

Department of Zoology
M.SC. ZOOLOGY
Indira Gandhi National Tribal University, Amarkantak (MP)

Course code	Courses	Title of the Course	Credits
SEMESTER I			
MZT 101	Core Course-1	Non-Chordates: Structure, Function and Evolutionary Significance	4
MZT 102	Core Course-II	Biosystematics and Quantitative Biology	4
MZT 103	Core Course-III	Cell and Molecular Biology	4
MZT 104	Core Course-IV	Tools and Techniques of Biology	4
MZL 101	MZT 101+ MZT 102	Laboratory Exercises I	2
MZL 102	MZT 103+ MZT 104	Laboratory Exercises II	2
MZG 105	General Electives-1	Elementary Biochemistry	3
MZGL 105	MZG 105	Laboratory Exercises 1	1
			24
SEMESTER II			
MZT 201	Core Course-V	Chordates: Structure, Function and Evolutionary Significance	4
MZT 202	Core Course-VI	Prokaryotes and Viral Biology	4
MZT 203	Core Course-VII	Biochemistry and Biophysics	4
MZT 204	Core Course-VIII	Molecular Endocrinology	4
MZL 201	MZT 201+ MZT 202	Laboratory Exercises III	2
MZL 202	MZT 203+ MZT 204	Laboratory Exercises IV	2
MZG 205	General Electives-2	Fundamentals of Physiology	3
MZGL 205	MZG 205	Laboratory Exercises 2	1
			24
SEMESTER III			
MZT 301	Core Course-IX	Developmental and Gamete Biology	4
MZT 302	Core Course-X	Animal Physiology	4
MZT 303	Core Course-XI	Genetics and Evolution	4
MZE 304	Major Electives-1	Major Electives-1 (Mammalian Reproductive Endocrinology and Toxicology-I / Medical Biochemistry and Clinical Genetics-I)	6
MZL 301	MZT 301+302+303	Laboratory Exercises V	2
MZL 304	MZE 304	Laboratory Exercises VI	2
			22
SEMESTER IV			
MZE 401	Major Electives-2	Major Electives-2 (Mammalian Reproductive Endocrinology and Toxicology-II / Medical Biochemistry and Clinical Genetics-II)	6
MZD 401		Dissertation	6
MZP 401		Presentation	4
		Total credits	86

* Minimum requirement of credits for M.Sc. Zoology is 72

M.Sc. ZOOLOGY
FIRST SEMESTER EXAMINATION

Title of the Paper	Credits	Contact Hrs./ Week	Maximum Marks	Sessional Marks		End Semester Examination Marks	Min. Pass Marks in End Sem. Exam.
				40			
MZT 101: Non-Chordates: Structure, Function and Evolutionary Significance	4	4 hrs.	100	10x2 test average	20(10 assignment+10 attendance)	60	24
				20	20		
MZT 102: Biosystematics and Quantitative Biology	4	4 hrs.	100	20	20	60	24
MZT 103: Cell and Molecular Biology	4	4 hrs.	100	20	20	60	24
MZT 104: Tools and Techniques of Biology	4	4 hrs.	100	20	20	60	24
MZL 101: Laboratory Exercises I	2	6 hrs.	50			50	20
MZL 102: Laboratory Exercises II	2	6 hrs.	50			50	20
MZG 105: Elementary Biochemistry	3	3 hrs.	100	20	20	60	20
MZGL 105: Laboratory Exercises 1	1	3 hrs.	50			50	
Total	24		650	200		450	

M.Sc. ZOOLOGY

I SEMESTER

MZT 101: Non-Chordates: Structure, Function and Evolutionary Significance

Unit-I

Diversity: Numerical strength, Size, Shape and symmetry, Habitat (Ecology), Grades of organization, Types of coelom

Phylogeny and Evolution of Invertebrates

Protozoa: Locomotion, Osmoregulation, Parasitic adaptation and host immune evasion

Unit-II

Metazoa: Organization, Polarity

Porifera: Canal system, Skeletal system

Unit-III

Coelentrates: Polymorphism and metagenesis, Coral reefs

Helminthes: Evolution of parasitism in Helminthes

Unit-IV

Annelida: Origin of Coelom and metamerism, Adaptive radiation

Arthropoda: Biological success, Larvae of crustaceans, Mouth parts of insects
Respiration, Social life in insects, Insect Control, metamorphosis

Unit-V

Mollusca: Torsion in gastropods, Significance of *Neopilina* in Molluscan phylogeny

Echinodermata: Symmetry, Water-vascular system, Larval forms

List of recommended books:

