FACULTY OF SCIENCES

SYLLABUS FOR THE BATCH FROM 2022 TO 2024

Programme Code: MZOO

Programme Name: M. Sc. Zoology

(Semester I- IV)

Examinations: 2022-2024

Department of Zoology

Khalsa College, Amritsar

S.No.	PROGRAMME OBJECTIVES
1.	Achieve excellence in education and scientific research in the field of Zoology.
2.	Develop and implement ways and means to ensure quality performance and outputs of the Zoology program.
3.	Optimal use of modern technology in education and scientific research
4.	Implementation of advanced training to improve the skills of graduates in Zoology and related fields.
5.	Creating engaging academic and scientific environment to attract outstanding faculty, researchers and students.
6.	Provide consultancy and organize extension activities.
7.	Provide quality education offering skill based programs and motivate the students for self-employment in applied branches of Zoology.
8.	Inculcate the spirit of resource conservation and love for nature
9.	Conduct field studies and different projects of local and global interests.
10.	Provide opportunities for professional and personal development through curricular and co-curricular activities
11.	Improve the national and international partnerships with academic institutions and research centers

S.No.	PROGRAMME SPECIFIC OUTCOMES (PSOS)
PSO-1	Students enrolled in M.Sc. Zoology will study and acquire complete knowledge of disciplinary as well as allied biological sciences
PSO-2	Students are able to correctly use biological instrumentation and proper laboratory techniques
PSO-3	Students will be able to identify the relationship or synchronization between structure and function at all levels: molecular, cellular and organismal
PSO-4	Students will also be able to describe economic, ecological and medical significance of various animals
PSO-5	Students will be able to explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ system
PSO-6	Perform, Assess and implement practical techniques and procedure to solve biological problems and analyse and quantify data collected during any project

COURSE SCHEME							
SEMESTER - I							
Course Code	**Course Name**	**Hours /Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
ZooC-501	Functional Organization of Animals – I	**6**	75	-	25	100	4
ZooC-502	Animal Ecology	**6**	75	-	25	100	6
ZooC-503	Cell Biology	**6**	75	-	25	100	8
ZooC-504	Computer Fundamentals& Data Processing	**4.5**	37	-	13	50	11
ZooC-551	Practical- I (F.O.A. -I)	**3**	-	37	13	50	13
ZooC-552	Practical- II (Ecology &Cell Biology)	**3**	-	37	13	50	14

SEMESTER - II							
Course Code	**Course Name**	**Hours /Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
ZooC-601	Functional Organization of Animals- II	**6**	75	-	25	100	16
ZooC-602	Applied Zoology I (Invertebrates)	**4.5**	56	-	19	75	18
ZooC-603	Evolution	**4.5**	37	-	13	50	21
ZooC-604	Seminar	**2**				50	24
ZooC-605	Biostatistics	**4.5**	37	-	13	50	25
ZooC-651	Practical- III (F.O.A.-II)	**3**	-	37	13	50	27
ZooC-652	Practical-IV(Evolution & Applied Zoology-I)	**3**	-	37	13	50	28

SEMESTER - III							
Course Code	**Course Name**	**Hours /Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
ZooC- 701	Research Techniques	**6**	75	-	25	100	29
ZooC- 702	Developmental Biology	**6**	75	-	25	100	31
ZooC- 703	General Biochemistry	**6**	75	-	25	100	34
ZooC- 704	Applied Zoology-II (Vertebrates)	**4.5**	56	-	19	75	37
ZooC- 751	Practical -V (Res. Tech. & App. Zoo.-II)	**3**	-	37	13	50	40
ZooC- 752	Practical VI (Dev. Biology &Biochemistry)	**3**	-	37	13	50	42

SEMESTER - IV							
Course Code	**Course Name**	**Hours /Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
ZooC- 801	Animal Behaviour & Wildlife conservation	**6**	75	-	25	100	43
ZooC- 802	Animal Genetics & Biotechnology	**6**	75	-	25	100	46
ZooC- 803	Concepts of Immunology	**6**	75	-	25	100	49
ZooC- 804	Biosystematics	**4.5**	37	-	13	50	51
ZooC- 851	Practical -VII (Behaviour and Wildlife)	**3**	-	37	13	50	54
ZooC- 852	Practical VIII (Genetics & Biosystematics)	**3**	-	37	13	50	56

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-I

COURSE CODE: ZooC–501

COURSE TITLE: FUNCTIONAL ORGANIZATION OF ANIMALS– I

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	Imparts conceptual knowledge of invertebrates, their adaptations and associations in relation to their environment
2	Provides a comprehensive knowledge about Complex Vertebrate interactions
3	Basic concepts of developmental & physiological aspects regarding various organ systems
4	Imparts knowledge about the evolutionary trends among different animal groups

Unit –I

- **Nutrition & Digestion**
  - Ingestion of soluble food and particulate food in relation to habitat and habits.
  - Symbiotic nutrition.
  - Mechanism of digestion and regulation of secretion in non-chordates and chordates.

Unit – II

- **Transport and Circulatory mechanisms**
  - Intracellular transport in Protozoa.
  - Circulation of external medium of transport within the body of sponges and cnidarians.
  - Open and closed types of circulatory system.
  - Chambered, tubular and ampullary hearts, neurogenic and myogenic hearts
  - Evolution of Heart and Cardiovascular system

Unit–III

- **Respiratory System:**
  - Respiratory organs in aquatic animals and aquatic respiration.
  - Respiratory organs in terrestrial animals and mode of respiration.
  - Distribution and brief chemistry of respiratory pigments and their function in non-chordates and chordates.
- **Reproduction**
  - Pattern of reproduction in non-chordates and larval forms.

- Evolution of the urino-genital system in chordates with special reference to the separation of the two systems.

Unit – IV

- **Osmoregulation and Excretion**
  - Osmoconformers and osmoregulators, hyper-, hypo- and iso-osmotic mediums.
  - Excretion and metabolic waste products – an introduction.
  - Excretory structures and waste disposal in non-chordates, coelom, coelomic ducts, nephridia, antennal / green glands, malpighian tubules.
  - Osmoregulation in non-chordates, adaptation to different environments / habitats.
  - Development and adult structural organization of chordate kidney: nephron, the functional unit.

Suggested Reading Material:

1. Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
2. Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan.
3. Brusca, R. C. and Brusca, G. J. (2003), Invertebrates second edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
4. Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
5. Hill, R. W., Wyse, G. K. and Anderson, N. (2004), Animal physiology. Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA.
6. Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.
7. Karp, G.(2005), Cell and Molecular Biology; concepts and experiments (4th ed.),Hoboken, John Willy and Sons, New York.
8. Meglitsch, P. A. and Schran, F. R. (1991), Invertebrate Zoology 3rd Ed. Oxford University Press, New York.
9. Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books seller & Publishers, Agra.
10. Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
11. Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate Zoology 7th ed. Saunders Publ., Philadelphia.
12. Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, New York.

COURSE OUTCOMES

CO-1	Understand the anatomical aspects of different animals
CO-2	Have a better understanding of structure and function of animal body.
CO-3	Have an insight of the internal systems and their functions
CO-4	Understand the physiological aspects regarding various organ systems
CO-5	Have a comprehensive knowledge about the evolutionary trends among different animal groups.

PROGRAMME CODE: MZOO
M.Sc. Zoology Semester-I
COURSE CODE: ZooC–502
COURSE TITLE: ANIMAL ECOLOGY

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	This paper introduce students to population ecology & environmental physiology
2	Imparts knowledge about various sampling techniques
3	Provides knowledge about biotic & abiotic world, habits & habitat and various adaptations for living in different environments
4	Students will learn about various protective mechanisms
5	Students will gain knowledge about various ecological interactions

Unit – I

- **Introduction and History of Ecology**
  - Structure and Functions of some special types of ecosystems (Grasslands, forests, deserts and aquatic ecosystems).
- **Weather**
  - Temperature, Moisture, Light, fire, Malentite, pollution

Unit – II

- **Analysis of Environment**
  - Resource
  - Food, its distribution, relative and absolute shortages
  - Place in which to live
- **Community Structure**
  - Ecological Niche, Food chains, Food webs, biomagnifications, succession / temporal changes.
- **Interactions and Coactions**
  - Between animals of same kind
  - Between animals of different kind
  - Predation, Parasitism, Commensalism, Mutualism etc.

Unit- III

- **Adaptations**
  - Cave, deep sea, arboreal, aerial, and subterrestrial.
  - Co-adaptations and adaptive resemblances (mimicry, warning colouration, seasonal polymorphism)
- **Population Ecology**
  - Concept of Population
  - Biotic potential and carrying capacity, dispersal and distribution, population growth and its regulations.
- **Methods of sampling**
  - Life tables and longevity
  - Migration and Ecesis

Unit – IV

- **Applied Ecology**
  - Anthropogenic interferences
  - Bio monitoring of environment using animal species
  - Modeling and Use of remote sensing (GIS) in ecology (introduction)
  - Ecological basis of pest regulation (in brief)
- **Bio Geography**
  - Zoo Geographical regions
  - Island ecology (endemicity)

Suggested Reading Material:

1. Anderwartha, H.G. and Birch, L. C. (1970), The distribution and abundance of animals, University of Chicago Press, Chicago London.
2. Beeby, A. (1992), Applying Ecology Chapman and Hall Madras.
3. Begon, M., Harper J. L. and Townsend, C. R. (1995), Ecology – Individuals, populations and communities, Blackwell Science, Cambridge UK.
4. Brewer, R. (1994), The science of Ecology, Saunders College of Publishing, New York.
5. Chapman, J. L. and Resis, M. J. (1995), Ecology- Principles and applications, Cambridge University Press, Cambridge UK.
6. Kaeighs, S. C. (1974), Ecology with special references to animal and Man, Prentice Hall Inc.
7. Odum, E. P. (1983), Basic Ecology.
8. Putmann, R. J. and Wratten, S. D. (1984), Principles of Ecology, Crown Helm, London.
9. Salanki, J., Jeffery E. and Hughes G. M. (1994), Biological Monitoring of the Environment (A manual of Methods) CAB International, Wallingford UK.

COURSE OUTCOMES

CO-1	Student will learn about the relationship between biotic & abiotic world.
CO-2	Student will be able to learn about different habits and habitat of animal & plants
CO-3	Students will be able to learn about adaptations for different environments.
CO-4	Students will be able to gain knowledge about coloration, crypsis, mimicry and protection from predators.
CO-5	Students will gain knowledge about various types of pollution viz air, water and land pollution.

PROGRAMME CODE: MZOO
M.Sc. Zoology Semester-I
COURSE CODE: ZooC–503
COURSE TITLE: CELL BIOLOGY

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	This paper is aimed to introduce structural and functional aspects of basic unit of life i.e. cell
2	Provides knowledge about cell properties, differences, evolution of eukaryotic cell from prokaryotic cell
3	Imparts knowledge about evolutionary theories, composition and properties of cell membrane
4	Develop understanding about structural and functional aspects of various cell organelles
5	Imparts understanding about various cell surface modifications, cytoplasm inclusions and phases of cell cycle

Unit-I

- **Introduction**
  - Cell – a unit of structure and function, cell theory.
  - General Properties of the Cell, Size, shape, number, life span and death.
  - Cell types: Prokaryotes and eukaryotes, Stem cells.
- **Organization of Prokaryote Cell**
  - Mycoplasma, Bacteria, Cyanobacteria (Blue Green Algae). Structure and importance of their study.
- **From Prokaryotes to Eukaryotes**
  - Events leading to origin of eukaryotic cells. Endo symbiotic theory &recent views.
- **Structure of Cell Membrane**
  - General properties of cell membrane, chemical composition.
  - The concept of unit membrane, Various Lipoprotein models including fluid mosaic model.

