puberty and delayed puberty, Menarche and Menopause, Hormonal control of Spermatogenesis and Oogenesis. Chemistry, biosynthesis, Mode of action and function of sex hormones Androgen, Estrogen and Progesterone. Remedies of population control, Reproductive health care programme, Sterility, IVF	15
Study Resources	• Hogarth, P. J. (1978). Biology of reproduction. Wiley. New York, NY. • Perry, J. S. (1971). The ovarian cycle of animals. Oliver and Boyd. Edinburgh, Scotland. • Austin, C. R., and Short, R. V. (1972). Reproduction in mammals (Vols. 1-8). Cambridge University Press. Cambridge, England. • Williams, R. H. (1981). Textbook of endocrinology. W. B. Saunders Company. Philadelphia, PA. • Chatterjee, C. C. (1985). Human physiology (Vol. II, 10thed.). Medical Allied Agency. Calcutta, India. • Nagabhushanam, R. (2003). Textbook of animal physiology (2nd ed.). Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India.	

MSc II (Zoology)
Semester III
ZOO-DSC-612: Palaeontology

Total Hours: 60 **Credits: 4**

Course Objectives	• To define fossils, explain the process of fossilization, and identify different types of fossil evidence. • To describe the principles of radiometric dating, including Uranium-Lead and Carbon-14 methods, and apply them to determine the age of rocks and fossils. • To differentiate between unaltered and altered fossils, and recognize various types like actual remains, petrified fossils, and coprolites. • To explain the importance of fossils in understanding the geological time scale, animal distribution patterns, and past environments.	
Course Outcomes	After successful completion of this course, students are expected to: • Critically evaluate fossil evidence for past life forms. • Interpret the geological history of Earth using radiometric dating techniques. • Analyze and classify different fossil types based on their preservation. • Utilize fossils to understand past animal distribution patterns and their evolutionary significance.	
Unit	**Topic**	**Hours**
I	**Palaeontology** a)Fossils-Definition, process of fossilizationand evidences, b)Determination of age of rocks and fossils (radiometric dating). i)Uranium-Lead method, ii)Radioactive carbon method **c)Natureoffossils-unalteredandalteredfossils d)Types of fossils**-i) Actualremains, ii)Petrified fossils,iii)Moultsandcasts,iv)Footprints andtrailsv)Coprolites **e)Significanceoffossils**	15
II	**Oparian-Haldanetheoryoforiginof life:** a)Miller-Urey'sexpt. b)Co-acervates Origin of vertebrates and major steps in vertebrate evolution. Mesozoic reptiles with special reference to origin diversity and extinction of dinosaurs. Mass extinction (Causes, five major extinctions, K-T extinction in detail), Role of extinction in evolution; Evolution of Horse, Phylogeny of Man.	15
III	**Geological time scale and distribution of animals** Geological time scale a)Meansof dispersalof animals, b)Barriersof dispersal(Physicaland,climaticand biological), c)Distributionof animals(continuousand discontinuous), d)Bathymetricdistribution(Geobiotic,limnobioticand holobiotic)	15
IV	**Zoogeographicalrealm a)Definitionandtypes** a)Studyoffollowingrealmswiththeirdistinctive animalDistributioni)Palaearcticregion ii)Nearticregion iii)Neotropicalregion iv)Ethiopianregion, v)Orientalregion vi)Australianregion c) Wallace'sline	15
Study Resources	• Barnes,C.W.1988. Earth,TimeandLife. JohnWileyand Sons,NewYork(Module2,3) • Bendall,D.S. (ed.)1983. EvolutionfromMoleculesto Man.CambridgeUniversityPress, UK(Module2,3and5) • BullJ. JandH. A. Wichman. 2001. Applied Evolution. Rev. Ecol. Syst. • ChattopadhyaySajib.2002. LifeOrigin,EvolutionandAdaptation.BooksandAllied(P) Ltd.Kolkata,India.	

MSc II (Zoology)
Semester III
ZOO-DSC-613: Inheritance Biology

Total Hours:60 **Credits: 4**

Course Objectives	• To explain the core concepts of Mendelian inheritance. • To differentiate between alleles (including multiple alleles and pseudoalleles). • To describe and analyze deviations from simple Mendelian inheritance patterns. • To explain complex genetic concepts.	
Course Outcomes	After successful completion of this course, students are expected to: • Predict offspring genotypes and phenotypes in Mendelian crosses. • Interpret genetic data and diagnose simple genetic disorders. • Critically analyze the influence of various factors on gene expression and inheritance patterns. • Discuss the complexities of human genetics and quantitative inheritance.	
Unit	**Topic**	**Hours**
I	**Mendeliesm and its extensions** Mendelian principles : Dominance, segregation, independent assortment. Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian principles : incomplete dominance, codominance, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.	15
II	**Gene mapping, extra chormosomal inheritance and microbial genetics** Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Microbial genetics : Methods of genetic transfers – transformation, conjugation, transduction and sex-duction	15
III	**Human and qualitative genetics** Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics : Polygenic inheritance, heritability and its measurements, QTL mapping	15
IV	**Genetic variation** Mutation causes of mutant: types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination : Homologous and non-homologous recombination including transposition.	15
Study Resources	• C.B. Pawar, (2018), Genetics Vol I and II, Himalaya Publishing House, Mumbai • M.W.Stricberger, (1984), Genetics, 4th Edition, MacMillan public Com. Inc, New York • B. Lewin, (2009), Genes Xth edition, Wiley Eastern Limited, New Delhi • R. L. Kotpal, (2020), Concept of Genetics, 6th Edition, Rastogi Publication, Meerut.	

