

Department of Zoology

School of Biological Sciences



Curriculum Framework

M.Sc. Zoology

[Session 2022-2023 Onwards]

Based on National Education Policy- 2020

Date of BoS: 13.09.2022

Doctor Harisingh Gour Vishwavidyalaya

(A Central University)

Sagar-Madhya Pradesh-470003

M.Sc.I Semester

Name of Course	PaperCourseCode	PaperTitle	Credits
Discipline Specific Major-1	ZOO-DSM-121	Animal Diversity–Theory	04
	ZOO-DSM-122	Animal Diversity–Practical	02
Discipline Specific Major-2	ZOO-DSM-123	Animal Physiology–Theory	04
	ZOO-DSM-124	Animal Physiology –Practical	02
Multi-Disciplinary Major-3	ZOO-MDM-125	Cell:Structure and Function– Theory	04
	ZOO-MDM-126	Cell:Structure and Function– Practical	02
Skill Enhancement Course	ZOO-SEC-127	Applied Biology–Theory	03
	ZOO-SEC-128	Applied Biology–Practical	01
	TotalCredits		22

M.Sc.COURSE,SESSION –2022-2023
PGFIRSTSEMESTERINZOOLOGY
ANIMAL DIVERSITY
COURSECODE: ZOO-DSM-121
THEORY

L	T	P	C
4	0	0	4

Unit I: Principles &Methods of taxonomy

- Broad classification of Animal Kingdom Principles of Taxonomy: Nomenclature: Binomial, Trinomial nomenclature. Tautonyms, Synonyms, and Homonyms.
- New trends in taxonomy: Ecological approach, Ethological approach, Cytological approach, Biochemical approach, Numerical Taxonomy and Phylocode.
- Taxonomic keys: Indented, simple non - Bracket Grouped type, combination, Pictorial, Branching type, Circular and Box - type.
- International Code of Zoological Nomenclature(ICZN)

Unit II: Protozoa and Mesozoa

- Polymorphism in Protozoa, Reproduction and feeding in Protozoa.
- Porifera: Interrelationship between different classes.
- Coelenterata: Polymorphism in Coelenterates.
- Ctenophora: Structural peculiarities and affinities.
- Platyhelminthes: Functional morphology and adaptive biology for parasitic mode of life. Annelida: Interrelationship between classes of Annelida.
- Phylogeny of Arthropoda, Mollusca and Echinodermata.

Unit III: Bilateria and Minor Phyla

- Origin and evolution trends in coelom formation.
- Theories on origin of metamerism.
- Platyhelminthes: Functional morphology and adaptive biology for parasitic mode of life. Annelida: Interrelationship between classes of Annelida.
- Phylogeny of Arthropoda, Mollusca and Echinodermata.
- Structural peculiarities and affinities of: Gastrotricha, Rotifera, Entoprocta, Phoronida, Ectoprocta and Branchiopoda.

Unit IV: Protochordates and Lower Terrestrial Vertebrates

- Ancestry of Chordates: Cephalochordates and Urochordates.
- Vertebrate Phylogeny-Agnatha, Ostracoderms and Gnathostomes-Placoderms, Acanthodians, Chondrichthyes and Osteichthyes.
- Tetrapod phylogeny - modern Amphibians, diversity, distribution, status and threats.
- Reptiles – origin and adaptive radiation.
- Skull of reptiles and its importance in biosystematics.
- Mesozoic world of reptiles and extinction.

Unit V: Birds and Mammals

- Origin of birds and mammals.
- Structural and functional modifications for aerial life.
- Orders under class Aves.
- Class Mammalia: Prototheria, Metatheria and Eutheria.
- Phylogeny of Mammalian orders.
- Adaptive radiation in mammals.
- Common Indian mammals and birds.

Essential Readings:

1. Barnes R. D. (1982) Invertebrates Zoology 6th endn. Toppan International Co.
2. Kotpal, R.L. (1982) Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publications.
3. Kotpal, R. L. The Birds. Rastogi Publications.

Suggested Readings:

1. Hyman L.H. (1940 - 1959). The Invertebrata, Vol. I to VI.
2. Carter, G. S. A. (1946) General Zoology of Invertebrates 2nd edn. (Wick and Jackson Ltd., London).
3. Borrardile, L.A. (1955) The Invertebrata. 2nd endn. Cambridge University Press.
4. Moore, R. C. Lalicker, C. G. and Fisher, A. G. (1952) Invertebrate Fossils, Mc. Graw Hill Book Co., New York.
5. Gardinar, M. S. (1972) Biology of the invertebrates, Mc Graw Hill Book Co., New York.
6. Waterman, A.J. (1971) Chordate Structure and Function. Macmillan Co. London.
7. Jolie, M. (1968) Chordate Morphology. East West Press.
8. Romer, A.S. (1976) Vertebrate Body.
9. Young, J.Z. (1950) Life of Vertebrates. Clarendon Press Oxford.