Unit – II

- **Golgi Complex**
  - Structure and Function of: Cisternae, vacuoles and vesicles,

- Functions: Role in secretion, cell wall formation, packaging of intracellular products and other functions, GERL concept.

- **Mitochondria**
  - Elaboration of the plasma membrane and multi enzyme complex, outer and inner membranes, cristae, matrix, inner and outer compartments,
  - Location of enzyme complexes of TCA cycle (and ATP generation)
  - Electron transport chain, semi autonomous nature (mitochondrial DNA, RNA, ribosomes and protein synthesis)
- **Endoplasmic Reticulum**
  - Extension of cell membrane, cisternae, Site of location
  - Compartmentalization of enzymes and metabolites and their associated functions.

Unit – III

- **Ribosomes**
  - A complex of ribonucleoprotiens
  - Dynamics of association - disassociation of ribosomes into polysomes, microsomes, Site of protein synthesis (initiation, elongation, translocation and termination phases of protein synthesis), Central dogma.
- **Lysosomes**
  - Polymorphic single membrane structure, site of proteolytic activity for intracellular digestion
  - Phagocytosis, increase in lysosomal activity with age, Lipofuscin pigments, diseases associated with lysosomes.
- **Peroxisomes and Glyoxisomes**
  - Single membrane structure; site of enzyme complexes involved in hydrogen peroxide metabolism, gluconeogenesis (conversion of non carbohydrate into carbohydrates)
  - Glyoxylate pathway, microperoxisomes.
- **Cytoskeleton:** Actin filament, Myosin, Intermediate filament, microtubules.

Unit – IV

- **Cell Surface Modifications:** Glycocalyx, villi, microvilli, caveolae.
- **Cytoplasmic Inclusions**
  - Inert storage materials, glycogen, starch, lipids, metabolic crystals
- **Nucleus**
  - Nuclear membrane, pores, chromatin, (euchromatin& heterochromatin), nucleolus,
  - Eukaryote chromosomes structure (DNA, Histone and other proteins, Nucleosome and solenoid concept).
  - Kientochore, centromere and gene structure.
- **Cell Continuity**
  - Phases of cell cycles
  - Mitosis and Meiosis

Suggested Reading Material:

1. Alberts, B. Bracy, P. Lewis, J. Raff, M. Roberts K and Watson, J. (eds.) (1994). Molecular Biology of the Cell, Garland Publishing , New York.
2. Avers, C. J. (1976). Cell Biology, Van Nostrand Reinhold, New York.
3. Cooper, G. M. (2004). The cell, A Molecular Approach ASM press, Washington, D. C.
4. Chandra Roy, S and DE Kumar, K. (2001) Cell Biology. New Central Book Agency (P) Ltd. Kolkata.
5. Darnell, J. Lodish, H. and Baltimore, D. (2004). Molecular Cell Biology, 2nd edition, Freeman, New York.
6. Derobertis, E. D. P. and Derobertis, E.M.F. (1987). Essentials of Cell and Molecular Biology. Hold Saunders – Philadelphia.
7. Hopkins, C. L. (1978). Structure and Functions of Cells . Saunders – Philadelphia.
8. Karp G. (1999). Cell and Molecular Biology. Concepts and Experiments, 2nd Editon John Wiley and Sons, Inc. New York, Brisbane, Toronto.
9. Powar, C. B. (1990). Cell Biology. Himalaya Publishing House, Bombay.
10. Sadava, D. E. (1993). Cell Biology – Organelle, Structure and Fucntions. H. Jones and Bartlett- Boston.
11. Smith & Wood (1992). Cell Biology, Chapman & Hall, London, New York.
12. Wolfe, S. L. (1983). Introduction of Cell Biology, Woodworth Belmont.

COURSE OUTCOMES

CO-1	The students will be able to understand the cell theory and cell principle.
CO-2	Understanding of properties of cell like cell size, shape, number, life span and death
CO-3	Differentiate between prokaryotic and eukaryotic cell.
CO-4	Know the structure of Mycoplasma, Bacteria, Cyanobacteria and importance of their study.
CO-5	Study the theories of evolution of eukaryotic cell from prokaryotic cell.
CO-6	Develop understanding about composition and properties of cell membrane including various lipoprotein models.
CO-7	Study the structure and functions of the cell organelles like Golgi complex, Endoplasmic reticulum, Mitochondrion, Ribosomes, Peroxysomes and glyoxysomes.
CO-8	Develop understanding about various cell surface modifications: Glycocalyx, Microvilli and Caveolae.
CO-9	Familiarized of various cytoplasmic inclusions in the cytoplasm: Glycogen, Starch, lipids, metabolic crystals.
CO-10	Study the cytoskeleton including microtubules, actin, myosin, intermediate filaments and their role in muscle contraction.
CO-11	Understand the phases of cell cycle including Mitosis and Meiosis.

PROGRAMME CODE: MZOO
M.Sc. Zoology Semester-I
COURSE CODE: CS-Zoo411
COURSE TITLE: COMPUTER FUNDAMENTALS & DATA PROCESSING

Credit hours/week: 4 hrs.
Total hours: 60 hrs.
Maximum Marks: 50
Theory: 37
Examination Time: 3 hrs. **Internal Assessment: 13**

Instructions to the Paper setters:

Note: 1. Medium of Examination is English Language.

2. The question paper covering the entire course shall be divided into three sections.

Section A: (Total weightage 09 marks). This section will have 9 compulsory very short answer type questions. Each question will carry 1 mark. Questions are to cover the whole of syllabus.

Section B: It will consist of essay type/numerical questions up to five pages in length. Four questions numbering 2, 3, 4 and 5 will be set by the examiner from Unit-I of the syllabus. The students will be required to attempt any two questions. Each question will carry 07 marks. The total weightage of this section shall be **14 marks.**

Section C: It will consist of essay type/numerical questions up to five pages in length. Four questions numbering 6, 7, 8 and 9 will be set by the examiner from Unit-II of the syllabus. The students will be required to attempt any two questions. Each question will carry 07 marks. The total weightage of this section shall be **14 marks**.

Course Objectives: Enable the student to

1.	To be proficient in office automation applications
2.	Handle the word processing software.
3.	Understand that in In Today's commercial world, automation helps the users with a sophisticated set of commands to format, edit, and print text documents.
4.	Use it as valuable and important tools in the creation of applications such as newsletters, brochures, charts, presentation, documents, drawings and graphic images.

Unit-I

MS-Word-2010: Overview of word processing software, creating, saving and opening a new file in MS-Word, various formatting tools, paragraphs and sections, indents and outdents, lists and numbering, types of lists, Headings, styles, fonts and font size. Editing, positioning and viewing texts, Finding and replacing text, inserting page breaks, page numbers, book marks, symbols and dates, Inserting header, footer, mail merge.

Unit-II

MS-Excel-2010: Worksheet: Introduction to worksheet, worksheet basics, building a worksheet, moving within worksheet, entering data into worksheet, saving & quitting worksheet, opening and moving around in an existing worksheet

Working with Formulae: cell referencing, use of formulae, auto sum, copying formulae, absolute & relative addressing, working with ranges- creating, editing and selecting ranges

Previewing & Printing Worksheet: page setting, print titles, adjusting margins, page break, headers and footers.

Unit-III

Graphs and Charts: using wizards, various charts type, formatting grid lines & legends, previewing & printing charts.

Data processing using excel: Pivot table, use multiple pivot tables and pivot charts to create dashboard, connect multiple slicers to the pivot tables, filter the data shown in the pivot, using formulas in pivot tables.

Unit-IV

MS-Power Point 2010: Introduction to MS Power Point, presentation overview, power point elements, exploring power point menu, entering information, presentation creation. Opening and saving presentation, slide view, slide sorter view, notes view, outline view, printing slides, formatting and enhancing text formatting

SUGGEESTED PRACTICALS

1) Introduction to MS Word
2) Creating Table in MS Word
3) Introduction to Page Formatting
4) Printing in MS Word
5) Mail Merge
6) Page Layout
7) Creating Slide Presentation in MS PowerPoint
8) Viewing the Slideshow
9) Adding Images in MS PowerPoint
10) Inserting Sound and Videos in MS PowerPoint
11) Introduction to MS Workbook
12) Creating different worksheets in MS Excel
13) Inserting Charts in MS Excel
14) Introduction to various functions in MS Excel

Books Prescribed:

1. Sinha, P.K. (1998). Computer Fundamentals. BPB Publications, New Delhi.
2. Peter Norton's (1998). Introduction to computers, Tata McGraw-Hill Publishing Company Limited, New Delhi

Course Outcomes: The student will be able to

CO-1	Use word processors, spreadsheets, presentation software.
CO-2	Describe the features and functions of the categories of application software
CO-3	Understand the dynamics of an office environment.
CO-4	Demonstrate the ability to apply application software in an office environment.

PROGRAMME CODE: MZOO
M.Sc. Zoology Semester-I
COURSE CODE: ZooC–131
COURSE TITLE: PRACTICAL-I (F.A.O.-I)

Credit hours/week: 3 hrs.
Total hours: 45 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

Course Objectives

1	Paper will teach students various digestive, nervous and muscular systems
2	Students will learn differences among invertebrates and vertebrates
3	Provide an understanding of different organs and their histological characteristics
4	Students will learn comparative systems like respiratory, reproductive and cardiovascular systems
5	Students will have a better understanding of internal systems and their functions

1. Study of permanent slides:-
- Mouth parts: honey bee, housefly, cockroach, butterfly, mosquito, and bug.
- Salivary glands.
- Blood of animals.
- Radula of Pila and jaws of Leech

2. Using slides/charts/models/videos study of following:-
- **Anatomy of gut in relation to food and feeding habits** of detritivores, carnivores, herbivores, omnivores and sanguivores.
- **Different kinds of Heart and blood vascular system in animals**.
- **Respiratory structures:** Gills (Crustaceans, Bivalves, Cephalopods, and Fish); Book Lungs (Scorpion); Trachea and spiracles (Cockroach).
- **Nephridia in annelids** (earthworm), green glands in crustaceans, Malphigian tubules in Cockroach.
- **Excretory system** of frog, lizard, bird and rat.
- **Histology** of ovary, oviduct, uterus, testis and placenta in different groups of invertebrates & vertebrates.
- **Reproductive organs** in Hydra, Flatworm, Earthworm, Cockroach, Pila, Fish, Frog, Lizard, Bird and Rat.

Minor changes in practical syllabus can be there as per the availability of materials.
*Dissections should strictly be done in accordance with the UGC guidelines and after getting approved from the Dissection monitoring committee of the respective institution.