MSc II (Zoology)
Semester III
ZOO-DSE-614(A): Molecular Biology

Total Hours: 30 **Credits: 2**

Course Objectives	• To explain the mechanisms of DNA replication. • To describe the process of transcription. • To analyze the process of translation. • To explain how gene expression is regulated at the transcription and translation levels in phages.	
Course Outcomes	After successful completion of this course, students are expected to: • 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.	
Unit	**Topic**	**Hours**
I	**DNA replication, repair:** Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.	8
II	**RNA synthesis and processing:** transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport.	7
III	**Protein synthesis and processing:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNAsynthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins.	8
IV	**Control of gene expression at transcription and translation level:** regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.	7
Study Resources	• Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics VIII ed.. Wiley India. • Powar, C.B. (2002). Genetics Vol I and II, Himalaya Publishing House, Mumbai • Stricberger, M.W. (2010). Genetics, 4th Edition, macMillon public Com. Inc, New York • Lewin B. (2010). Genes Xth edition, Wiley Eastern Limited, New Delhi • Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics, V Edition. John Wiley and Sons Inc • Gupta P.K. (2003). Cell and Molecular Biology.,Rastogi Publications.	

MSc II (Zoology)
Semester III
ZOO-DSE-614(B): Wildlife and Conservation Biology

Total Hours: 30 **Credits:2**

Course Objectives	• To analyze the rich biodiversity of India. • To critically evaluate current wildlife conservation approaches. • To define and differentiate between National Parks, Sanctuaries, Biosphere Reserves, Community Reserves, and Conservation Reserves. • To utilize the Red Data Book and understand conservation statuses.	
Course Outcomes	After successful completion of this course, students are expected to: • Propose solutions and advocate for improved wildlife conservation practices. • Develop management plans for specific protected areas or threatened species. • Critically analyze the effectiveness of national and international wildlife conservation efforts. • Discuss the ethical considerations and legal framework surrounding wildlife management in India.	
Unit	**Topic**	**Hours**
I	• Wildlife in India - Wildlife wealth of India and threatened wildlife. Reasons for wildlife depletion in India. • Wildlife conservation approaches and limitations. • National and State mammals and birds of India. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves - cores and buffers, Nodes and corridors. Community Reserve and conservation Reserves.	8
II	• Management of Wildlife - Red Data Book and Conservation status (endangered, vulnerable, rare, threatened and near threatened species) - definitions. • Distribution, status, habitat utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. • Wildlife Trade and legislation - Assessment, documentation, Prevention of trade. Policies and laws in Wildlife management (national) and ethics.	7
III	• Biodiversity extinction and conservation approaches - Perspectives and Expressions. • Identification and prioritization of ecologically sensitive area (ESA). • Coarse filter and fine filter approaches. Regional and National approaches for biodiversity conservation.	8
IV	• National and International efforts for conservation - Information on CITES, IUCN, CBD International agreements for conserving marine life. • Convention on wetlands of International Importance (Ramsar convention). Important projects for the conservation of endangered species in India. • Conservation of Natural Resources - Resources: Types and Degradations.	7
Study Resources	• M.Kato. The Biology of Biodiversity, Springer. • J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman and Hall, New York. • E.O. Wilson. Biodiversity, Academic Press,Washington. • B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.	

MSc II (Zoology)
Semester III
ZOO-DSC-615: Practicals on ZOO-DSC-611, 612 and 613

Total Hours:60 **Credits: 2**

Course Objectives	• To understand the physiological and biochemical aspects of reproductive cycles, pregnancy, and sperm count in humans and animals. • To gain knowledge in various contraceptive methods. • To explore fundamental concepts in evolutionary biology. • To develop skills in genetic analysis.	
Course Outcomes	After successful completion of this course, students are expected to: • Sucessfully discuss the physiological and biochemical aspects of reproductive cycles, pregnancy, and sperm count in humans and animals. • Explain different types of contraceptives and their usage. • Identify and describe fossils, zoogeographical realms, geological time scales, and stages of human evolution. • Train in genetic analysis.	
Sr. No.	**Practical**	**Hours**
1	Study of oestrus cycle.	4
2	Determination of pregnancy test. (E)	4
3	Estimation of glycogen from ovary / testis by Anthron method. (E)	4
4	Estimation of Sperm count. (E)	4
5	Study of types of contraceptives	4
6	Studyoffossils.	4
7	Study of Lamarkismusetheory-ex.Giraffe and Naturalselectiontheory-Darwinfinches	4
8	Identificationofzoogeographicalrealmsusingmap.	4
9	Studyofgeologicaltimescale	4
10	Identification/featuresofstagesofHuman evolution – Australopithecus, Pithecanthropus, Neanderthal man and Cromagnon man	4
11	Calculate gene frequency of PTC (Phenylthiocarbamide) taster in the given human population. (E)	4
12	Study of Sex linked character in Drosophila-White, and Bar Eye	4
13	Calculation of gene frequency of ABO blood group in human population. (E)	4
14	Study of human traits – widow'speak, ear lobes, dimple cheek, rolled tongue. (E)	4
15	Study of Barr body in human buccal epithelium. (E)	4
Study Resources	• Gardner, E. J., Simmons, M. J., Snustad, D. P. (2008). Principles of Genetics.VIII Edition. Wiley India. • Snustad, D. P., Simmons, M. J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. • Klug, W. S., Cummings, M. R., Spencer, C. A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings. • Russell, P.J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings. • Abbas,K.AbulandLechtmanH.Andrew(2003.)CellularandMolecularImmunology. V Edition. SaundersPublication.	