10. Colbert, E.H. (1955) Evolution of the Vertebrates. John Wiley and Sons Inc. New York.
11. Hobart M. Smith. Evolution of Chordate structure, Holt, Rinehart and Winston. Inc. New York.
12. Halstead, L.B. (1969). The Pattern of Vertebrate Evolution. Freeman and Co. San Francisco. U.S. A.
13. Kapoor, V.C. (1991) Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.

Learning outcome:

After completing the course students will able to learn

- Understand the principles and practice of systematics.
- In-depth knowledge on the diversity and relationships in animal world
- An holistic appreciation on the phylogeny and adaptations in animals

M.SC.COURSE,SESSION –2022-2023
PGFIRSTSEMESTERINZOOLOGY
ANIMAL DIVERSITY
COURSE CODE: ZOO-DSM-122
PRACTICAL

L	T	P	C
0	0	2	2

1. Study of selected Protozoans and Helminthes of medical importance.
2. Study of sections of certain animals from Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of coelom.
3. Identification and study of larval forms from all major phyla of Invertebrates.
4. Identification and study of types of minor phyla.
5. Identification and study of invertebrate fossils.
6. Study of prepared slides of mouth parts of Honey bee, Housefly, Thrips, Mosquito, Bed bug and Butterfly to relate structure and type.
7. Study of Amphioxus, Balanoglossus, Ascidian, Peteromyzon to bring out their affinities.
8. Study of the following specimens with Reference to their adaptive features for their respective modes of life: a) Echeneis; b) Ichthyophis/Uraeotyphus; c) Hyla; d) Draco; e) Pigeon; f) Bat.
9. Study of the following skull types with Reference/Books to jaw suspensions; a) Fish; b) Frog; c) Calottes; d) Rat/Rabbit.
10. Mounting of: Sting of Honey bee, Nephridia of earthworms, cycloid scales.

M.SC.COURSE,SESSION –2022-2023
PGFIRSTSEMESTERINZOOLOGY
M. SC. I SEMESTER
ANIMAL PHYSIOLOGY
COURSE CODE: ZOO-DSM-
123THEORY

L	T	P	C
4	0	0	4

Unit I: Circulatory System

Blood and circulation - Blood corpuscles, haemopoiesis, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, haemostasis.

Cardiovascular System: Comparative anatomy of heart structure in vertebrates, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

Unit II: Respiratory System and Thermal Regulation

Respiratory system - Comparison of respiration in in vertebrates, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Thermoregulation in poikilotherms, homeotherms and heterotherms - hibernation, aestivation - diapause.

Unit III: Nervous System and Sense Organs

Nervous system - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

Sense organs - Vision, hearing and tactile response.

Unit IV: Digestive and Excretory System

Digestive System- Digestion and adsorption of proteins, carbohydrates and lipids and role of gastrointestinal hormones in digestion, Energy balance, BMR

Excretory system - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Unit V:Reproduction and Endocrine glands

Reproductive process and Endocrine Glands- Reproductive process. Structure and function of Pineal, Pituitary, Thyroid, Parathyroid, Thymus, Adrenal, Ovary and Testis; basic mechanism of hormone action,

hormones and diseases.

Chemical co-ordination - neurosecretions in insects, mollusks and crustacean endocrine glands in invertebrates; endocrine control of reproduction in vertebrates with reference to human endocrine related disease and disorder.

Essential Readings:

1. Hoar, W.S (1968): General and Comparative Physiology, Prentice Hall
2. Prosser, C.L. (1973): Comparative Animal Physiology, 3rd edn. W.B. Saunders & Co., Philadelphia.
3. Wood, D.W. (1968): Principles and Animal Physiology
4. Bentley, (1971): Endocrine and osmoregulation Springer verlag, N.Y., 25
5. Palmen, J.D. Brown, J.R. and Hastirigs, J. W. (1970): Biological clocks, Academic Press, London

Suggested readings:

1. Animal Physiology: Adaptation and Environmental, Nelson, K.S. (ed.) Cambridge University Press, UK
2. Comparative Animal Physiology, Prosser, C.L. & Brown, Jr. F.A.; Saunders. USA
3. Invertebrate: Structure and Function, Barrington, E.J.W.; Oxford, Clarendon Press.
4. Invertebrate Zoology, Barnes, Robert.D; Saunders. USA
5. Invertebrate Zoology, Jordan E.L, Verma, P.S; S.Chand Publishing, New Delhi
6. Modern Text Book of Zoology: Invertebrates, 12th Edition Kotpal, R.L.; Rastogi Publication, Meerut

Learning Outcome:

1. Students will have complete structural and functional mechanism of animal physiology.

M.SC.COURSE,SESSION –2022-2023
PGFIRSTSEMESTERINZOOLOGY
M. SC. I SEMESTER
ANIMAL PHYSIOLOGY
COURSE CODE: ZOO-DSM-124
PRACTICAL

L	T	P	C
0	0	2	2

1. Determination of Proteins by Biuret Method
2. Determination of Glucose by Anthrone Method / Somogi Method
3. Determination of Lipids by Vanillin Method
4. Determination of Glycogen by Kemp's Method
5. Estimation of Cholesterol by Acetic Anhydride Method
6. Determination of Enzyme Activities of SDH, LDH and GDH
7. Effect of Substrate Concentration and pH on Succinate Dehydrogenase Activity
8. Estimation of Acetyl Cholinesterase (ACHE)
9. Estimation of Haemoglobin
10. Estimation of Coagulation Time
11. Dissection of pituitary, adrenal and gonad in vertebrate animals
12. Histological study of pituitary, adrenal, testis, ovary, corpus luteum, pancreas and thyroid gland.

M.SC.COURSE,SESSION –2022-2023
PGFIRSTSEMESTERINZOOLOGY
CELL: STRUCTURE AND FUNCTION
COURSE CODE: ZOO-MDM-125
THEORY

L	T	P	C
4	0	0	4

Unit I: General information of Cells

- Universal features of cells
- Chemical components of a cell: Macromolecules and energy sources
- Catalysis and use of energy by cells
- Proteins, Lipids, Carbohydrates, Nucleic Acids
- Structural organization of eukaryotic chromatin chromosomes, Heterochromatin, Euchromatin, Transposons, Operon, unique and repetitive DNA, interrupted genes, gene families.

Unit II: Cell organization-I

- Light microscopy: types and applications; Purification of Cell organelles
- Plasma Membrane: Biomembrane structure; Transmembrane transport of ions and small molecules; transport of macromolecules, Electrical properties of membranes
- Intracellular compartments, protein sorting
- Intracellular membrane traffic
- Cellular energetics: Mitochondria and Chloroplast; Glucose and Fatty acid catabolism, peroxisomes, plastids and vacuoles.

Unit III: Cell organization-II

- Nucleus: Nuclear envelop, Nuclear pore complex, Nuclear import and export signals/receptors, Nuclear lamina, Nuclei- structure and functions,
- Cytoskeleton: Actin, Myosin, Microtubules and Microfilaments, role in motility.
- Endoplasmic reticulum: Structure and functions; Protein modification, protein targeting and translocation, Protein transport to Golgi apparatus, ER signals.
- Golgi apparatus: Structure and functions, *cis*- and *trans* faces, matrix proteins, vasicular transport. Lysosomes: Structure and functions, lysosomal enzymes, Autophagy, lysosomal storage diseases.

Unit IV: Cell Communication, Growth and Development

- Gene expression and its control at transcriptional and post transcriptional level.
- Nerve Cells: Neurons and Glia, Voltage gated ion channels, Neurotransmission and its regulation, Communication at synapses, Sensational cells, Axon growth.

- Cell Junctions: Types and functions; Cadherins mediated adhesion, Catenin, actin mediated contraction, role of Desmosomes for mechanical strength, tight junctions and transmembrane adhesion, scaffold proteins, Gap junctions: Metabolic and Electrical activity; Plasmodesmata; Calcium independent cell-cell adhesion.
- Regulation of Haematopoiesis, General principles of cell communication, extracellular matrix, integrins,
- Regulation of eukaryotic Cell Cycle: CDK regulation, MPF activity, Molecular mechanism of mitotic events, Cell cycle control in mammalian cells, check points in cell cycle regulation. Meiosis cell division, Gametogenesis and fertilization, Cell differentiation, Cell diversity and patterning in early vertebrate embryo.
- Cancer: Oncogenes, Tumor Suppressor Genes, Cancer and cell cycle, virus induced cancer, metastasis, therapeutic intervention of uncontrolled cell growth.

Unit V: Cell signaling

- Hormones and their receptors, Extracellular signal and cellular response
- Cell surface receptors, highly conserved components of intracellular signal transduction pathways
- G Protein coupled receptor systems: Regulation of ion channels; Activation or inhibition of adenylyl cyclase, activation of phospholipase C, Integration response of cells to environmental influences
- Cell signaling pathways that control gene activity: TGF β receptors and Smad transcription factors; Cytokine receptors; Tyrosine kinase receptor; Activation of Ras and MAP kinase pathways; Phosphoinositides as signal transducer; Activation of gene transcription; Signal induced protein cleavage.

Essential Readings:

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing Inc., New York.

Suggested Readings:

1. Lehninger, Principles of Biochemistry, Fifth Edition.
2. Genetics: Principles and Analysis: Daniel L. Hartl, Elizabeth W. Jones

Learning outcome:

Students will gain insight into the most significant molecular and cell biology used today to expand understanding of biology.