Course Outcomes

CO-1	Understand various systems like digestive, nervous and muscular system
CO-2	Compare and contrast the systems of invertebrates and vertebrates
CO-3	Have an insight of the internal systems and their functions
CO-4	Have a better understanding histological characteristics of different organs
CO-5	Understand comparative systems like respiratory and cardiovascular systems

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-I

COURSE CODE: ZooC–552

COURSE TITLE: PRACTICAL-II (ECOLOGY & CELL BIOLOGY)

Credit hours/week: 3 hrs.
Total hours: 45 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

Course Objectives

1	The subject familiarized students with basic principle and working of various types of microscopes and lens aberrations
2	Students will acquire practical knowledge of protozoans, nematodes, soil arthropods collection methods
3	Students will learn to perform experiments related to population diversity indices and microtomy techniques
4	Perform various cytochemical techniques: carbohydrates, nucleic acids, proteins, lipids and enzymes
5	Students will study various tissues using permanent slides & cell organelles through electron micrographs

1. Population estimations: Using Mark and Release method and to study the effect of migration on them (Using Moong and Mash beans).
2. Estimation of population:
    a. Insect population using sweep net method.
    b. Protozoans
    c. Nematodes
    d. Soil arthropods
3. Combined population studies using quadrates.
4. To determine diversity indices (richness, Simpson, Shannon-Wiener).
5. Intrapopulation distribution and Poisson distribution, construction of life table and survivorship curves from given data.
6. Microscopy:
    a. Principles of compound, phase contrast and electron microscopy.
    b. Use and care of Light compound microscope.
    c. Lens aberrations
7. Study of Cells: using permanent slides
    a. Prokaryote cells: Lactobacillus, E. coli. Blue green algae.
    b. Eukaryote cells, Testicular material (for studies of spermatogenesis).
8. Microtomy:
    a. Introduction of the instrument – its use and care.
    b. Preparation of permanent slides: Principles and procedures – Section cutting of tissues and staining of tissues with Haematoxylin/Eosin method.

9. Study of permanent slides of various tissues (gut region, liver, lung, spleen, kidney, pancreas, testis, ovary, tongue, skin etc.).
10. Cytochemical techniques: Study carbohydrates, nucleic acids, proteins, lipids and enzymes.
11. Study of electron micrographs of various cell organelles – plasma membrane, Mitochondria, Golgi complex, Lysosomes, Endoplasmic reticulum (smooth and granular), Cilia, Centrioles, inclusions like glycogen, lipids etc.

Course Outcomes

CO-1.	Estimate the population size of Insect population using sweep net method.
CO-2.	Acquire practical understanding towards collection methods of Protozoans, Nematodes, Soil arthropods
CO-3.	Perform combined population studies using quadrates.
CO-4.	Perform experiments to determine diversity indices/ richness using Simpson, Shannon-Wiener methods.
CO-5.	Study intra-population distribution and Poison distribution, construction of life table and survivorship curves from given data.
CO-6	Get familiarized with basic principle and working of various types of microscopies including compound, phase contrast and electron microscope
CO-7	Develop understanding about the use and care of Light compound microscope and Lens aberrations.
CO-8	Study different cell types including prokaryote cells: Lactobacillus, E. coli. Blue green algae and Eukaryote cells: Testicular material (for studies of spermatogenesis).
CO-9	Get demonstrations regarding microtomy: Introduction of the instrument - its use and care along with the preparation of permanent slides: Principles and procedures - Section cutting of tissues and staining of tissues with Hematoxylin/Eosin method.
CO-10	Study various tissues (gut region, liver, lung, spleen, kidney, pancreas, testis, ovary, tongue, skin etc.) using permanent slides & cell organelles through electron micrographs.
CO-11	Perform various cytochemical techniques: carbohydrates, nucleic acids, proteins, lipids and enzymes.

*Minor changes in practical syllabus can be there as per the availability of materials.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-II

COURSE CODE: ZooC–601

COURSE TITLE: FUNCTIONAL ORGANIZATION OF ANIMALS–II

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

Course Objectives

1	This topic will provide a thorough knowledge about the evolution of invertebrates and vertebrates
2	Provides a better knowledge of human body and its systems
3	Understand the various anatomical aspects of different animals
4	Students will learn physiological aspects regarding various organ systems
5	Students will learn an insight of the internal systems and their functions

Unit - I

- **Integumentary System**
  - Embryonic origin
  - General features of the Integument
  - Specializations of integument
  - Evolution of Skin
- **Muscular System**
  - Classification of Muscles, Structure of Skeletal Muscles and cardiac muscle, Tendons
  - Muscle mechanics
  - Muscle Function Basis of Muscles contraction,
  - Muscle Fiber, Muscle organs and fibers
  - Bone-muscle lever systems

Unit–II

- **Skeletal System**
  - Exo- and Endo-Skeleton in Invertebrates
  - Appendicular skeleton in vertebrates, Basic Components
  - Phylogeny of fishes and tetrapods
  - Evolution of the Appendicular system
  - Form and Function
  - Swimming

- Terrestrial locomotion

Unit – III

- **Integratory Systems**
  - Chemical coordination of body functions through neuro-secretion in non-chordates.
  - Physiology of nerve net and giant fibre system.
  - Evolution of functional anatomy of brain.
- **Endocrine System**
  - Endocrine organs
  - Chemical coordination of body functions through hormones and neuro secretions

Unit-IV

- **Sensory System**
  - General sensory organs
  - Free sensory receptors
  - Encapsulated sensory receptors
  - Associated sensory receptors
  - Mechanisms of perceiving stimuli
  - Special sensory organs (Mechano, Radiation, Chemo and Electro-receptors)
  - Additional special sensory organ

Suggested Reading Material:

1. Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
2. Brusca, R. C. and Brusca, G. J. (2003), Invertebrates Second Edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
3. Cooper, G. M. (2004), The Cell: A Molecular Approach, IIIrd edition, ASM Press, Washington, D.C.
4. Engemann, J. G. and Hegner, R. W. (1981), Invertebrate Zoology (3rd ed.) Macmillan, New York.
5. Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
6. Hill, R. W., Wyse, G. K. and Anderson, N. (2004), Animal Physiology. Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA.
7. Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.
8. Karp, G.(2005), Cell and Molecular Biology; Concepts and Experiments (4th ed.), Hoboken, John Willy and Sons, New York.
9. Meglitsch, P. A. and Schran, F. R. (1991), Invertebrate Zoology 3rd Ed. Oxford University Press, New York.
10. Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books Seller & Publishers, Agra.
11. Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
12. Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate Zoology 7th ed. Saunders Publ., Philadelphia.
13. Willmer, P. . Stone, G. and Johnston, I (2000). Environmental Physiology of Animals, Blackwell Science.
14. Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, New York.

COURSE OUTCOMES

CO-1	Have an insight of the internal systems and their functions
CO-2	Have a better understanding of our own body
CO-3	Understand the various anatomical aspects of different animals
CO-4	Understand the physiological aspects regarding various organ systems
CO-5	Have a knowledge about the evolution among different invertebrates and vertebrates

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-II

COURSE CODE: ZooC–602

COURSE TITLE: APPLIED ZOOLOGY- I (INVERTEBRATES)

Credit hours/week: 4.5 hrs.
Total hours: 67.5 hrs.
Maximum Marks: 75
Theory: 56
Internal Assessment: 19

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 12 marks). This section will have 6 compulsory very short answer type questions. Each question will carry 2 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 44 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 11 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	This paper is aimed to introduce Prawn, Fish, Pearl culture, Apiculture, Lac culture and Sericulture
2	Students will teach economically important arthropod species and their significance
3	To understand the knowledge about the cultivation of Mulberry, maintenance of the farm, seed technology, silkworm rearing and silk reeling.
4	Students learn farm management, techniques and hatchery operations of prawn and pearl culture
5	Imparts knowledge about vermiculture and vermicomposting at domestic and commercial level

Unit – I

- **Arthropods (Important Species and their Economic Importance)**
  - Diplopods and Chilopods
  - Arachnids (other than plant pests)
  - Insects (other than insect pests of crops, parasite of man and domestic animals)
    - As pollinators
    - In Biological pest management
    - As source of food
    - Venomous insects
- **Apiculture**
  - History and Introduction
  - Honey bee and kinds
  - Social organization and colony nests
  - Life Cycle
  - Relation between honeybees and plants
  - Flora for Apiculture
  - Honey composition, quality and importance
  - Bee keeping, selection, methods, precautions
  - Products of bee keeping

- Bee enemies and diseases

Unit – II

- **Lac culture**
  - Introduction
  - Lac insects: species, Life cycle and Host plants
  - Lac composition, properties & importance
  - Cultivation and Harvesting of Lac
  - Enemies of Lac insect and host plants
  - Lac industry in India
- **Sericulture**
  - Indian sericulture in industry distribution and prospects
  - Silkworm moth species and their Life Cycle
  - Silk composition, kinds and uses
  - Mulberry cultivation
  - Rearing of silkworm
  - Treatment and disposal of cocoons
  - Silk reeling, twisting and weaving
  - Diseases & pests of silkworm

Unit – III

- **Crustaceans (Important species and their Economic Importance)**
  - Crab, lobsters, copepods.
- **Prawn Culture**
  - Introduction to prawns
  - Prawn: species
  - Fresh water prawn farming and Marine Prawn farming
  - Methods of Prawn farming.
  - Spoilage and its prevention.
  - Processing and preservation of prawns.
  - Future of prawn culture
- **Molluscans (**Economically important species**)**
  - Eulamellibranchs
  - Gastropods
  - Cephalopods
- **Pearl Culture**
  - Pearl culture, Historical background
  - Pearl oyster –species
  - Pearl formation, composition, quality and commercial value
  - Artificial culturing of pearls, synthetic pearl types and their manufacturing.
  - Methods of harvesting
  - Problems of pearl industry

Unit – IV

- **Economic Importance of :-**

- **Protozoans**
  - Important Parasitic species, diseases caused, prevention and cure.
- **Annelids**
  - Leeches
  - Vermiculture - Species of worms, condition for efficient vermiculture (domestic and commercial level), Economics of Vermiculture
- **Helminthes ((Important species and their Economic Importance)**
  - Liver flukes
  - Cestodes/ tapeworms
  - Roundworms (Animal and plant parasitic Nematodes)
- **Echnioderms** (Important species and their Economic Importance)
  - Sea cucumbers,
  - Star Fish

Suggested Reading Material

1. Bhamrah, H. S. &Juneja, K. (2001), An Introduction to Mollusca. Anmol Publications Pvt,. Ltd. New Delhi.
2. Bhatnagar, R. K. and Palta, R. K. (2003), Earthworm ; Vermiculture and Vermicomposting , Kalyani Publishers India.
3. Carter, G. A. (2004) Beekeeping , Biotech Books, New Delhi.
4. Fenermore, P. G. and Prakash, A. (1992), Applied Entomology, Wiley Eastern Ltd. New Delhi.
5. Ghorai, N. (1995), Lac Culture in India. International Books and Periodicals, New Delhi.
6. Jhingran , V. G. (1991) Fish and Fisheries of India, Hindustan Publishing Company India.
7. Kumar, A. and Nigam, P. M. (1989), Economic and Applied Entomology EMKAY Publishing Co. New Delhi.
8. Mishra, R. C. (1995), Honey Bees & their Management in India. ICAR, New Delhi.
9. Mustafa, S. (1990) Applied and Industrial Zoology. Associated Publishing Company, New Delhi.
10. Shukla, G. S. &Upadhaya, V. B. (1991-92), Economic Zoology, Rastogi Publications, Meerut.
11. Sathe, T. V. and Jadhav, A. D. (2001) Sericulture and Pest Management, Daya Publishing House, New Delhi.
12. Shimizu, M. (1972) Handbook of Silkworm Rearing (Agricultural Techniques Manual-1) Fuji Publishing Co. Ltd , Tokyo, Japan.
13. Singh, S. (1962), Bee Keeping in India, I. C. A. R. Publications, New Delhi.
14. Sobti, R. C. (1992), Medical Zoology, Nagin Chand & Co. Jalandhar.
15. Srivastava, P. A. (1977), Economic Zoology, Commercial Publication Bureau, Kanpur.
16. Ullal, S.R. and Narsimhanna, M. N. (1981), A Handbook of Practical Sericulture, Central Silk Board, Bombay.