MSc II (Zoology)
Semester III
ZOO-DSE-616(A): Practical on Molecular Biology

Total Hours: 60 **Credits: 2**

Course Objectives	• To apply various methods for estimating the concentration of DNA, RNA, and protein in biological samples. • To isolate DNA and protein using techniques like agarose gel electrophoresis and chromatography. • To utilize techniques like SDS-PAGE and isoelectric point determination to analyze protein structure and function. • To perform and interpret results from advanced techniques like DNA amplification, thermal melting analysis, and diagnostic tests like ELISA.
Course Outcomes	After successful completion of this course, students are expected to: • Accurately estimate DNA, RNA, and protein. • Successfully isolate DNA and protein. • Interpret data from protein analysis techniques to understand protein structure and function. • Gain knowledge about advanced techniques like DNA amplification, thermal melting analysis, and diagnostic tests like ELISA.

Unit	Practical	Hours
1.	Estimation of DNA in a given sample by Diphenylamine Method. (E)	4
2.	Estimation of RNA in a given sample by Orcinol method. (E)	4
3.	Estimation of Protein by any suitable method. (E)	4
4.	Isolation of crude DNA from suitable material. (E)	4
5.	Demonstration of Agarose gel electrophoresis for DNA. (E)	4
6.	Demonstration of SDS page electrophoresis for protein. (D)	4
7.	Isolation of protein by using acetone precipitation. (E)	4
8.	Determination of isoelectric point of amino acid (pKa). (E)	4
9.	Determination of λmax for Protein. (E)	4
10.	Paper chromatography for amino acid. (E)	4
11.	Qualitative test for HCG. (E)	4
12.	To learn DOT-ELISA technique for detection of an Antigen. (E)	4
13.	Demonstration of Amplification of DNA. (E)	4
14.	Isolation of cellular components using cellular density gradient centrifugation. (E)	4
15.	Determination of thermal melting of DNA. (E)	4

Study Resources

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics VIII ed.. Wiley India.
- Powar, C.B. (2002). Genetics Vol I and II, Himalaya Publishing House, Mumbai
- Stricberger, M.W. (2010). Genetics, 4th Edition, macMillon public Com. Inc, New York
- Lewin B. (2010). Genes Xth edition, Wiley Eastern Limited, New Delhi
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics, V Edition. John Wiley and Sons Inc.
- Gupta P.K. (2003). Cell and Molecular Biology.,Rastogi Publications.

MSc II (Zoology)
Semester III
ZOO-DSE-616(B): Practical on Wildlife and Conservation Biology

Total Hours: 60 **Credits: 2**

Course Objectives	• To distinguish and identify various mammal, bird, and reptile species in the field. • To demonstrate proper use, care, and maintenance of essential wildlife study tools like compasses, binoculars, GPS units, and cameras. • To identify and analyze animal evidence like tracks, scat, nests, and calls to understand wildlife presence and behavior. • To implement various field methods for monitoring and estimating mammal, bird, and reptile populations using direct and indirect evidence.	
Course Outcomes	After successful completion of this course, students are expected to: • Conduct independent wildlife surveys in diverse habitats. • Collect and analyze reliable data on wildlife abundance and diversity. • Contribute to wildlife conservation efforts through data collection and informed decision-making. • Appreciate the importance of responsible wildlife observation and minimize disturbance to animals in their natural environments.	
Unit	**Practical**	**Hours**
1.	Identification of mammalian fauna. (E)	4
2.	Identification of avian fauna. (E)	4
3.	Identification of herpeto-fauna. (E)	4
4.	Demonstration of basic equipment needed in wildlife studies use, care and maintenance(Compass, Binoculars, Global Positioning System,Various types of Cameras and lenses). (D)	4
5.	Familiarization and study of animal evidences in the field; Identification of animalsthrough pug marks, hoof marks, scats, pellet groups, nest, antlers etc. (E)	4
6.	Demonstration of different field techniques for flora and fauna. (D)	4
7.	Trail / transect monitoring for abundance and diversity estimation of mammals (direct and indirect evidences).(E)	4
8.	Trail / transect monitoring for abundance and diversity estimation of bird (direct and indirect evidences).(E)	4
9.	Trail / transect monitoring for abundance and diversity estimation of reptiles(direct and indirect evidences). (E)	4
10.	Study of trap camera in forest. (E)	4
11.	Study of control of forest fire. (D)	4
12.	Survey of aquatic birds. (E)	4
13.	Scat analysis of predators.(D)	4
14.	Study of Prey and predators interaction. (D)	4
15.	Visit to Natioan park, Museum, National Sanctury	4
Study Resources	• M.Kato. The Biology of Biodiversity, Springer. • J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman and Hall, New York. • E.O. Wilson. Biodiversity, Academic Press, Washington. • B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.	