M.SC.COURSE,SESSION –2022-2023
PGFIRSTSEMESTERINZOOLOGY
CELL: STRUCTURE AND FUNCTION
COURSE CODE: ZOO-MDM-126
PRACTICAL

L	T	P	C
0	0	2	2

1. Visualization methods for cells and sub-cellular components: light microscopy, phase contrast microscopy, scanning and transmission microscopes. Laser scanning confocal microscope and atomic force microscope.
2. Demonstration of cell sorting by flow cytometry
3. Use of different types of centrifuge
4. Staining of Golgi complex, mitochondria, peroxisomes etc.
5. Experiment on osmosis
6. Study of hemolysis
7. Introduction to nucleic acid and protein sequence databases: data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation.
8. Staining of neurons

M.SC.COURSE,SESSION-2022-2023
PG FIRST SEMESTER (SKILL ENHANCEMENT COURSE) IN ZOOLOGY
COURSECODE: ZOO-SEC-127
APPLIED BIOLOGY
THEORY

L	T	P	C
3	0	0	3

Unit I: Microbial Biology

- Various methods of microbial control: physical, chemical and biological. Sterilization techniques- moist heat and dry heat sterilization, filter sterilization of thermolabile substances and air, chemical sterilization.
- Culture media and preparation.
- Microbial fermentation and production of small and macro molecules.
- Molecular approaches to diagnosis and strain identification.

Unit II: Recent advances in biological sciences

- Introduction to computational biology, Brief overview of sequence alignment (BLAST) and FASTA. Bioinformatics databases: NCBI, PDB, SWISS PROT, Pfam, etc.
- Application of Bioinformatics - drug discovery, protein structure elucidation, molecular dynamic simulation, and genomic data analysis.
- Overview of genomics, proteomics, metabolomics and metagenomics and its application to health and agriculture.
- Transgenic animals and plants.
- Biosensors and its applications.

Unit III: Applied entomology

- Sericulture: species of silkworm, life history of *Bombyx mori*.
- Apiculture: species of honeybees, life history, products of bees, enemies of bee.
- Lac culture: species of lac insect, life history of *Laccifer lacca*, enemies of lac industry.

Unit IV: Cattle farming

- Traits and economic importance of different species of livestock.
- Basis of Sire selection and evaluation.
- Heterosis, causes, measurement and its application in animal breeding.
- Breeding methods for improvement of dairy cattle and buffaloes. Species hybridization, linebreeding, outbreeding, outcrossing, top crossing and grading up. Conservation of germplasm.
- An overview of breakdown of organic matter and biogas plant.

Unit V: Aquaculture

- Overview of aquaculture practices and integrated fish farming.
- Introduction to polyculture of fish, common fishes used in polyculture, factors affecting species selection and stocking rates.
- Freshwater fishes, cold water fishes and brackish water fishes.
- Culture of shrimps, prawns, edible oysters and pearl oysters.
- Fabrication and maintenance of the aquarium.

Essential readings (All latest editions)

1. Willey J, Sherwood L, Woolverton CJ. Prescott's Microbiology. McGraw Hill Publishers
2. Lesk, A. Introduction to bioinformatics. Oxford University Press.
3. Srivastava: A text book of applied entomology, Vol II. Kalyani Publishers.
4. Banerjee G. C. A Textbook Of Animal Husbandry. Oxford University Press.
5. Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, ICAR

Suggested readings (All latest editions)

1. Ananthanarayan R, and Paniker CKJ. Textbook of microbiology. Orient Blackswan.
2. Ghosh, Z. and Mallick, B. Bioinformatics: Principles and Applications. Oxford University Press.
3. David and Ramamurthy: Elements of Economic Entomology, Namrutha
4. Hafez, E. S. E. Reproduction in Farm Animals. Lea & Fabiger Publisher
5. Dunham R.A. Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K

Learning outcome:

After successful completion of this course, the students will be able to:

1. Understand the basic and fundamental aspects of applied biology.
2. Develop an understanding about the basics and applied aspects of computation biology, sericulture, apiculture, lac culture, cattle farming and aquaculture

M.SC. COURSE, SESSION – 2022-2023
PG FIRST SEMESTER(SKILL ENHANCEMENT COURSE) IN ZOOLOGY
COURSE CODE:ZOO-SEC-128
APPLIED BIOLOGY
PRACTICAL

L	T	P	C
0	0	1	1

1. Sterilization techniques, media preparation and agar plate preparation.
2. Visit to cell culture and microbial culture facility.
3. Familiarization with bioinformatics databases: NCBI, PDB, SWISS PROT, Pfam, etc.,
4. Pairwise sequence alignment using BLAST.
5. Writing a sequence in FASTA format.
6. Sericulture: Life history of silk worm
7. Apiculture: Life history of honey bee
8. Lac culture: Life history of Lac insect.
9. Edible fresh water fishes.
10. Visit to animal breeding centre or biogas plant. Submission of visit report.