COURSE OUTCOMES

CO-1	Be familiar with the economically important arthropod species and their significance
CO-2	Develop a knowledge of farming of insects for increasing food production
CO-3	Understand importance of insects as pollinators and bio-control agents
CO-4	Utilize modern methods and economic aspects of apiculture, sericulture and lac culture
CO-5	Identify different species and casts of honeybees and species of silkworm.
CO-6	Analyze harvesting and marketing strategies of prawn and pearl culture
CO-7	Understand the significance of vermicomposting at domestic and commercial level.
CO-8	Identify economically important protozoans, helminthes and echinoderms

PROGRAMME CODE: MZOO
M.Sc. Zoology Semester-II
COURSE CODE: ZooC–603
COURSE TITLE: EVOLUTION

Credit hours/week: 3 hrs.
Total hours: 45 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 09 marks). This section will have 6 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 28 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 07 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	This course helps students to gain fundamental knowledge about origin of life
2	Knowledge of evolutionary theories and evidences will be imparted
3	Topics related to natural selection and variations will be discussed
4	Students will learn about speciation and extinction
5	Students will learn topics related to quantitative and molecular aspects of evolution

Unit – I

- **Origin of Life**
  - Origin of Micro molecules
  - Origin of Macro molecules
  - Origin of Viruses
  - Origin of Genetic code
  - Origin of Prokaryotes
  - Origin of Unicellular eukaryotes and multicellularity
- **Organic Evolution**
  - Theories
  - Evidences
  - Separation of kingdoms

Unit –II

- **Variations**
  - Types of variations
  - Causes of variations
  - Mutation rates and directions
- **Natural Selection:**
  - Types of selection
  - Selection forces

- Experimental demonstration of Natural selection
- Industrial melanism and polymorphism
- Sexual selection
- Selection and non adaptive character

Unit-III

- **Speciation**
  - Isolation and its types
  - Gradual and abrupt
  - Origin of higher categories
- **Distribution of Species**
  - Island, Ocean and Continental distribution
  - Theories of continental drift.
- **Extinction**
  - Kinds of extinction
  - Causes of extinction
  - Great extinctions

Unit-IV

- **Quantative and Molecular Aspects of Evolution**
  - Hardy- Weinberg law
  - Selection pressure
  - Mutation pressure
  - Genetic drift
  - Migration
  - Meiotic drive
  - Brief account:
    - Evolution of genome in viruses, prokaryotes and eukaryotes
    - Evolution of sexual reproduction
    - Molecular clocks
    - Future Course of Evolution

Suggested Reading Material

1. Avers, C. J.(1989). Evolution Process and Pattern in Evolution Oxford University, Press, New York, Oxfor.
2. Ayala, F. J. and Valentine J. W. (1979). Evolving the theory and Process of Organic Evolution, Benjamin Cumming.
3. Brookfield, A. P. (1986). Modern aspects of Evolution. Hutchinson London, Melbourne.
4. Gallow, P. (1983). Evolutionary principles. Chapman and Hall.
5. Freeman, S. and Herron, Jon C. (2007). Evolutionary analysis Pearson Prentice Hall, New Jersey.
6. Futuyma, D. J. (1998), Evolutionary Biology, Sinauer Assoc. Inc. Pub. USA.
7. Meglitsch, P. A. (1991), Invertebrate Zoology (3rd edition), Oxford University Press.
8. Minkoff, E. C. (1983), Evolutionary Biology, Addison Wesley Pub. Co., London.
9. Wen-Hsiung Li (1997), Molecular Evolution, Sinauer associates Inc.Pub. USA.

COURSE OUTCOMES

CO-1	Students will know about population genetics, human evolution, various concepts about origin of species, extinctions, phylogenetic tree making
CO-2	A student who has completed the course should have solid knowledge of fitness, the measure for selection, and how it can be measured empirically
CO 3	Upon completion of the course, a student should be able to counter arguments against evolution, critically evaluate popularized writings which take up evolutionary topic or use evolutionary argumentation.
CO-4	Upon completion of the course, a student should be able to better distinguish scientific from unscientific arguments
CO-5	After the course, a student should be able to see evolutionary biology as a powerful set of tools for approaching current changes in biodiversity and addressing future challenges.

PROGRAMME CODE: MZOO
M.Sc. Zoology Semester-24
COURSE CODE: ZooC–604
COURSE TITLE: SEMINAR/ PROJECT

Credit hours/week: 2hrs.
Total hours: 30 hrs.
Maximum Marks: 50

Instructions:

The students are required to present a seminar on a topic of relevance and importance from the subject of Zoology or carry out research project on the assigned topic and present a seminar. The seminar carries 50 marks (10 for material, 15 for presentation, 5 for discussion and 20 for the seminar based paper at the end of the semester).

COURSE OBJECTIVES

1	To inculcate knowledge regarding presentation techniques
2	To enhance the scientific writing skills including introduction, methodology, techniques, results, discussion, and bibliography.
3	To provide knowhow regarding project work/field study.

COURSE OUTCOMES

CO-1	Institutional cum field work study report emphasizes theoretical aspect development.
CO-2	Students are able to develop good presentation technique through the use of multimedia and other teaching aids.
CO-3	Students develop skills for collection and analysis of data.
CO-4	Evaluation of the project report enhances viva voce capabilities through open defense type interactions.

PROGRAMME CODE: MZOO
M.Sc. Zoology Semester-II
COURSE CODE: ZooC–605
COURSE TITLE: BIOSTATISTICS

Credit hours: 4.5 hrs.
Total hours: 67.5 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

Note: The question paper will be set as per the pattern given below:

Section A: (Very short answer-type) It will consist of 7 questions. All are compulsory. Each question carries 1 mark (Total 07 marks).

Section B: (Short answer-type) The candidate will be required to attempt any 6 questions out of the given 10questions. Each question carries 3 marks. (Total marks 18).

Section C: (Essay type) The candidates will be required to attempt any 2 questions out of the given four questions. Each question carries 6marks. (Total marks 12).

UNIT-I

- **Elementary Statistics**

Representation of data- discrete data, continuous data, histogram, polygons, frequency curves. The mean Variability of data, Standard deviation.Median, Quantiles, Percentile, Skewness, Box and whisker diagrams (box plots), Introduction to statistical sampling from a population, Random Sampling.

UNIT-II

- **Probability**

Experimental Probability, Probability when outcomes are equally likely, Subjective Probabilities, Probability laws Probability rules for Combined events, Conditional Probability and Independent Events, Probability trees, Bayes theorem. Probability Distribution Bernoulli Distribution, Binomial Distribution Poisson Distribution Uniform Distribution Normal Distribution, Normal approximation to binomial distribution, Central limit theorem.

UNIT-III

- **Multivariate Analysis**

Regression and correlation:, Correlation & Regression, Scatter diagram, Regression function, Linear correlation and regression lines, Product moment correlation coefficient. Cluster analysis: Basics (Tree clustering), Distance Measures, Hierarchial tree, linkage rules (single and complete linkage, UPGMA), Two-way joining, k-means clustering and interpretation of results, expectation maximization. Principal Component Analysis (PCA): Principles and Applications to real life data.

UNIT-IV

Random Variables Discrete and continuous Random variables Cumulative distribution function, Probability Mass function, Probability Density Function Expectation of random variables experimental approach and theoretical approach. Expectation of X and variance of X, Expectation of function

E[g(X)] . Hypothesis Testing: Fischer test, Chi Square test, Student ttest, ANOVA in reference to experimental deign.

Suggested Reading Material:

1. Batschelet, Mathematics for Life Sciences
2. Hussain I. et. al. Mathematics, A textbook for class XI, NCERT.
3. Joshi, D.D. et. al. Mathematics, A textbook for class XII, NCERT.
4. S. Sokal, R. and James F. Introduction to Biostatistics.

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-II

COURSE CODE: ZooC–271

COURSE TITLE: PRACTICAL-III (F.A.O.-II)

Credit hours/week: 3 hrs.
Total hours: 45 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

Course Objectives

1	Course will provide an understanding of histological characteristics of different organs like skin, muscle fibers and endocrine glands
2	Students will learn to compare and contrast various invertebrate systems
3	Provides an understanding about insect morphology and insect wings
4	Students will gain knowledge about comparative anatomy of nervous system
5	Provides knowledge about comparative antennary and wing modifications of insects

1. Study of permanent slides:
   - Skin of fish, frog, lizard, bird and mammal.
   -Setae of earthworm
   -Spicules of Sponges and Herdmania.
   -Internal ear of fish
   - Tentorium of grasshopper
   - Muscle fibers, cartilage and bone.
   - Endocrine glands of vertebrates.
2. Appendicular skeleton.
3. Study the following with the help of charts/models/videos/permanent slides.
   - Appendages of Prawn
   - Wing venation, coupling and types of wings of insects.
   - Comparative anatomy of nervous system in Earthworm, Cockroach, Pila, Sepia, Fishes, Bird and Mammal.
   - Eye muscles of fish/mammal
   - Modification of antenna in arthropods

*Minor changes in practical syllabus can be there as per the availability of materials.

**Dissections should be done in accordance with the UGC guidelines and after getting approved from the Dissection monitoring committee of the respective institution.

Course Outcomes

CO-1	Have a better understanding histological characteristics of different organs like skin
CO-2	Compare and contrast the systems of invertebrates
CO-3	Have an understanding insect morphology and wings
CO-4	Understand various systems like nervous system
CO-5	Understand comparative antennary and wing modifications of insects

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-II

COURSE CODE: ZooC–282

COURSE TITLE: PRACTICAL-IV (EVOLUTION & APPLIED ZOOLOGY-I)

Credit hours/week: 3 hrs.
Total hours: 45 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

Course Objectives: Students will learn to

1	use regression, correlation and variance analysis for gene frequency
2	Have knowledge about Hardy-Weinberg law and its application on a population
3	Handle various tools, crafts and gears used in Apiary, Fishery, Sericulture and Pest control
4	Analyze the physico-chemical characteristics of honey, qualities of lac & vermicompost.
5	Visit apiary, vermicomposting unit, sericulture unit and prawn farm and learn to prepare reports

1. Calculations for regression, correlation and variance of gene frequency and genetic equilibrium (taking pea pods).
2. Examination of principle of natural selection as a process related to evolution in a population (using colored marbles / beads).
3. Comparison of skeleton for listing evolutionary trends.
4. Comparison of molluscan shells to depict polyphyletic origin.
5. Comparison of homologous & analogous structures (e.g. insect antenna, legs, vertebrate limbs etc.).
6. Demonstration of kinds of mimicry in various groups of animals.
7. Mapping of geographic distribution of some birds, insects, fish etc.
8. Study of various evolutionary phenomenon using slides / photographs.
9. Study of fossils.
10. Preparation of Phylogenetic tree using some Priory weight characters with the help of 8 – 10 animals from various categories.
11. Physico-chemical analysis of honey.
12. Physico-chemical analysis of vermicompost.
13. Study of various qualities of lac.
14. Visit to apiary/vermicomposting unit/ sericulture unit/ Prawn Farm and preparation of report

* Minor changes in the practical syllabus can be done as per availability of the material.