MSc II (Zoology)
Semester III
ZOO-RP-617 Research Project I

Guidelines for Research Project at PG in Science
Semester III

Hours: 120 **Credits: 4**

Course Objectives

1. To give exposure to the students to research culture and technology
2. To introduce students to how to select a research topic, plan, perform experiments, collect and analyze the data
3. To foster self-confidence and self-reliance in the students as they learn to work and think independently

Course outcomes

After successful completion of this course, students are expected to:

- Conceive a problem based on published research and conduct a comprehensive literature survey.
- Plan and carry out the tasks in the given framework of the dissertation and present the work in writing and viva.
- Learn handling of instruments, use of chemicals and how to conduct the experiments
- Learn how to present the project in PowerPoint and answer the queries to examiners and the science of writing.

Credit distribution (1 credit for each unit)

- Identification of a research topic, formulation of research problem, objectives, sample size and hypothesis, etc
- Preparation of Outline
- Review of literature
- Bibliography

The systematic approach towards the execution of the project should be as follows: (Wherever applicable)

1. The complete tenure of the research project should be one year. It should be allotted during the third semester and completed in the fourth semester.
2. Weekly 8 hours should be allotted to the research project in a regular timetable.
3. In the third semester, students will be evaluated based on a credit distribution mentioned above. In the fourth semester, students should perform further research work, collect and analyze the data, compile the results and prepare and submit the final dissertation.
4. Students may be given an opportunity to participate in ongoing research activities in the respective Departments/Schools/Supervisors' laboratories. This will familiarize them with the literature survey and give them a fundamental understanding of designing and executing a research project.
5. Students may work individually or in groups (not more than 3 students) to be decided by the concerned department/supervisor.
6. Each research group should have a different research topic with some possible level of novelty.

7. The student should select the topic relevant to priority areas of concern or allied subjects with the guidance of supervisor/ head of the department.
8. Students are encouraged to work on multidisciplinary and applied projects, but it is not mandatory criteria.
9. At the beginning, students should submit the outline of the research work to be carried out in the project. (Writing in order: Title, Aim and objectives, Literature to be collected, Experimental plan or method design, expected outcome etc.)
10. Write and submit a Literature Review Report and Research outline

Tentative order for review: Title of the Project, Certificates, Acknowledgment, Abstract and Keywords, Contents, Introduction, Literature Review, Aim of the Project, Materials and Methods, Bibliography/reference etc.

Tentative order for research outline: Title page, introduction, background and significance of study, problems to be investigated, objective, hypothesis, chapter scheme, bibliography.

11. At the end of the third semester, each student should submit a detailed Literature Review Report and research outline.
12. An appropriate and essentialconclusive statement must be drawn at the end of the study.
13. Students should maintain lab notebooks, and the Supervisor may ask them to submit the mid-semester progress report.
14. For documents related to project submission: Font- Times New Roman, Heading Font Size-14, Normal Text Size-12, spacing-1.5, both sides justified and 1 inch margin on all side, both side printing on A-4 size.
15. Three copies of the Literature Review Report, research outline should be prepared (one copy for each department, guide, and student).
16. At the end of the semester, the candidate should prepare and present research work using a PowerPoint presentation with modern ICT tools and present the same in front of his/ her respective department during the Internal Examination.
17. For external examination the candidate will have to present the research work and face viva voce.
18. Students may present their research work in Avishkar/Webinars/Conferences.
19. Students should note that plagiarism is strictly prohibited.

Internal examination (40 marks): Components of continuous internal assessment:

- Draft Research Outline (10 marks)
- Draft Review of literature (10 marks)
- Working Bibliography (10 marks)
- PowerPoint presentation, and oral examination (10 marks)

External examination (60 marks)and Components of external assessment:

- Final submitted review report, research outline in bound form at the time of examination **(40 marks)**
- Overall presentation reflecting the contribution of work, response to questions **(20 marks)**