Department of Zoology

School of Biological Sciences



Curriculum Framework

M.Sc. Zoology II Semester

[Session 2022-2023 Onwards]

[Based on National Education Policy- 2020]

Date of BoS: 13.09.2022

Doctor Harisingh Gour Vishwavidyalaya

(A Central University)

Sagar-Madhya Pradesh-470003

M.Sc.IISemester

Name of Course	PaperCourseCode	PaperTitle	Credits
Discipline Specific Major-1	ZOO-DSM-221	Developmental Biology–Theory	04
	ZOO-DSM-222	Developmental Biology –Practical	02
Discipline Specific Major-2	ZOO-DSM-223	Fundamental Processes of Biology–Theory	04
	ZOO-DSM-224	Fundamental Processes of Biology – Practical	02
Multi-Disciplinary Major-3	ZOO-MDM-225	Evolution and Behavioral Science–Theory	04
	ZOO-MDM-226	Evolution and Behavioral Science –Practical	02
Skill Enhancement Course	ZOO-SEC-227	Inheritance Biology–Theory	03
	ZOO-SEC-228	Inheritance Biology–Practical	01
	TotalCredits		22

P.G.COURSE,SESSION 2022-2023
M.SC.SECOND SEMESTER IN ZOOLOGY
DEVELOPMENTAL BIOLOGY
COURSE CODE: ZOO-DSM-221
THEORY

L	T	P	C
4	0	0	4

Unit I: Principles of Development in Biology

- Introduction to Developmental Biology: The Stages of Animal Development, Embryonic Homologies, Malformations and Teratology.
- Developmental Patterns in Unicellular Protists and Metazoa.
- The Developmental Mechanics of Cell Specification.
- Determining the Function of Genes during Development.

Unit II: Early Embryonic Development

- Introduction to Embryonic Development: Structure of Gametes, Recognition of Egg and Sperm, Acrosomal Reaction.
- The Early Development of Snails.
- The genetics of axis specification in *Drosophila*.
- Early Mammalian Development: Mammalian Anterior-Posterior Axis Formation, Dorsal- Ventral and left-Right Axes in Mammals.

Unit III: Later Embryonic Development

- Tetrapod limb Development.
- Sex Determination approaches in Developmental Biology.
- Metamorphosis, Regeneration and Aging.
- The Development of Blood Cells: The Stem Cell concept, the pluripotential hematopoietic stem cells, Blood and lymphocyte lineages, hematopoiesis.

Unit IV: Ramifications of Developmental Biology

- Environmental regulation of animal development.
- Hox Genes: Descent with Modification.
- Homologous Pathways of Development.
- Teratogenesis: Introduction, Principles and Teratogenic agents.

UnitV:Regenerative Biology,Environment and Development

- Cellular and molecular aspects, Genomic equivalence and cytoplasmic determinants.
- Environmental control of gene regulation, Epigenetic regulation of developmentally relevant genes.

Essential readings:

1. Scott F. Gilbert and Michael J. F. Barresi, Developmental Biology (11th Edition), 2017, Oxford University Press.

Suggested Readings:

1. John E. Hall and Michael E. Hall, Medical Physiology (3rd South Asia edition), 2020, Elsevier Health Science Publisher.
2. Brian Dale, Fertilization: From Gamete to Early Embryo, 2013, Cambridge University Press.
3. Gautam N. Allahbadia and Caludio F. Chillik, Human Embryo Transfer, 2015, Springer Nature Publisher.
4. David K. Gardner, Botros R. M. B. Rizk, and Tommaso Falcone, Human Assisted Reproductive Technologies, 2011, Cambridge University Press.

Learning Outcome:

After completing the course, students will able to learn:

1. Mechanism of fertilization
2. Embryonic development in different organism
3. Implantation of foetus and placentation in mammals

P.G.COURSE,SESSION 2022-2023
M.SC.SECONDSEMESTERINZOOLOGY
COURSE CODE: ZOO-DSM-222
DEVELOPMENTAL BIOLOGY
PRACTICAL

L	T	P	C
0	0	2	2

- Demonstration of different types of Ovarioles in insects. e.g. in (i) Cockroach/Grasshopper (Panoistic type) (ii) *Dysdercus/Bagrada/Sphaerodema* (Acrotrophic type) and (iii) *Musca/Drosophila* (polytrophic type).
- Preparation of window on hen's egg to see the development of embryo.
- Squash preparation of testes of male insects to demonstrate spermatogenesis.
- Section of ovaries of mammals showing oogenesis, development of graafian follicles and corpus luteum.
- Section of testes of a mammal (rat/rabbit) showing spermatogenesis.
- Development of chick showing morphogenesis & organogenesis by using 2,4,6,8,10 days incubated hen's eggs.
- Effect of xenobiotics on teratogenesis using snail egg masses as model material.