Course Outcomes

CO-1	Use regression, correlation and variance analysis for gene frequency
CO-2	Hardy-Weinberg law and its application, phenomena of natural selection in a population
CO-3	Compare vertebrates skeleton to understand evolutionary trends
CO-4	Understand phylogenetic tree and polyphyletic origin of characters
CO-5	Map geographic distribution of animals
CO-6	Compare and contrast homology and analogy
CO-7	Observe the various tools, crafts & gears used in Apiary, Fishery, Sericulture and Pest control
CO-8	Analyze the physico-chemical characteristics of honey, qualities of lac & vermicompost
CO-9	Understand apiary, vermicomposting unit, sericulture unit and prawn farm

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-III

COURSE CODE: ZooC–701

COURSE TITLE: RESEARCH TECHNIQUES

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	This paper is aimed to understand systematic approach to research and also study of systematic approach to solving a research problem by applying appropriate research methods
2	Students will learn centrifugation, chromatography and spectroscopy
3	Students will develop an insight into electrophoretic techniques
4	Course will develop an understanding about radio isotopic techniques and scintillation counters
5	To equip the learner to use the tools and techniques for project work research in biology.

Unit-I

- **Centrifugation**
  - Basic principles, theory and applications of preparative and analytical centrifugation
  - Rotor types, sedimentation co-efficient and care of rotors
- **Chromatography**
  - Theory, principle and application of column, paper, thin layer, ion-exchange affinity chromatography, GLC, HPLC and FPLC

Unit-II

- **Spectroscopy**
  - Lambert Beer's law, theory & principles of single and double beam UV/Visible spectroscopy
  - Principle of NMR, ESR, Mass spectroscopy and their application in biology for qualitative and quantitative determination of biomolecules
  - Introduction to fluorescence spectroscopy and IR spectroscopy

Unit-III

- **Electrophoresis**
  - Theory and application SDS-PAGE and Agarose Gel electrophoresis
  - Introduction to IEF, (Iso-electric focusing) 2-D gel and capillary electrophoresis

- Applications in biology for isolation of biomolecules based on charge and molecular weight

- **Introduction to gene amplification techniques**

Unit-IV

- **Radioisotopic Techniques**
  - Basic concepts of radioisotopy
  - Theory and applications of Geiger- Muller tube, solid and liquid scintillation counters, primary and secondary fluors
  - Safety rules for radioisotopic studies
  - Biological applications

Suggested readings:

1. Freifelder, D (1982). Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2nd edition, W.H. Freeman & Company, San Fransisco.
2. Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi
3. Slater, R.J. (1990). Radioisotopes in Biology- A Practical Approach, Oxford University Press, NY.
4. Tinoco Kenneth Saur and J.C. Wang. Physical Chemistry: Principles and Applications in Biological Sciences, 3rd edition.
5. Wilson, K and Goulding, K.H. (1991). Biologist's Guide to Principles and Techniques of Practical Biochemistry. 3rd., Edward Arnold, London.

COURSE OUTCOMES

CO-1	To develop an understanding regarding centrifugation and chromatographic techniques
CO-2	To teach each and every aspect of spectroscopy
CO-3	To develop an insight into electrophoretic techniques related to carbohydrates and proteins
CO-4	To develop an understanding about radio isotopic techniques and scintillation counters

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-III

COURSE CODE: ZooC–702

COURSE TITLE: DEVELOPMENTAL BIOLOGY

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

Course Objectives

1	To understand the basic concept of developmental biology. To acquire an in depth knowledge of the relationship between gene and development as well as environment and development.
2	Students will gain knowledge about assisted reproductive technologies like IVF and ET.
3	Introduction about the morphology of sperm & ovum; process of fertilization
4	Outline and study the developmental stages in vertebrates
5	Develop an understanding about regeneration and metamorphosis

Unit – I

- **Gametogenesis and Fertilization**
  - Spermatogenesis and oogenesis, vitellogenesis
  - Egg and sperm interaction, fertilization
  - Natural and artificial parthenogenesis.
  - In vitro fertilization and embryo transplantation.

Unit – II

- **Cleavage, Gastrulation & Differentiation**
  - Cleavage and its patterns
  - Biochemical changes during cleavage, influence of male and female pronuclei during early development
  - What determines cleavage pattern
  - Gastrulation and morphogenetic movements
  - Morphogenesis of germ layers
  - Morphogenetic field
  - Differentiation
  - Determination
  - Transdetermination

Unit – III

- **Induction and Maturation**
  - Induction, organization, competence and inductive response, Hierarchies of induction, principles of reciprocal action
  - Control of metamorphosis and morphophysiology of metamorphosis in insects and frog
  - Regeneration in Platyhelminthes and Coelenterates
  - Histomorphological changes in regeneration of
    - Tail in Amphibians and Reptiles
    - Limb in amphibians
    - Vertebrate lens
  - Concept of growth at cellular, subcellular and organ level.

Unit – IV

- **Genetic Control of Development**
  - Nuclear determination of developmental events.
  - Molecular basis of early embryonic development.
  - How is genetic control exercised during development.
  - Influence of extrinsic factors on genetic control
  - Nucleus and cytoplasmic interactions during development.

Suggested Readings:-

1. Balinsky, B.I. (1981). An Introduction to Embryology, Saunders, Philadelphia.
2. Bellairs, R. (1971). Development Processes in Higher Vertebrates, University of Miami Press, Miami.
3. Berrill. N.J. (1971): Developmental Biology. McGraw Hill, New Delhi.
4. Browder, L. Developmental Biology, a Comprehensive Synthesis Plenum, New York.
5. Dawnpart, Developmental Biology.
6. Ebert, J.D. & Sussex, IM. (1970): Interacting Systems in Development, Holt, Rinehart and Winston, New York.
7. Gilbert, F. (1985, 95 & 2000): Developmental Biology, Sinaur.
8. Goel, S.C. (1984): Principles and Animal Developmental Biology, Himalaya, Bombay.
9. Grant, P. (1978): Biology of Developing System.
10. Karp. G. &Berrill, M.J. (1981): Development. McGraw Hill, New Delhi.
11. Loomis, W.F. (1986) Developmental Biology Macmillan, New York.
12. Miller, W.A. (1997). Developmental Biology Springer Verlag, New York.
13. Oppenheimer, J.M. and Willer, B.H. (1964): Foundation of Experimental Embryology, Prentice-Hall, New Delhi.
14. Pritchard, D.J. (1986): Foundation of Development Genetics, Taylor and Francis, London.
15. Saunders, J.W. (1982): Developmental Biology, Patterns, Principles, Problems, MacMillan, New York.
16. Spratt, N.T. Jn. (1971): Developmental Biology, Wordsworth, Belmont, Co.
17. Waddigton CH. (1966): Principles of Development and Differentiation. MacMillan, New York.

COURSE OUTOMES

CO-1	Learn the concepts of developmental biology, gametogenesis, the process of differentiation of eggs and sperms before fertilization
CO-2	Knowledge of assisted reproductive technologies like IVF and ET
CO-3	Understand and appreciate the genetic mechanisms development
CO-4	Understanding the role of model organisms
CO-5	Understand the causes of infertility and can take preventive measures
CO-6	Understanding and significance of regeneration and metamorphosis
CO-7	Understand the events that led up to and comprise the process of fertilization
CO-8	Know about macro-, meso- and micromeres which form into specific cells in the embryo
CO-9	Find scope to do research on different developmental processes of animals
CO-10	Study theories of preformation, concepts like growth, differentiation & reproduction
CO-11	Describe the key events in early and systematic embryological development
CO-12	Elucidateofearlyembryonicdevelopmentofinvertebratesandvertebrates
CO-13	know the inducer and inductor role in embryogenesis and
CO-14	Knowledge about metamorphosis and the process of regeneration.
CO-15	Explain the concept of mesoderm induction and pattern formation with examples.

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-III

COURSE CODE: ZooC–703

COURSE TITLE: GENERAL BIOCHEMISTRY

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

Course Objectives

1	Understand the fundamental chemical principles that govern complex biological systems.
2	To perform, analyze & report an experiments and observations in physiology and biochemistry
3	To appreciate the chemical foundation of life processes. To understand the structure and metabolism of biologically significant molecules
4	Biochemical understanding through scientific enquiry into the nature of mechanical, physical, and biochemical functions of humans, their organs, and the cells of which they are composed

Unit – I

- **Biomolecules**
  - Biological fitness of organic compounds. Dimension and shape of biomolecules
  - Supramolecular structures and cell organelles
- **Water**
  - Physical properties and structure of water, hydrogen bonding
  - Solvent properties of water, ionization of water, fitness of aqueous environment for living organism
  - pH and buffers
- **Proteins**
  - Amino acids as building blocks of proteins, essential amino acids, non-protein amino acids, structure of peptide bond
  - Organizational levels of protein structure. Relationship between primary and higher order structures
  - Supramolecular assemblies of proteins
  - Solubility denaturation, functional diversity and species specificity of proteins, chemical synthesis and sequencing of polypeptides
  - Protein classification

Unit – II

- **Enzymes**
  - Catalytic specificity
  - Enzyme substrate complex, active sites
  - Michaelis – Menton kinetics, Vmax and Km and their significance
  - Reversible and Irreversible inhibition, Regulatory enzymes
- **Carbohydrates**
  - Definition, families of monosaccharides, structure of carbohydrates, stereoisomerism, trisaccharides and polysaccharides (starch, glycogen, cellulose, dextrins)
  - Sugars of bacterial cell wall

Unit – III

- **Lipids**
  - Definition and Classification of lipids
  - Fatty acids and essential fatty acids
  - General structure and functions of major lipid subclasses, acylglycerols, phosphoglycerides, Sphingolipids, terpenes, steroids and prostaglandins.
- **Biological membranes**
  - Common features, structural components, phospholipids, glycolipids and cholesterol.
  - Lipid bilayer and membrane proteins
  - Fluid mosaic model and membrane asymmetry
  - Transport across membranes.

Unit – IV

- **Generation and storage of metabolic energy**-Bioenergetics of Metabolic Pathways:
  - Glycolysis
  - Pentose phosphate pathway
  - Glyoxalate
  - Citric acid cycle
  - Oxidative phosphorylation
  - Gluconeogenesis
  - β oxidation of fatty acids
  - Biosynthesis of saturated fatty acids
  - General reactions and metabolism of amino acids.
- **Nucleic Acid Structure:**
  - Watson and Crick model of double DNA helix, synthesis of Nucleotides
  - Chemical Synthesis of Nucleic acid.

Suggested Reading Material:

1. Conn, E.E., Stump. P.K. Bruening, S. and Doi R.H. (1987) Outlines of Biochemistry 5th edition John Wiley and Sons Inc., New York.
2. Fischer, J. and Arriold, J.R.P. (2001). Instant notes in Chemistry for Biologists Viva Books Pvt. Ltd.
3. Harper, H.A. (2000): Harper's Biochemistry 25th ed.