SEMESTER IV

MSc II (Zoology)
Semester IV
ZOO-DSC-621: Animal Physiology II

Total Hours: 60 **Credits:4**

Course Objectives	• To understand the mechanisms of nerve impulse. • To explore sensory physiology. • To gain comprehensive knowledge of the endocrine system. • To learn about general physiological processes.	
Course Outcomes	After successful completion of this course, students are expected to: • Demonstrate knowledge of nerve impulse conduction. • Explain sensory coding mechanisms, receptor functions. • Identify and describe the roles and mechanisms of hormones. • Gain knowledge of body fluids, bioluminescence, chronobiology, pheromones, Aging.	
Unit	**Topic**	**Hours**
I	**Nervous System:** Conduction of nerve impulse, conduction of impulse through non-myelinated neuron, conduction of impulse through myelinated neuron, synapse, conduction of impulse through synapse, neuromuscular junction, properties of nerve impulse.	15
II	**Sensory Physiology:**Classification of Receptors: Chemoreceptors, Mechanoreceptorsand Radioreceptors; Acoustico lateral line system ; Echolocation or Sonar; Electroreception; Magnetoreception.	15
III	**Endocrine system:**Hypothalamo- Hypophyseal system – Specific function of hypothalamus, Hypothalamic hypophyseal portal system – hypothalamic control of Anterior pituitary, regulation of posterior pituitary hormones. Mechanism of Hormone action at cellular level, Cyclic AMP – Biochemical role, Cyclic AMP as II messenger.	15
IV	**General Physiology:** Types of body fluids, importance of body fluid, concentration of body fluid, composition and physico chemical properties of Intracellular and Extracellualr fluid, composition of intestinal fluid, Bioluminescence, Chronobiology, pheromones, Aging.	15
Study Resources	• A. Mariakuttikan and N. Arumugam, (2017) Animal Physiology, Saras Publication. • Pandey and Shukla, (2004) Regulatory mechanism in vertebrates. Rastogi Publication. • Hogarth, P. J. (1978). Biology of reproduction. Wiley. New York, NY. • Perry, J. S. (1971). The ovarian cycle of animals. Oliver and Boyd. Edinburgh, Scotland. • Austin, C. R., and Short, R. V. (1972). Reproduction in mammals (Vols. 1-8). Cambridge University Press. Cambridge, England. • Williams, R. H. (1981). Textbook of endocrinology. W. B. Saunders Company. Philadelphia, PA. • Chatterjee, C. C. (1985). Human physiology (Vol. II, 10th ed.). Medical Allied Agency. Calcutta, India. • Nagabhushanam, R. (2003). Textbook of animal physiology (2nd ed.). Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India.	

MSc II (Zoology)
Semester IV
ZOO-DSC-622: Histology and Histochemistry

Total Hours: 60 **Credits: 4**

Course Objectives	• To define histology, explain its historical development, and identify its applications in biological research and diagnosis. • To differentiate between various types of tissues. • To describe the principles and operation of different microtome types. • To explain the steps involved in basic histological processing.	
Course Outcomes	After successful completion of this course, students are expected to: • Interpret histological findings. • Select appropriate microtome types for specific tissue preparation needs. • Perform basic histological techniques efficiently and troubleshoot common issues. • Utilize histological data in conjunction with other biological information.	
Unit	**Topic**	**Hours**
I	• Definition, history, application of histology • Types of tissue, characteristics and location. • Types of microtome- Rocking microtome, Rotary microtome, Base sledges microtome, Sliding microtome, Freezing microtome, Ultra microtome and cryostat. • Basic histological processes: From fixation to mounting • Faults in section cutting. Their reasons and remedy	15
II	• Definition, concept and scope of histochemistry. • Basic principle of histochemistry, Goal of histochemistry. • Related term and special disciplines within histochemistry • Single and double staining method.	15
III	• Detection of carbohydrates- Periodic acid-Schiff reaction, staining methods for glycogen. • Detection of protein- Million reaction, DNFB reaction • Detection techniques for lipids- Sudan black, Herxheimer method • Techniques specific for DNA- Fulgenrection • Techniques specific for RNA- Methyl- green pyronin stain	15
IV	• Special staining methods: Vital staining, Staining methods for connective tissue, staining of mitochondria. • Staining methods for nervous system (methods for axon and neurofibrils) • Fluorescence Antibody techniques- Direct staining, Sandwich technique, Application • Chromosome staining methods	15
Study Resources	• Histochemistry by Pease, A. G. E., 1976 • Microscopic histochemistry: by Gomori • Ham R. W., Textbook of histology • Bourne, G. H. An Introduction of Functional Histology • Poddar and Mukhopadhyay, An Advanced Laboratory Manual of Zoology	

MSc II (Zoology)
Semester IV
ZOO-DSE-623(A): Forensic Science

Total Hours: 30 **Credits: 2**

Course Objectives	• To define forensic science, explain its historical development, and recognize its importance in the legal system. • To describe the services and functionalities provided by various forensic science laboratories. • To explain the proper procedures for collecting, packaging, and preserving biological evidence at a crime scene. • To identify the significance of different types of biological evidence, including hair, body fluids, and skeletal remains.	
Course Outcomes	After successful completion of this course, students are expected to: • Critically evaluate the role of forensic science in criminal investigations and court proceedings. • Appreciate the importance of proper evidence handling to maintain chain of custody. • Collect and package biological evidence in a manner that preserves its integrity for analysis. • Interpret basic forensic analyses of biological evidence to assist in investigations.	
Unit	**Topic**	**Hours**
I	**Forensic Science : Definition, History and Development** • Scope and importance of forensic science • Forensic Science Laboratories And Facilities: • Services and functionalities provided by various FSLs	7
II	**Biological Evidences Collection and Packaging:** • Nature and importance of biological evidence. • Protection of Biological Evidences; Documentation; Recognition, Collection, Packaging and transportation of Biological Evidences • Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Comparison of hair samples. Morphology and biochemistry of human hair. Comparison of human and animal hair.	8
III	**Analysis of Biological Fluid** Saliva; Semen; Vaginal Fluid; Urine; Sweat; Serological Concepts; Antigen / Antibodies; Polyclonal antibodies; Monoclonal antibodies; Antiglobulins; Blood Grouping Human and Non-human; Analysis of Skeletal Remains	8
IV	**Forensic Entomology** Basic Principle of Insect Biology; Life Cycle of Blow flies and Dermestid Beetles; Collection of entomological evidence during death investigations Estimation of Time of Death; Preservation of Sample.	7
Study Resources	• Nanda, B.B. and Tewari, R.K. (2001) : Forensic Science in India : A vision for the twenty first century Select Publisher, New Delhi. • James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to	

	scientific and investigative techniques CRC Press, USA. • Barnett (2001): Ethics in Forensic Science. • Saferstien : Forensic Science, Handbook - I, II and III, Prentice Hall Inc. USA.