M.SC.COURSE,SESSION -2022-2023
M.SC.IISEMESTER
FUNDAMENTAL PROCESSES OF BIOLOGY
COURSE CODE: ZOO-DSM-
223THEORY

L	T	P	C
4	0	0	4

12hrs/Unit(Total:60Hrs)

Unit I:DNA replication, repair and recombination

- DNA structure & function; Different topological forms of DNA.
- DNA denaturation and renaturation curves.
- DNA replication in prokaryotes and eukaryotes: general rules, mechanisms of DNA polymerase.
- DNA damage and repair mechanisms.
- Homologous and site-specific recombination.

Unit II:RNA synthesis and processing

- DNA-Dependent Synthesis of RNA.
- Transcription factors and machinery, formation of initiation complex, transcription. activator and repressor.
- RNA polymerases, capping,elongation, and termination.
- RNA processing, RNA editing, splicing, and polyadenylation.
- Structure and function of different types of RNA.
- RNA transport.

Unit III:Protein synthesis and processing

- Ribosome, formation of initiation complex, initiation factors and their regulation.elongation and elongation factors, termination, genetic code.
- Aminoacylation of tRNA, tRNA-identity.
- AminoacyltRNAsynthetase, and translational proof-reading.
- Translational inhibitors.
- Post- translational modification of proteins.

Unit IV:Control of gene expression at transcription and translation level

- Regulating the expression of phages, viruses, prokaryotic and eukaryotic genes.
- Role of chromatin in gene expression.
- Gene silencing.
- Constitutive, Inducible and Repressible gene expression.
- Positive and Negative control of gene expression.
- Lac, Tryptophan, arabinose operons; Concept of attenuation.
- Lytic cascade and lysogenic repression in lambda bacteriophage.

Unit V: Innate and adaptive immune system

- Innate and adaptive immune system Cells and molecules involved in innate and adaptive immunity.
- Antigens, antigenicity and immunogenicity.
- B and T cell epitopes, structure and function of antibody molecules.
- Generation of antibody diversity, monoclonal antibodies, antibody engineering.
- Antigen-antibody interactions.
- MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells.
- B and T cell receptors.
- Complement system.
- Hypersensitivity and autoimmunity.

Essential Readings

1. Alberts Bruce , Johnson A , Lewis J , Raff M , Roberts K, Walter P (2014) Molecular Biology of the Cell. 5th Edition, Taylor and Francis. New York, USA.
2. Krebs JE., Kilpatrick ST. and Goldstein ES. (2013). Lewin' GENES XI, Jones & Bartlett Learning. Burlington, MA.
3. Kuby Immunology, International Edition (2018) by Judy Owen, Jenni Punt, Sharon Stanford and Patricia Jones.

Suggested readings:

1. TroppBE (2012) Molecular Biology: Genes to Proteins. 4th Edition, Jones & Bartlett, Learning, Burlington, MA.
2. Allison A. Elizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken, New Jersey.
3. Fundamentals of Immunology, VII Edition (2012) by William E. Paul.
4. Immunology, VIII Edition (2013) by David Male, Jonathan Brostoff, David Roth and Ivan Roitt.
5. Cellular and Molecular Immunology, First- South Asia edition (2017) by Abdul K Abbas, Andrew H. Litchman and Shiv Pillai.

Learning outcome:

1. The course teaches the students about genes at molecular level.
2. Student will exhibit a knowledge base in molecular biology involved in fundamental processes.
3. Students will gain the knowledge about DNA, RNA and their replication, DNA repair mechanism, transcription and translation.
4. Students can critique and professionally present primary literature articles in the fundamental biology and immunology

M.SC. COURSE, SESSION – 2022-2023
PG SECOND SEMESTER IN ZOOLOGY
COURSE CODE: ZOO-DSM-224
FUNDAMENTAL PROCESSES OF BIOLOGY
PRACTICAL

L	T	P	C
0	0	2	2

1. Preparation of solutions for molecular biology experiments.
2. Isolation of total histones and electrophoretic analysis.
3. Isolation of non-histone chromosomal proteins (high mobility group proteins) and electrophoretic analysis.
4. Isolation of plasmid DNA from bacteria.
5. Isolation and characterization of DNA using agarose gel electrophoresis.
6. Quantification of DNA using Diphenyl amine method.
7. RNA isolation and analysis on formaldehyde gel.
8. Quantification and purity determination of DNA /RNA using UV-Visible spectroscopy.
9. Digestion of DNA using restriction endonucleases.
10. Resolution and molecular weight estimation of fragmented DNA using Agarose gel electrophoresis.
11. Blood film preparation and identification of cells.
12. Isolation of mouse spleenocytes by density gradient centrifugation
13. ELISA
14. Radial immune-diffusion
15. Immunological diagnosis (Blood group)