4. Holde, K.E.V., Johnson, W.C. and Shing, P. (1998). Principles of Physical Biochemistry Prentice Hall, Inc., USA.
5. Lehninger, A (2000). Principles of Biochemistry. 3rd Edition. Kalyani Publishers.
6. Lehninger A.D. Nelson D.L. & Cox M.M. (1993) & (2000), Principles of Biochemistry, 2nd and 3rd ed. Worth Publishers, New York.
7. Morris, H. Best, L.R., Pattison, S., Arerna, S. (2001). Introduction to General Organic Biochemistry. 7th Ed. Wadsworth Group. Rawn, J.D. (1989). Biochemistry, Niel Patterson Publication U.S.A. North Carolina
8. Sheehon, D (2000). Physical Biochemistry: Principles and Applications – John Wiley & Sons Ltd., England.
9. Stryer, L. (1988). Biochemistry, 3rd edition San Francisco W.H. Freeman

COURSE OUTCOMES

CO-1	The scope of biochemistry is applied in medicine, nutrition and agriculture
CO-2	Students investigate the causes and cure of diseases and effect of nutritional deficiencies
CO-3	Students have scope of career in research laboratories
CO-4	Biochemistry also cover genes, their inheritance and expression

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-III

COURSE CODE: ZooC–704

COURSE TITLE: APPLIED ZOOLOGY- II (VERTEBRATES)

Credit hours/week: 4.5 hrs.
Total hours: 67.5 hrs.
Maximum Marks: 75
Theory: 56
Internal Assessment: 19

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 12 marks). This section will have 6 compulsory very short answer type questions. Each question will carry 2 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 44 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 11 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	To train the students in a wide range with Applied Zoology to provide future careers
2	This paper introduced about aqua culture systems, induced breeding techniques and post harvesting techniques
3	Understands concepts of fisheries, fishing tools and site selection
4	Aqua culture systems, induced breeding techniques, post harvesting techniques
5	Develop a knowledge of farming of aquatic organisms for increasing food production and animals beneficial to human

Unit-I

- **Pisciculture**
  - Economically important fresh water and marine fishes
  - Fish culture: aims and evolution
  - Fish Farming Technologies
  - Factors affecting fish culture
  - Problems of seed collection from natural resources (in brief)
  - Induced breeding methods
  - Products and by products from pisciculture
- **Poultry**
  - Nomenclature and breeds of poultry birds
  - Poultry products
  - Egg structure and quality, nutritive values, abnormalities in eggs, factors affecting size and egg processing
  - Broilers, meat processing
  - Poultry Rearing / Farming
    - Nutritional Requirements

– Housing and equipment
  - Poultry diseases
  - Poultry products and by products

Unit - II

- **Fur Industry**
  - Fur producing animals
  - Fur farming, dressing, processing and dyeing
  - Fur industry in India

- **Leather Industry**
  - Animals of leather industry
  - Processing of skin, flaying, Curing, salting and tanning
  - Enemies of skin industry

Unit-III

- **Dairy Farming**
  - Milching animals, Breeds, Housing and raising and Tools of management
  - Artificial insemination and IVF for improvement of stock
  - Milk composition and dairy products
- **Wool Industry**
  - Animals of wool industry
  - Types, structure and physicochemical properties of wool
  - Processing of wool: shearing, clearing, drying, bleaching, dyeing, spinning and twisting.

Unit -IV

- **Piggery**
  - Characteristics of swine and important breeds
  - Breed selection, management and housing; and nutritional needs
  - Products (Pork, Bristles, Lard, Sausages) and by products
  - Diseases of Pigs
- **Other Utilities of Animals**
  - Pharmaceuticals from animals (in brief)
  - Use of animals in vaccine production

Suggested Reading Material:-

1. Banarjee, G. C. (1982), Poultry. Oxford and IBH Pub. New Delhi
2. Banarjee, G. C. (1991), Text book of Animal Husbandry. Oxford and IBH Pub, New Delhi.
3. Jawal, P. L. (1977), Handbook of Animal Husbandry, I. C. A. R., Pub. New Delhi.
4. Jhingaran, V. G. (1991), Fish and Fisheries of India, Hindustan Pub. Co. India.
5. Khanna, S. S. (1986), An Introduction to Fishes, Central Book Depot, Allahabad.
6. Mustafa, S. (1990), Applied and Industrial Zoology, Rastogi publications, Meerut.
7. Sarkar, K. T. (1991), Theory and Practice of Leather manufacture. The Author, Madras.
8. Shami, Q. J. and Bhatnagar, S. (2002) Applied Fisheries .Agrobios India.
9. Shukla, G. S. &Upadhaya, V. B. (1991-92), Economic Zoology, Rastogi Publications, Meerut.

10. Srivastava, P. A. (1977), Economic Zoology, Commercial Publication Bureau, Kanpur.
11. Toor, H. S. and Kaur, K. (1996), Fish Culture Manual. PAU, Ludhiana.
12. Yadav, M. (2003) Economic Zoology, Discovery Publication House, New Delhi.

COURSE OUTCOMES

CO-1	Understands concepts of fisheries, fishing tools, site selection, preparation and management of fish culture ponds
CO-2	Aqua culture systems, induced breeding techniques, post harvesting techniques
CO-3	Develop a knowledge of farming of aquatic organisms for increasing food production and animals beneficial to human
CO-4	Observe culture techniques and farm management of piggery, poultry, fur, leather, wool and milk producing animals
CO-5	Analyze harvesting and marketing strategies fur, leather and wool industry
CO-6	UnderstandthetechniqueoffishpreservationandWaterqualitymonitoringtechniques
CO-7	Meet the basic and overall knowledge requirement of the students various livestock specifically the farm animals
CO-8	Have expertise of the housing system, feeding requirements, feeding habits and use of low-cost feed technology for better economic return of various animals farms
CO-9	Know the importance and contribution of livestock in the state and national economy
CO-10	Understand the use of animals in vaccine production and pharmaceutical industry

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-III

COURSE CODE: ZooC–751

COURSE TITLE: PRACTICAL -V

(RESEARCH TECHNIQUES & APPLIED ZOOLOGY-II)

Credit hours/week: 3 hrs.
Total hours: 45 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

COURSE OBJECTIVES

1	Exposure to a variety of advanced methods and principles which they could employ in research
2	To equip the learner to use spectrophotometers, rotors and centrifuges for research in biology
3	To develop a practical approach regarding electrophoretic and chromatographic techniques
4	Students will learn practical preparation of solutions, standards and standard curves
5	To understand systematic approach to research and also study of systematic approach to solving a research problem by applying appropriate research methods

I. Chromatography Techniques :(for separation of macromolecules)

1. Paper chromatography
2. Thin layer chromatography
3. Gel permeation chromatography

II. Spectrophotometric Techniques:

4. Preparation of standard curve of BSA, DNA, RNA
5. Measurement of the transmission of light through different solutions or substances at different wavelengths of light.
6. Estimation of DNA/RNA using teaching kits.

III. Electrophoresis Techniques:

7. Preparation of native polyacrylamide gel
8. Gel separation of proteins by native PAGE
9. Preparation of SDS-polyacrylamide gels
10. Separation of proteins by SDS-PAGE
11. Direct and Indirect ELISA

IV. Centrifugation:

12. Sedimentation using Swing out Rotor and Angle Rotor
13. Differential centrifugation.

V. Applied Zoology

14. Physico-chemical analysis of milk.
15. Study of different qualities of leather.
16. Study of different qualities of wool.
17. Visit to poultry/piggery/dairy/rabbit/sheep/fish farm/meat processing/leather industry/wool industry and preparation of report. The report shall carry 5 marks in the practical examination.

* Minor changes in the practical syllabus can be there as per availability of the live materials.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

COURSE OUTCOMES

CO-1	To develop a practical approach regarding centrifugation and chromatographic techniques
CO-2	To teach students how to use spectrophotometers, rotors and centrifuges and their care
CO-3	To teach students the preparation of agarose and SDS-PAGE Gels
CO-4	Practical preparation of standard curves of BSA, and their application in spectroscopic techniques
CO-5	To teach students physic-chemical analysis of milk, different qualities of leather and wool
CO-6	Students visit to poultry/ piggery/ diary/ rabbit/ sheep/ fish farm/ leather/ wool industry

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-42

COURSE CODE: ZooC–752

COURSE TITLE: PRACTICAL -VI

(DEVELOPMENTAL BIOLOGY AND BIOCHEMISTRY)

Credit hours/week: 3 hrs.
Total hours: 45 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

COURSE OBJECTIVES

1	Preparation of acid-base solutions, buffers, standards and reagents
2	Isolate and estimate biochemials from biological source by suitable method
3	On-hand training of developmental stages of chick and frog, comparative knowledge of spermatogenesis and oogenesis
4	Observe larval forms throughout the animal kingdom

1. Study of different larval forms across the animal Kingdom using charts/models/videos.
2. Developmental stages of chick and frog through slides/charts.
3. Metamorphosis through charts/audio video means in frog and insect.
4. Study of Gametes through permanent slides

a) Spermatogenesis in rat/frog/grasshopper.	c) Study of Ovary (rat/frog/grasshopper)
b) Study of testis (rat/frog/grasshopper).	d) Oogenesis in rat / frog/fish

5. Quantitative analysis of proteins by Lowry/ Bradford method.
6. Estimation of Lipids.
7. Estimation of Carbohydrates.
8. Study of absorption spectra of coloured solutions.
9. Preparation of buffer solutions and estimation of their pH.
10. Preparation of Titration curve of weak acids and strong base & calculations of pKa value.
11. Determination of acid value of a fat.
12. Determination of iodine number of a fat.
13. Determination of saponification value of a fat.
14. SDS-PAGE and staining using different stains.
15. Estimation of enzyme activity and the effect of temperature and pH on their activity.

* Minor changes in the practical syllabus can be there as per availability of the live materials.

COURSE OUTCOMES

CO-1	Students can get hand on training about biochemical reaction taking place inside the cell
CO-2	Quantitative and qualitative analysis of proteins, carbohydrate, fats etc.
CO-3	Students have scope in pharmaceutical and research laboratories
CO-4	In-depth comparative knowledge of spermatogenesis and oogenesis
CO-5	Studies of larval forms throughout the animal kingdom
CO-6	On-hand training and understanding of developmental stages of chick and frog
CO-7	Compare and contrast spermatogenesis and oogenesis
CO-8	Prepare acid and base solutions of desired strength

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-IV

COURSE CODE: ZooC–801

COURSE TITLE: ANIMAL BEHAVIOUR & WILDLIFE CONSERVATION

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	To introduce wide variety of animal behaviors and their neurophysiology
2	Help understand response of animals to different instincts, communication & memory
3	This paper is aimed to teach quantitative Biology, Biodiversity and Wildlife
4	Awareness about the values of wild life, its habitat & management and conservation measures
5	Understand causes of biodiversity depletion, wildlife legislation, its amendments & implementation

Unit - I

- **Introduction**
  - Ethology as a branch of biology
  - Animal psychology- Classification of behavioral patterns,analysis of behaviour (ethogram)

  Stereotyped behavior (orientation, reflexes), Instincts vs. learnt behavior, Imprinting
- **Neural and Hormonal Control of Behaviour**
- **Genetic and environmental components in the development of behaviour**
- **Communication**
  - Chemical, Visual, tactile and Audio communication
  - Functions of communication
  - Song specificity in birds
  - Evolution of language (primates)
  - Host-parasite relations

Unit-II

- **Social Behaviour**
  - Aggregations-schooling in fishes, flocking in birds, herding in mammals
  - Advantages and disadvantages of living in groups.
  - Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness
  - Social organization in insects and primates

- **Reproductive Behaviour**
  - Evolution of sex
  - Mating and Courtship behaviour
  - Sperm competition
  - Sexual selection and Parental care
- **Learning and Memory**
  - Conditioning (classical and operant),
  - Habituation
  - Associative learning
  - Reasoning and Cognitive Skills

Unit – III

- **Wild life in India**
  - Introduction to conservation biology
  - Conservation and sustainable development
  - Conservation vs preservation
  - Patterns and process of biodiversity
  - losses and threats to biodiversity
  - Population genetics and conservation
  - Biological consequences of habitat fragmentation; edge effects.
  - Protected areas, National Park, Wildlife Sanctuaries, Conservation Reserve, Community Reserve; Tiger Reserves, Elephant Reserves.
  - Conservation outside protected areas.
  - Control of invasive species.
  - Significance of ecological restoration in conservation. Introduction/ reintroduction and translocation.
  - Need for ecosystem service valuation
- **Wildlife Conservation**
  - Wildlife Conservation Principles and practices of wildlife management.
  - Wildlife management in India.
  - Management of special habitats; riparian zones. Grasslands etc.
  - Species conservation projects; tiger, lion, rhino, crocodile etc.
  - Role of Biology in management.
  - Conservation breeding programs and their importance.
  - Management Plan for Protected Areas; Forest working plans and wildlife management plans.
  - Environmental Impact Assessment (EIA).
  - Human dimensions in wildlife management.