MSc II (Zoology)
Semester IV
ZOO-DSE-623(B): Toxicology

Total Hours: 30 **Credits: 2**

Course Objectives	• To explain the definition, scope, and historical development of toxicology. • To identify the main sources of toxic compounds and describe their movement through the environment. • To categorize different classes of toxicants and understand exposure routes in various settings. • To explain the principles of toxicity testing, toxicant processing in vivo, and toxic action mechanisms.	
Course Outcomes	After successful completion of this course, students are expected to: • Critically analyze the potential hazards of various chemicals in our environment. • Evaluate the importance of dose-response relationships in assessing toxicity. • Discuss the methods used to assess the safety of new chemicals and drugs. • Explain the mechanisms by which toxicants enter the body, distribute to different organs, and exert their harmful effects.	
Unit	**Topic**	**Hours**
I	**Introduction to Toxicology:** Definition and Scope, Relationship to Other Sciences, A Brief History of Toxicology, Dose-Response Relationships, Sources of Toxic Compounds, Movement of Toxicants in the Environment	7
II	**Classes of Toxicants:** Exposure Classes, Toxicants in Air, Water, Soil, Domestic and Occupational Settings, Metals, Agricultural Chemicals (Pesticides), Food Additives and Contaminants, Toxins, Solvents, Therapeutic Drugs, Drugs of Abuse, Combustion Products, Cosmetics	8
III	**Applied Toxicology:** Toxicity Testing - Experimental Administration of Toxicants, Chemical and Physical Properties, Exposure and Environmental Fate, *In Vivo* Tests, *In Vitro* and Other Short-Term Tests, Ecological Effects, Risk Analysis	7
IV	**Toxicant Processing *In Vivo*:** Absorption and Distribution of Toxicants, Cell Membranes, Mechanisms of Transport, Physicochemical Properties Relevant to Diffusion, Routes of Absorption, Toxicant Distribution, Toxicokinetics, Toxic Action: Acute Toxicity, Perspectives on Informatics in Toxicology	8
Study Resources	• Pande, Shukla and Trivedi, (2011), Fundamentals of toxicology, 4th Revised edition, New Central Book Agency, New Delhi. • Sharma P. D., (2018), Toxicology, Rastogiprakashan, Meerut • Dr. M. A. Subramanian, (2010), Toxicology: Principles and methods, MJP publishers, Chennai.	

MSc II (Zoology)
Semester IV
ZOO-DSC-624: Practical on Animal Physiology II

Total Hours:60 **Credits: 2**

Course Objectives	• To provide students with an in-depth understanding of neurophysiological processes. • To examine sensory systems and reflex actions through practical demonstrations. • To explore thehypothalamo-hypophyseal system. • To study body fluids, aging, apoptosis, pheromone release, and biological clocks.
Course Outcomes	After successful completion of this course, students are expected to: • Students will gain practical skills and enhancing their understanding of the nervous system's functionality. • Students will be able to conduct and interpret sensory tests and applying these skills in clinical and research settings. • Students will comprehend the cellular mechanisms of hormone action, the functioning of thehypothalamo-hypophyseal system. • Students will understand the mechanisms of aging, apoptosis, pheromone signaling.

Sr. No.	Practical	Hours
1	Study of EEG.	4
2	Study of cranial nerves in human.	4
3	Study of neuro-muscular junction.	4
4	Study of action potential.	4
5	Testing of the Blind Spot. (E)	4
6	Testing for Color Blindness. (E)	4
7	Examining the effects of Smell, Texture, Temperature and Taste. (E)	4
8	Study of reflex action. (E)	4
9	Study of Hypothalamo- Hypophyseal system.	4
10	Study of Mechanism of Hormone action at cellular level.	4
11	Study of bioluminescence.	4
12	Study of body fluids	4
13	Study of aging and apoptosis	4
14	Demonstration of pheromone release from the body of ants. (D)	4
15	Study of biological clock.	4

Study Resources

- A. Mariakuttikan and N. Arumugam, (2017) Animal Physiology, Saras Publication.
- Hogarth, P. J. (1978). Biology of reproduction. Wiley. New York, NY
- Perry, J. S. (1971). The ovarian cycle of animals. Oliver and Boyd. Edinburgh, Scotland.
- Austin, C. R., and Short, R. V. (1972). Reproduction in mammals (Vols. 1-8). Cambridge University Press. Cambridge, England.
- Williams, R. H. (1981). Textbook of endocrinology. W. B. Saunders Company. Philadelphia, PA.
- Chatterjee, C. C. (1985). Human physiology (Vol. II, 10th ed.). Medical Allied Agency. Calcutta, India.
- Nagabhushanam, R. (2003). Textbook of animal physiology (2nd ed.). Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India.