M.SC. COURSE, SESSION – 2022-2023
PG SECOND SEMESTER IN ZOOLOGY
COURSE CODE: ZOO-MDM-225
EVOLUTION AND BEHAVIOR
THEORY

L	T	P	C
4	0	0	4

Unit I: Origin of Cells and Unicellular Evolution and Molecular Evolution:

- Origin of Basic Biological Molecules
- Abiotic synthesis of organic monomers and Polymers
- Concept Oparin and Haldane, Experiment of Miller (1953)
- The First Cell; Evolution of Prokaryotes and Eukaryotes Cells
- Concept of Neutral Evolution
- Molecular Divergence and Molecular Clocks
- Molecular Tools in Phylogeny
-

Unit II: Mechanism of Evolution

- Population Genetics- Populations, Gene Pool, Gene Frequency
- Hardy-Weinberg Law
- Concept and Rate of Change in Gene Frequency through Natural Selection, Migration, and Random Genetic Drift
- Adaptive Radiation and Modification
- Isolating Mechanism
- Speciation- Allopatric, and Sympatric
- Convergent Evolution, Sexual Selection and Co-evolution

Unit III: Behavior and Communication

- Historical background, Stimulus-Response, Causal factors, Quantitative aspects – Duration, interval frequency.
- Behavior bouts. Darwinian Perspective on Animal behavior, Scope of ethology, Genetic basis of behavior.
- Evolution of communication, Sensory mechanisms: Electrical, Chemical, Olfactory, Auditory and Visual. Dance language of honey bees, Pheromonal communication (Ants and mammals).

Unit IV: Neurophysiological aspects of Behavior and Learning

- Reflex action, Kinesis, Taxes,
- Fixed action patterns. Sherrington's neuro-physiological concepts in behaviour – Latency, summation, fatigue.
- Short- and long-term memory, Habituation, Classical conditioning (Pavlov's experiments), Instrumental conditioning, Latent learning, Trial and error learning, Instinct, Imprinting.

Unit V:Reproduction and Types of Behavior

- Reproductive strategies, Mating systems, Courtship, Sexual selection- patterns, parental care and investment.
- Orientation, Navigation, Migration (Fishes and birds), Navigation cues. Biological rhythms – Circadian, Circannual, Lunar periodicity, Tidal rhythms. Genetics of biological rhythms.
- Sociobiology (Brief account only)
- Aggregations – schooling in fishes, herding in mammals, Group selection, Kin selection, altruism, reciprocal altruism, inclusive fitness, co-operation, territoriality, alarm call, social organization in insects and primates.
- Adaptations to stress- basic concept of environmental stress, acclimation, acclimatization, avoidance and tolerance.
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Essential Readings:

1. Lee C. Drickamer, Stephen H.Vessey, Elizabeth Jakob.2002. Animal Behaviour –Mechanisms, Ecology, Evolution (5 th edn).McGraw-Hill Publishing Company, New York Macfarland, D1998.
2. Animal Behaviour – Psychobiology, Ethology and Evolution. Pitman publication Ltd. London.
3. Animal Behaviour: Reena Mathur (3rd edition) (2010-2011). Publisher Rastogi publication
4. Animal Behaviour (Ethology), Agrawal VK.; S. Chand Publications, New Delhi.

Suggested Readings:

1. An Introduction to Animal Behaviour, By Aubrey Manning ELBS publication.
2. Animal Societies and Evolution, A scientific American publication. W.H. Freeman and Co. USA.
3. Animal Behaviour, By Niko Tinbergen, Time Life International, Netherland.
4. Behaviour Ecology: Krebs & Davis, (3rd 1993, Blackwell).
5. Merrel, D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc.
6. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
7. Futuyama, D.J. Evolutinary Biology, Suinuaer Associates, INC Publishers, Dunderland.

Learning Outcome:

Students will be able to understand and identify the behavior in a variety of taxa and get a deep interest in evolutionary processes. Designing and implementing experiments to test hypotheses relating to animal behavior and the quantitative concept of evolution.

M.SC. COURSE, SESSION – 2022-2023

PG SECOND SEMESTER,

COURSE CODE: ZOO-MDM-226

EVOLUTION AND BEHAVIOR

PRACTICAL

L	T	P	C
0	0	2	2

- To Study the Convergent and Divergent Evolution Using Museum Specimens.
- To Study the Practical Applications of Hardy-Weinberg Law.
- To Study Parental Care/ nest building/ sexual dimorphism.
- Demonstration of Reflexes in Man.
- Study of Learning Behavior.
- Study of Learning Behavior in Mice by Using a Zigzag or T-Shaped Maze.
- Study of Wall-seeking Behavior in Mice
- A Field Study of Foraging or Trail Making Behavior in a Seed Harvester or Predatory Ant Species.