Unit – IV

- Conservation Laws, Policies and Management National parks, Wildlife Sanctuaries, Conservation reserves, Community reserves, Biosphere Reserves in India; National Wildlife Conservation policy and Action Plans.

- Forest (Conservation) Act; Wildlife (Protection) Act; Environment (Protection) Act; Traditional Forest Dwellers (recognition of Forest Right) Act; National Conservation Authorities (National Biodiversity Authority and National Tiger Conservation Authority), and International Conservations viz., RAMSAR Convention, Convention on Biological Diversity, Convention on migratory Species.
- Eco-sensitive Zones, wetlands of National Importance, Project Elephant, Project Snow Leopard, Important Bird Areas, Coastal and Marine Biodiversity, Forestry and Forest Management in India.
- **Status of Wildlife in Punjab- A brief account**

Suggested Reading Material:

1. Aggarwal, (2000), Wildlife of India.
2. Alcock, J. (1998), Animal behaviour, An evolutionary approach Sinauer Assoc., Sunderland, Mass, USA.
3. Drickamer, L. C. and Vessey, S. H. (1986), Animal Behaviour - Concepts, Processes and Methods. (2nd ed.), Wordsworth Publ. Co., California.
4. Giles, R. H. (1984), Wildlife Management Techniques, Natraj Publishers, Dehradun.
5. Gopal, R. (1992), Fundamental of Wildlife management Justice Home Allahabad.
6. Hosetti, B. B. (1997), Concepts in Wildlife Management, Chawla Press, Delhi.
7. Huntingford F. (1984), The study of animal Behaviour, Chapman and Hall, London.
8. Manning, A. (1979), An Introduction to Animal Behaviour, 3rd Edition. The English Language Book Society and Edward Arnold Publishers Ltd.
9. Manning, A. and Dawkins, M. S. (1992 & 1998), An Introduction to Animal Behaviour, 4th ed. (Cambridge low price editions). Cambridge University Press, Cambridge.
10. Negi, S. S. (1995), Hand Book of National Park, Sanctuaries and Biosphere Reservoirs in India, Indus publishing Co., New Delhi
11. Prater, S. H. (1980), The Book of Indian Animals, Bombay Natural History Society, Bombay.
12. Saharia, V. B. (1982), Wildlife in India, Natraj Publisher, Dehradun.
13. Sharma, B. D. (1994), High Altitude Wildlife of India, Oxford IBH, New Delhi.
14. Sharma, B.D. (1999), Indian Wild Life Resources Ecology and Development. Daya Pub. House, Delhi.
15. Sharma, B.D. (2002), Man environment and wildlife animal. IBH Publishing Co., Pvt. Ltd. New Delhi.
16. Teague, R. D. (1987), A manual of Wildlife Conservation, Natraj Publishers, Dehradun.
17. Tikadar, B. K. (1988), Threatened Animals of India, Publications of Zoological Survey of India, Calcutta.
18. Tirvedi, P.R. and Singh, U. K. (1996), Environmental Laws of Wildlife.

COURSE OUTCOMES: the students will be able to

CO-1	Understand different behavioural patterns, communication & memory
CO-2	Analyze genetic, environmental, hormonal and neural controls of animal behaviour
CO-3	Have insight into our various social behaviors in insects and primates
CO-4	Understand on a variety of reproductive behaviors and their evolution
CO-5	Study faunal diversity and learn to implement conservation measures to save diversity
CO-6	Understand importance of wildlife and conservation for protected areas
CO-7	Learn causes of depletion of wildlife & conservation ethics
CO-8	To understand wildlife legislation its amendments and implementation

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-IV

COURSE CODE: ZooC–802

COURSE TITLE: ANIMAL GENETICS & BIOTECHNOLOGY

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	To provide a fundamental knowledge on genetics, its law, genes and chromosomes, inheritance, heredity, cause of genetic disorders and the method of gene transfer.
2	Understand genetic information in the DNA & its selective expression as functional protein
3	Understand Mendels work on transmission trait, Genetic Variations, Mendelian genetics, Linkage, Crossing over and Chromosomal mapping, Mutations, Sex determination
4	Acquire a broad understanding of Genetics including the physical and chemical basis of heredity.
	Understand the types and classification of mutations & mutagens and their underlying mechanism
5	Study of structure and infection cycles of eukaryotic viruses

Unit I

- **DNA-** The genetic material:
  - DNA: Structure, Properties, Replication and Packaging DNA into chromosomes
  - Prokaryote nucleoid structure.
  - Chemical composition of eukaryote chromosomes.
  - Euchromatin, Heterochromatin and banding pattern.
  - Repetitive DNA and sequence organization.
  - Protein synthesis
- **Linkage, Crossing over and Chromosome Mapping**
  - Cytological basis of crossing over.
  - Two factors crosses, Three factor crosses and interference.
  - Somatic Cell hybirdization.

Unit II

- **Mutations**
  - Introduction and classification of mutation.

- Molecular basis of mutation.
- Radiation and chemical inducted mutation
- Correlation between mutagenicity and carcinogenicity.
- Mutation Frequency.
- Practical applications of Mutations.

- **Gene Concepts**
  - Classical versus molecular concepts of Gene.
  - Complementation test for functional allelism.
  - Regulation of gene expression in Prokaryotes and Eukaryotes.

Unit III

- **Bacterial Genetics**
  - Transformation, transduction and conjugation.
  - F mediated sex-duction.
  - Mechanism of recombination in bacteria.
  - Plasmid, Episome, IS elements and Transposons.
- **Genetics of Viruses**
  - Organisation and expression of bacteriophage genomes
  - Structure and infection cycles of viruses of eukaryotes
  - Animal viruses and cancer.

Unit IV

- **Recombinant DNA technology**
  - Gene cloning and Sequencing.
  - Restriction endonuclease.
  - Vectors.
  - cDNA cloning.
  - Identification of Specific clone with a specific probe.
  - Techniques: Southern, Northern, Western Blotting, PAGE, PCR, DNA finger printing, DNA foot printing.
  - In situ hybridization, RFLP.
  - Practical applications of gene cloning.
- **Extranuclear inheritance**
  - Criteria for extranuclear inheritance
  - DNA and drug resistance.
  - Mitochondrial DNA and genetic diseases.
  - Mechanism of Sex determination, Sex differentiation, Sex linked inheritance.

Books Recommended:

1. Ayala, F.J. & Kiger, Jr. J.A. (1980) Modern Genetics. The Benjamin Cummings Publishing Co. Inc.
2. Brown T.A. (1992). Genetics- A Molecular Approach, 2nd ed. Van NostrandRainhold

3. De-Robertis, F.D.P. and De-Robertis Jr., E.M.E. (1987). Essentials of Cell and Molecular Biology, Saunders, Philadelphia.
4. De-Robertis, F.D.P. and De-Robertis Jr., E.M.E. (1987). Cell and Molecular Biology, Saunders, Philadelphia.
5. Freifelder, D. &Malacinski. G.M. (1993) : Essentials of Molecular Biology, Jones & Bartlett Publishers, Boston.
6. Gardener, E.J., Simmons, M.T.J. & Sunstad, D.P. (1999): Principles of Genetics, 8th ed. John Wiley & Sons, New York.
7. Miglani, G.S. (2000). Basic Genetics Narosa Publishing House, New Delhi.
8. Sambrook, J., Fritisch, E.F. and Maniatis, J. (1989). Molecular Cloning. A lab manual.
9. Satson, J.D. et. al. (1987) : Molecular Biology of Gene, 4th ed. Vol. I & II. The Benjamin / Cummings Publishing Co., Inc.
10. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (1999) Instant notes in Genetics. New Delhi
11. Zubay. U.G. (1987), Genetics. The Cummings Publishing Co., Inc.

COURSE OUTCOMES

CO-1	Students will acquire a broad understanding of Genetics including the physical and chemical basis of heredity
CO-2	Understand the basic organization and chemical composition of prokaryotic and eukaryotic genomes
CO-3	Understanding of genetic phenomenon like linkage, crossing over and chromosomal mapping
CO-4	Understanding the types and classification of mutations and mutagens along with their underlying mechanism
CO-5	Basic aspects of flow of genetic information from DNA to Protein. Understand gene expression and regulation mechanisms among prokaryotes and eukaryotes
CO-6	Be able to distinguish between maternal effect, sex-linked, and extra nuclear modes of inheritance
CO-7	Study the organization and expression of bacteriophage genome; structure and infection cycles of eukaryotic viruses with special focus on animal virus and cancers
CO-8	Have a better understanding of bacterial genetics and means of genetic recombination
CO-9	Understanding the role of genetic technologies in industry related to pharmaceuticals, biotechnology, and diagnostic clinics

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-IV

COURSE CODE: ZooC–803

COURSE TITLE: ANIMAL CONCEPTS OF IMMUNOLOGY

Credit hours/week: 6 hrs.
Total hours: 90 hrs.
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

Instructions to the Paper setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES: course aims to

1	Introduce the cellular and molecular basis of immune responsiveness
2	Impart in depth knowledge of tissues, cells & molecules involved in host defense mechanisms
3	To teach students cells and organs of the immune system & types of immunity
4	Interactions of antigens, antibodies, complements and other immune components
5	Understand immune mechanisms in disease control, vaccination, process of immune interaction

Unit-I

- **Introduction**
  - Types of immunity-innate and adaptive.
  - Features of immune response-memory, specificity and recognition of self and non-self.
  - Terminology and approaches to the study of immune system.
  - Immunity to viruses, bacteria, fungi and tumors.
- **Cells and Organs of the immune system**
  - Lymphoid cells, heterogeneity of lymphoid cells, T-cells, B-cells, Null cells, Monocytes, polymorphs
  - Primary and secondary lymphoid organs-thymus, Bursa of fabricius, spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT)
  - Lymphocytes traffic.

Unit-II

- **Humoral Immunity:**
  - Antigen-antibody interactions, affinity and avidity, high and low affinity anti-bodies.
  - Immunoglobulins-classes and structure
  - Molecular mechanism of generation of antibody diversity.
  - Complement fixing antibodies and complement cascade.
- **Cell Mediated Immunity**
  - T-cell subset and surface markers

- T-dependent and T-independent antigens
- Recognition of antigens by T-cells and role of MHC; structure of T-cell antigen receptors

Unit-III

- **Immunological Disorders**
  - Types of Hypersensitivity reactions
  - Autoimmune disorders, their underlying molecular mechanism, actiology, diagnostic, prognostic and prophylactic aspects
  - Immunodeficiency disorders; AIDS.
- **Immuno biotechnology: Hybridoma Technology**
  - Immunization of animals, isolation of stimulated spleen cells, Myeloma cell lines used as fusion partners. Fusion methods
  - Detection and applications of monoclonal antibodies,
  - Vaccines: conventional vaccines, Viral vaccines, Bacterial vaccines, peptide vaccines, genetically engineered vaccines
  - Production and application of lymphokines

Unit-IV

- **Immunodiagnostic Procedures**-Various types of Immunodiffusion and immunoelectrophoretic procedures-
  - Immunoblot
  - ELISA
  - RIA
  - Agglutination of pathogenic bacteria
  - Haemagglutination and inhibition.