MSc II (Zoology)
Semester IV
ZOO-DSC-625: Practical on Histology and Histochemistry

Total Hours:60 **Credits: 2**

Course Objectives	• To understand the basic morphology and structure of cells and tissues. • To develop practical skills in mounting various tissue types including smooth muscle, epithelial, skeletal muscle, and nervous tissue. • To learn and apply methods for detecting cellular components such as proteins, carbohydrates, nucleic acids, and lipids. • To gain experience in histological techniques including vital staining, immunohistochemistry, and enzyme estimation.
Course Outcomes	After successful completion of this course, students are expected to: • Students will be able to identify and describe the morphology of different cell and tissue types. • Students will demonstrate proficiency in mounting and preparing tissue samples for microscopic examination. • Students will effectively apply techniques for detecting and analyzing cellular components and structures. • Students will produce and submit high-quality permanent slides and accurately perform specific staining and histochemical procedures.

Sr. No.	Practical	Hours
1	To examine the basic morphology of cell and tissue.	4
2	Mounting of smooth muscle from suitable material. (E)	4
3	Mounting of epithelial tissue from suitable material. (E)	4
4	Mounting of skeleton muscle from suitable material. (E)	4
5	Mounting of nervous tissue from suitable material. (E)	4
6	Detection of protein by any suitable method. (E)	4
7	Detection of Carbohydrate (Polysaccharides) by Periodic acid- Schiff reaction. (E)	4
8	Detection of nucleic acid – DNA by Fulgen method. (E)	4
9	Identification of specified hisotological sections with reasons	4
10	Study of stratified squamous epithelium from cheek of man. (E)	4
11	Demonstrate the staining of the sections for calcium. (D)	4
12	Vital staining of Mitochondria by using Janus Green- B stain. (E)	4
13	Study of Imunohistochemistry (IHC).	4
14	Detection of alkaline phosphatase from given material. (E)	4
15	Submission of permanent slide- any five.	4

Study Resources	• Histochemistry by Pease, A. G. E., 1976 • Microscopic histochemistry: by Gomori • Ham R. W., Textbook of histology • Bourne, G. H. An Introduction of Functional Histology • Poddar and Mukhopadhyay, An Advanced Laboratory Manual of Zoology

MSc II (Zoology)
Semester IV
ZOO-DSE-626(A): Practical on Forensic Science

Total Hours: 60 **Credits:2**

Course Objectives	• To learn methods for the examination and identification of various biological stains including blood, semen, saliva, and urine. • To understand and apply techniques for determining blood groups. • To develop skills in forensic anthropology. • To acquire proficiency in hair analysis,.	
Course Outcomes	After successful completion of this course, students are expected to: • Students will demonstrate the ability to conduct and interpret tests for biological stains. • Students will accurately determine blood groups and perform microscopic examinations of biological samples. • Students will effectively estimate stature and determine sex from skeletal remains such as skulls and pelvises. • Students will identify and analyze hair and diatom samples, prepare slides, and determine the origin of species using forensic techniques.	
Sr. No.	**Practical**	**Hours**
1	Examination and identification of blood stains: Benzidin test, Hemin test.	4
2	Determination of blood groups from fresh and dry blood sample. (E)	4
3	Examination and identification of semen stains: Acid phosphate test, Microscopic examination of spermatozoa. (E)	4
4	Estimation and identification of saliva stains: Amylase test, Microscopic examinationof epithelial cells. (E)	4
5	Examination and identification of urine stains. (E)	4
6	Determination of the side and measurement of long bones for stature estimation. (E)	4
7	Determination of sex from skull and pelvis. (E)	4
8	To examine hair morphology and determine the species to which the hair belongs. (E)	4
9	To prepare slides of scale pattern of human hair. (E)	4
10	To examine human hair for cortex and medulla. (E)	4
11	Determination of origin of species (Tube method and agar gel method).	4
12	Identify the given pugmark of wild animal and give its characteristics.	4
13	Identification, classification and microscopic examination of Diatoms.	4
14	Identification of teeth. (E)	4
15	Visit to any one Forensic Laboratory.	4
Study Resources	• L. Stryer, Biochemistry, 3rd Edition, W.H. Freeman and Company, New York (1988). • APPLETON and Lange, Norwalk (1993). • S. Chowdhuri, Forensic Biology, BPRD, New Delhi (1971). • R. Saferstein, Forensic Science Handbook, Vol. III, Prentice Hall, New Jersey (1993).	