M.SC. COURSE, SESSION – 2022-2023
PG SECOND SEMESTER (SKILL ENHANCEMENT COURSE) IN ZOOLOGY
COURSE CODE: ZOO-SEC-227
INHERITANCE BIOLOGY

THEORY

L	T	P	C
3	0	0	3

Unit I: Mendelian genetics and its extension and methods of gene mapping

- Dominance, segregation, independent assortment.
- Concept of gene: allele, multiple alleles, pseudoalleles, complementation tests.
- Extension of Mendelian principles: codominance, incomplete dominance, gene. interactions, pleiotropy, genomic imprinting, penetrance and expressivity, sex linked inheritance, extra chromosomal inheritance, dosage compensation.

Unit II: Methods of gene mapping, microbial, human and quantitative genetics

- Recombination, linkage and crossing over, Linkage maps, tetrad analysis, mapping with molecular markers, somatic cell genetics.
- Exchange of genetic material in bacteria: transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating.
- Pedigree analysis: symbols used, construction and analysis of pedigrees, lod score for linkage testing.
- Polygenic inheritance, heritability and its measurements, QTL mapping.

Unit III: Gene mutation and DNA repair

- Types and causes of gene mutations, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic metants, insertional mutagenesis.
- Structural and numerical alterations of chromosomes: deletion, duplication, inversion, translocation, aneuploidy and polyploidy.
- Methods for detection of induced mutation.
- DNA damage and repair mechanisms.

Unit IV: Eukaryotic chromatin structure and chromosome organization

- Nature of genetic material, evidences of DNA as the genetic material
- Chromosomal proteins: histones and their modifications, non-histone proteins, scaffold/matrix proteins.
- Chromatin condensation, Heterochromatin and euchromatin, centromere, kinetochore and telomere.
- Chromosome and chromatid type aberrations.

Unit V: Human genetic disorders

- Overview of Mendelian inheritance and diseases.
- Sickle cell, hemochromatosis, cystic fibrosis, Duchenne muscular dystrophy,
- Huntington's disease, achondroplasia, phenylketonuria.
- Turner syndrome, Down Syndrome, Patau syndrome, Klinefelter syndrome.
- Metaphase chromosome banding, karyotypes.

Essential readings:

1. Snustad & Simmons: Principles of Genetics (2012, John Wiley)
2. Griffith et al: Modern Genetic Analysis (2008, Freeman)
3. Russell: Genetics (2010, Benjamin Cummings)

Suggested readings:

1. Alberts et al: Molecular Biology of the Cell (2008, Garland)
2. Hartl & Jones: Essential Genetics: A Genomic perspective (2009, Jones & Bartlett)
3. Karp: Cell and Molecular Biology (2010, John Wiley & Sons)
4. Krebs et al: Lewin's Genes X (2011, Jones & Bartlett)
5. Lodish et al: Molecular Cell Biology (2008, Freeman)
6. Pierce: Genetics – A Conceptual Approach (2012, Freeman)

Learning outcome:

After successful completion of this course, the students will be able to:

1. Describe fundamental molecular principles of genetics.
2. Develop an understanding about the modern genetic analysis by explaining the mechanisms leading to genetic recombination and gene mapping.
3. Analyze pedigree charts and perform pedigree analysis.
4. Explain the inheritance of complex traits and genetic basis of various human disorders.

M.SC. COURSE, SESSION – 2022-2023
PG SECOND SEMESTER (SKILL ENHANCEMENT COURSE) IN ZOOLOGY
COURSE CODE: ZOO-SEC-228
INHERITANCE BIOLOGY

PRACTICAL

L	T	P	C
0	0	1	1

1. Culture and handling of *Drosophila* and study of its life cycle, stages of growth and identification of anatomical structures.
2. Examination of wild type and mutant flies of *Drosophila*.
3. Basics of setting up genetic crosses and observation of phenotypes from monohybrid and dihybrid crosses and verification of the results using chi square test.
4. Dissections of salivary glands from third instar larvae of *Drosophila* and temporary squash preparation of polytene chromosomes.
5. Study of meiosis in grasshopper testes by squashing method.
6. Study of sex chromatin in human female from buccal epithelial and hair bud cells.
7. Study of human karyotypes.
8. Study of permanent slides/photomicrograph of the following: (a) Dicentric bridge in the anaphase 1 chromosomes of grasshopper, (2) inversions in polytene chromosomes of *Drosophila*, (3) Lampbrush chromosomes, (4) G-banded and C-banded metaphase chromosomes, (5) chromatid exchanges and chromosomal anomalies, (6) sister chromatid exchanges.
9. Polymerase chain reaction (PCR) and its applications.
10. Primer design: Guidelines for primer designing; tools for designing primers.
11. DNA gel electrophoresis of PCR amplified products.