Suggested readings:

1. Kuby, J., Immunology W. H. Freeman and Company, New York, (1992).
2. Paul, W.E., Fundamental Immunology, 2nd edition, Raven Press, New York. (1989).
3. Paul, W.E.: Immunology; recognition and response. W.H. Freeman, New York. (1991).
4. Playfair, J.H.L.: Immunology at a glance, 5th edition, Blackwell Scientific Publications, Oxford. (1992).
5. Roitt, I. M. Brostoff, J and Male, D., Immunology, 2nd edition, Gover Medical Publishing, New York. (1989).
6. Roitt, I. M., Essential Immunology, 6th edition, Blackwell Scientific Publications, Oxford. (1988).

COURSE OUTCOMES

CO-1	Get opportunity to know about the immune system & Processes of organisms.
CO-2	Techniques to cure immunological diseases & a guide for a better health to the common people of the society.
CO-3	The most important role of immunology recently seen by the world in the time of Corona Pandemic where it is guiding and teaching that how to prevent Corona and rumors arising from it as well as in production of life saving Vaccines.
CO-4	They get opportunity of Job as Advisor, Teacher, Researcher, Technicians in the academics as well as research and pharmaceutical institutes.
CO-5	Act as Volunteers to assist the professionals and to guide the people to mitigate the pandemic.

PROGRAMME CODE: MZOO
M.Sc. Zoology Semester-IV
COURSE CODE: ZooC–804
COURSE TITLE: BIOSYSTEMATICS

Credit hours/week: 4.5 hrs.
Total hours: 67.5 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

Instructions to the Paper setters:
The question paper will be divided into 2 sections.
Section A: (Total weightage 09 marks). This section will have 6 compulsory very short answer type questions. Each question will carry 1.5 marks. Questions are to cover the whole of syllabus.
Section B: (Total weightage 28 marks). This section will have eight questions, two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 07 marks and its answers should not exceed 6 pages. The questions should not have more than two subparts.

COURSE OBJECTIVES

1	Course aims to introduce the students for the salient features of Taxonomy and the methodologies used in systematic
2	To understand the evidence that living species share descent from common ancestry and how this fact explain the traits of living species
3	Provide understanding of the fundamental principles of systematic in which the animals are how to classify according to their characters and the theories which have to be followed for classification
4	Acquire a thorough knowledge of principles and practices of biosystematics
5	International rules of nomenclature and classification is studied

Unit-I

- **Introduction**
  - Terms / Definitions
  - History/Development of theories / kinds of classifications.
  - Importance of Biosystematics
- **Material basis of Biosystematics**
  - Different attributes or evidences
  - Character kinds
  - Character weighing
- **New aspects of Biosystematics**
  - Cytotaxonomy
  - Chemotaxonomy
  - Molecular taxonomy

Unit-II

- **Taxonomic Procedures**
  - Taxonomic collections

- Preservation
- Identification
- Taxonomic keys (Different kind, salient features, merits and demerits)

- International Code of Zoological Nomenclature
- Nomenclature Principles, important rules, their interpretation and application in the scientific nomenclature.

Unit –III

- **Taxonomic Publications**
  - The Scientific publications
  - Systematic publications
  - Contents of publications
- **Taxonomic Hierarchy**
  - Species category and various concepts of species; Subspecies and other sub specific categories; Decision at species and sub species level
  - Hierarchy of categories- Lower and higher categories

Unit-IV

- History of Kingdom systems
- Resume of Whittaker's system and other recent systems of classification
- An outline of classification of kingdom Animalia
- Salient features of minor phyla.

Suggested Reading Material:

1. Gote, H.E. (1982), Animal Taxonomy, Edward Arnold.
2. Jaffery, C. (1973), Biological Nomenclature, Edward Arnold.
3. Kapoor, V.C. (1987), Theory and Practice of Animal Taxonomy, IPH Pb. New Delhi.
4. Kitching, I.J., Forey, P.L. Humpheries, C.J. & William, D. 1998. Cladistics: Theory and Practice of Parsimony Analysis, Oxford University Press.
5. Mayer, E. (1969), Principle of Systematic Zoology, McGraw Hill Book Co. London.
6. Mayer, E. &Aschhok (1991), Principles of Systematics, McGraw Hill Book Co. London.
7. Minell, A. (1993), Biological Systematics, The State of Art. Chapman & Hall, London.
8. Quicke, D.L.J, (1996), Principles & Techniques of Contemporary Taxonomy, BlackyAcademic & Professional, London, New York, Madras.
9. Sebuh, Randall T. 2000, Biological Systematics: Principles & Applications Cornell University Press 256 pp.
10. Winston, J. 1999. Describing Species Practical Taxonomic Procedure of Biologists. Columbia University Press, Lincoln, R.J. Dictionary of Ecology, Evolution and Systematics.

COURSE OUTCOMES

CO-1	Illustrate the methodologies used in systematic
CO-2	Understand various theories relevant to biosystematics
CO-3	Acquire a thorough knowledge of principles and practices of biosystematics
CO-4	Knowledge of the diversity and inter-relationships of animals
CO-5	Develop a holistic appreciation on the phylogeny and adaptations in animals.
CO-6	Understand the taxonomic procedures to identify a species. Explain the importance of taxonomic keys and taxonomic characters
CO-7	Acquire the skills of nomenclature of species and subspecies.
CO-8	Apply the International rules of Nomenclature to give a scientific name to animals which are found during research
CO-9	Understand the gradual development and evolutionary history of different kinds of living organisms from earlier forms over several generations
CO-10	Differentiate between species, subspecies, sibling species, race and deme
CO-11	Justify the inclusion of a given organism in a given phylum.

PROGRAMME CODE: MZOO
M.Sc. Zoology Semester-IV
COURSE CODE: ZooC–851
COURSE TITLE: PRACTICAL -VII (BEHAVIOUR AND WILD LIFE)

Credit hours/week: 3hrs.
Total hours: 45 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

COURSE OBJECTIVES

1	To study different behavioral patterns using photographs
2	To study the influence of temperature on development and population build up in Tribolium
3	To investigate the locomotive, explorative and habituation behaviour in earthworm
4	To study geotaxis, humidity preference and photo taxis in various experimental animals
5	To study latent and operant learning in rat
6	To investigate the chemosensory responses in drosophila
7	To teach students how to record their body rhythms

1. To study the influence of temperature on development and population built up of *Tribolium/Rhizopertha/Callosobruchus*.
2. To study the food preference in different animals.
   a) Tribolium/Rhizopertha
   b) *Pierisbrassicae*.
3. To investigate the locomotive, explorative, withdrawal and habituation behaviours in Earthworm/Slug
4. To study the latent and operant learning in rat.
5. To study the thigmotaxis response in *Callosobruchus/ Tribolium/ Rhizopertha*
6. To study the Geotaxis Responses in
   a) Tribolium
   b) Ant
   c) *Pierisbrassicae* Larvae
   d) Slug
7. To study the Humidity Preference in
   a) Drosphila / Zaprionus
   b) Tribolium
   c) Callosobruchus
   d) *Pierisbrassicae* Larvae
8. To study the Phototaxis to Point Source and Different Colours of Light.
   a) Earthworm
   b) Zaprionus
   c) Tribolium
   d) Callosobruchus
   e) *Pierisbrassicae* Larvae
9. Use of videos to study the

a) Grooming and righting behaviour in cockroach.
b) Tarsal response in butterfly/housefly.
c) Equilibrium study on housefly.
d) Effect of temperature on opercular movement in fish

10. To Investigate the Chemosensory Responses in *Zaprionus / Bactrocera*.
11. Study of body rhythms in human beings.
12. Study of animal behaviour patterns using photographs.
13. Wildlife project as assignment.

* Minor changes in the practical syllabus can be done as per availability of the live materials.
As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

COURSE OUTCOMES

CO-1	Students can employ the learnt practical knowledge in grabbing research projects
CO-2	Students further incorporate studied behaviour in live experiments
CO-3	Students explore the locomotive, explorative and habituation behaviour in earthworm
CO-4	Students employ geotaxis, humidity preference and photo taxis in various experimental works
CO-5	Students can employ taught knowledge to enhance their working ability

PROGRAMME CODE: MZOO

M.Sc. Zoology Semester-IV

COURSE CODE: ZooC–852

COURSE TITLE: PRACTICAL -VIII (GENETICS AND BIOSYSTEMATICS)

Credit hours/week: 3 hrs.
Total hours: 45 hrs.
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

COURSE OBJECTIVES

1	Identify museum specimen/pictures of minor phyla, Invertebrates, Proto-chordates and Chordates
2	Classify animals on the basis of the its relation to other animals by body structure external characters
3	Understand the use of various kinds of keys to identify and classify animals
4	Understand the use of equipment for collection of animals.
5	Have in-depth knowledge of museology- placement and arrangement of animals depicting their classification and interrelationships. Categorize animals according to the phylogeny.
6	On-hand training of preservation techniques
7	The students will be well equipped to become very competent in research or teaching fields after completion of this course
8	Collect and preserve animal samples using common methods. Compare the methods of collection and preservation of insects
9	Write scientific report of field/institutional visit.
10	Prepare temporary slide of various cells to demonstrate the cell morphology and cell division, giant chromosome and pedigree analysis chart.
11	Determine the gene distance and order, genotype and phenotype ratios and allelic frequencies from the given data.

1. To prepare and study the karyotype of human cell from meta phase pictures
2. To study the pedigree analysis of family.
3. To study blood groups in human beings.
4. Demonstration of Barr body in the oral epithelium of human beings.
5. To study different stages of mitosis in root tips of *Allium cepa*.
6. To study permanent slides of:
- Mitosis in bone marrow cells of rat.
- Stages of meiosis in testis of rat/grasshopper/*Allium cepa*.
- Polytene chromosomes in third instar larvae of *Zaprionus paravittiger*

7. To study dermatoglyphics with palms of hands and fingertips.
8. To study inheritance of morphogenetic human characters.
9. Isolation of DNA from plant tissues.
10. Numerical based on Mendelian laws of inheritance and Linkage.
11. Serum extraction from blood.
12. ELISA & RIA Rocket Immuno- electrophoresis.
13. Demonstration of various kinds of equipment required for collection and preservation of animals.

14. Videos of Methods of collection and preservation.

15. Kinds of keys and their use at higher and lower category levels.

*** Minor changes in the practical syllabus can be done as per availability of the live material.**

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

COURSE OUTCOMES

CO-1	Can be appointed as curator and archivist in museum for placement and arrangement of animals depicting their classification and interrelationships.
CO-2	The students will be well equipped to become very competent in research or teaching fields after completion of this course
CO-3	Competent enough to collect and preserve animal samples using studied methods.
CO-4	Provides students insight into maintaining healthy relationships with their opposite gender and allows them to make right choice about their life partner thus preventing congenital/consanguial diseases.
CO-5	Become competent enough to write scientific report after completing this course