MSc II (Zoology)
Semester IV
ZOO-DSE-626(B): Practical on Toxicology

Total Hours:60 **Credits: 2**

Course Objectives	• To investigate the impact of different concentrations of pesticides and heavy metals on respiratory behavior and opercular movements of fish or mosquito larvae. • To determine LC50 values of pesticides and heavy metal salts using fish or mosquito larvae. • To calculate and analyze Probit values to assess toxicity levels and effects on biological systems. • To study biochemical and histopathological changes in cells and tissues exposed to toxicants, including pesticides and heavy metals.	
Course Outcomes	After successful completion of this course, students are expected to: • Students will demonstrate proficiency in conducting. • Students will accurately determine LC50 values through experimental methods using appropriate biological indicators. • Students will analyze Probit values to understand the dose-response relationship and toxicity levels of pesticides and heavy metals. • Students will effectively document and analyze biochemical and histopathological changes in cells and tissues affected by toxicants.	
Sr. No.	**Practical**	**Hours**
1	Effect of different concentrations of pesticide on the respiratory behaviour of any fish / mosquito larvae.(E)	4
2	Measurement of opercular movements of fish, exposed to different concentration of any heavy metals. (E)	4
3	Determine the LC 50 value of any one pesticide by using fish / mosquito larvae.(E)	4
4	Determine the LC 50 value of one heavy metal salt by using fish/ mosquito larvae. (E)	4
5	Calculate and analyseProbit value. (E)	4
6	Study of toxicant damage in cells and tissue Histopathological changes) with the helpofmicrophotographs/Xerox copies.	4
7	Effect of any pesticides on biochemical changes in fish/ suitable material. (E)	4
8	Effect of any heavy metals on biochemical changes in fish/ suitable material. (E)	4
9	Evaluate cell toxicity *in vitro* in cell line. (E)	4
10	Evaluate acute toxicity of any insecticide. (E)	4
11	Evaluation of subchronic toxicity of any insecticide.	4
12	Evaluation of chronic toxicity of any insecticide.	4
13	Study the toxic air and water pollutantants.(E)	4
14	Study of occupational toxicants.	4
15	Visit to study the air, water toxicants area e.g. industry effluents outlay area.	4
Study Resources	• Pande, Shukla and Trivedi, (2011), Fundamentals of toxicology, 4th Revised edition, New Central Book Agency, New Delhi. • Sharma P. D., (2018), Toxicology, Rastogiprakashan, Meerut • Dr. M. A. Subramanian, (2010), Toxicology: Principles and methods, MJP publishers, Chennai.	

MSc II (Zoology)
Semester IV
ZOO-RP-627 Research Project II

Guidelines for Research Project at PG in Science
Semester IV

Hours: 180 **Credits: 6**

Course Objectives

1. To give exposure to the students to research culture and technology
2. To introduce students to how to select a research topic, plan, perform experiments, collect data and analyze the data
3. To foster self-confidence and self-reliance in the students as they learn to work and think independently

Course outcomes

After successful completion of this course, students are expected to:

1. Conceive a problem based on published research and conduct a comprehensive literature survey.
2. Plan and carry out the tasks in the given framework of the dissertation and present the work in writing and viva.
3. Learn handling of instruments, use of chemicals and how to conduct the experiments
4. Learn how to present the project in PowerPoint and answer the queries to examiners and the science of writing.

The systematic approach towards the execution of the project should be as follows: (Wherever applicable)

1. The complete tenure of the research project should be one academic year. It should be allotted during the third semester and completed in the fourth semester.
2. Weekly 12 hours should be allotted to the research project in a regular timetable.
3. In the fourth semester, students should perform further experimental work, analyze the data and compile the results.
4. Students may be given an opportunity to participate in ongoing research activities in the respective Departments/Schools/Supervisors' laboratories. This will familiarize them with the literature survey and give them a fundamental understanding of designing and executing a research project.
5. Students may work individually or in groups (not more than 3 students) to be decided by the concerned department/supervisor.
6. Each research group should have a different research topic with some possible level of novelty.
7. The student should select the topic relevant to priority areas of concern or allied subjects.
8. Students are encouraged to work on multidisciplinary and applied projects, but it is not mandatory criteria.
9. Students are expected to work in line with the research outline and literature review,which was submittedin the third semester.
10. Students are expected to learn how to execute the research work systematically and overcome the hurdles. Students will get the opportunity to learn about practical aspects of many characterization techniques or models and further how to effectively employ them in the research work. Students should be able to critically evaluate the literature on

the topic, identify the research gaps, plan and perform the experiments, interpret the results, understand the limitations of the work and draw conclusions.

11. At the end of the semester, each student should submit a detailed Research Report.
12. The format of the final research report shall be as per the guidelines of respective department. (**Example**:Title of the Project, Certificates, Acknowledgment, Abstract and Keywords, Contents, Introduction, Literature Review, Aim and objective, Materials and Methods, Result, Data analysis and Discussions, conclusion, limitations, suggestion, future scope, Bibliography, Appendix etc.)
13. An appropriate and essential conclusive statement must be drawn at the end of the study.
14. Students should maintain lab notebooks, and the supervisor may ask them to submit the mid-semester progress report.
15. For documents related to project submission: Font- Times New Roman, Heading Font Size-14, Normal Text Size-12, spacing-1.5, both sides justified and 1 inch margin on all side, both side printing on A-4 size.
16. Three copies of the dissertation should be prepared (one copy for each department, guide, and student).
17. At the end of the semester, the candidate should prepare and present research using a PowerPoint presentation using modern ICT tools during the Internal and External Examination.
18. Besides writing a dissertation, students are encouraged to write a manuscript/patent if the results obtained are worthy of publication.
19. Students may present their research work in Avishkar/Webinars/Conferences.
20. Students should note that plagiarism is strictly prohibited.

Internal examination (60 marks): Components of continuous internal assessment:

- Literature collected, methodological planning, analysis of data, design and work, progress reports etc (30 marks)
- Presentation in Webinars/Conferences/publication and departmental presentationetc(20 marks)
- Oral examination (10 marks)

External examination (90 marks)and Components of external assessment:

- Evaluation of dissertation submitted in bound form at the time of examination **(60 marks)**
- Presentation (PPT format) **(15 marks)**
- Overall presentation reflecting the contribution of work, Response to questions **(15 marks)**