- Invertebrates 2nd Ed .: Richard C. Brusca, et al.Sinauer Associates, Inc., Publishers
- Invertebrate Zoology: A Functional Evolutionary Approach, 7th Ed.: Edward E. Ruppert Richard S. Fox Robert D. Barnes Cengage Learning
- Biology of the Invertebrates : Jan Pechenik McGraw Hill Ryerson publication
- Invertebrate Zoology 3rd Ed.: Paul A. Meglitsch, Oxford University Press.
- Invertebrate Zoology 6th Ed.: Barnes, R. D. and Ruppert, E. E., Brooks Cole.
- Modern Text Book of Zoology: Invertebrates: R. L. Kotpal Rastogi Publications

MZT 102: Biosystematics and Quantitative Biology

Unit-I

Basic concepts: Historical perspective, Material basis, Importance and applications

Trends in Biosystematics: Chemo-, molecular and cytotaxonomy

Molecular basis of conservation of diversity

Unit-II

Keys in Taxonomy

Biodiversity Indices: Shannon-Weinner index, Dominance index, Similarity and dissimilarity index, Association index

Unit-III

Nature and scope of Biostatistics: Primary and secondary data, Methods of data representation (Tabulation and Graphics), Frequency distribution, Central tendency, Dispersion, Hypothesis testing (t-test, Chi-square test), R x C Contingency table

Unit-IV

Bivariate Data: Central and raw moments up to fourth order, Skewness, Kurtosis and their measures, Analysis of variance (ANOVA) - One way and two way, Post hoc test, Correlation, regression

Unit-V

Probability: Concept, Classical and statistical definition of probability, Additive and multiplicative theorems of probability, Conditional probability and Baye's theorem, Binomial, Poisson and normal distributions with their properties and applications

Non-parametric statistics: Mann-Whitney U, Wilcoxon matched-pairs test, Kruskal- Wallis test

List of recommended books:

- Principle of Animal Taxonomy: G. G. Simpson, Oxford IBH Publishing Company
- The Diversity of Life: E. O. Wilson, WW Northem and Company
- Biodiversity: E. Mayer, Academic Press, London
- Statistical methods 8th Ed: GW Snedecor and WG Cochran, East-west press.
- Biomtery, 3rd Ed.: RR Sokal, and FJ Rohlf, Freeman
- Biostatistical Analysis, 5th Ed.: JH Jarr, Pearson
- Computational book of statistics, 2nd Ed.: J.L Bruning and, B.L. Scot Kintz, Foresman and company.
- Medical Statistics at a Glance: A Petrie, and C. Sabin, Blackwell Science
- Statistics, 4th Ed.: DH Freedman R Pisani, R Purves, WW Norton and Company

MZT 103: Cell and Molecular Biology

Unit-I

Biomembranes and Transport: Structural and functional aspects of plasma membrane, Active and passive membrane transport, sodium pump, Endocytosis and exocytosis, Role of coated vesicles in transport

Unit-II

Cellular Receptors and Signaling: Cell surface receptors, Signaling via G-Protein Linked receptors, cAMP, IP₃, Diacylglycerol as second messengers, adenylate cyclase system, inositol phosphate pathway, role of Ca²⁺ ions in signaling process; Signal transduction via enzyme-linked surface receptors, receptor tyrosine kinases, Steroid receptors

Unit-III

Transcription: Mechanism of transcription in prokaryotes and eukaryotes, RNA polymerase, Promoters, Transcription factors, Concept of anti-termination

RNA Processing: Post-transcriptional processing of rRNA, tRNA and hnRNA among eukaryotes, Discovery of introns and role of spliceosomes in introns removal

Unit-IV

Translation: Genetic code; Mechanism of translation in prokaryotes and eukaryotes, Post-translational modifications

Protein Targeting and Sorting: Concept of signal peptide, Signal recognition particle (SRP), SRP receptor, transport of soluble and membrane bound proteins in Endoplasmic reticulum

Unit-V

Organization and functions of eukaryotic cell organelles:

Mitochondria: Membrane structure, Genome organization, Transport of proteins

Chloroplasts: Genome organization, Transport of proteins

Golgi apparatus: role in protein glycosylation and transport

Lysosomes: intracellular digestion, sorting of lysosomal enzymes

List of recommended books:

- Becker's World of the Cell 8th Ed.: J.Hardin, G.P. Bartoni, Pearson Education.
- Molecular Cell Biology 7th Ed.: Lodish, Baltimore, W. H. Freeman and Co.
- Molecular Biology of the Cell 5th Ed.: Bruce Albert, Garland Publication, NY.
- iGenetics: A Molecular Approach 3rd Ed.: P.J. Russel, Pearson Education.
- Principles of Genetics 8th Ed.: Gardner, Simmons and Snustad, John Wiley.
- Cell and Molecular Biology: P.K. Gupta, Rastogi Publications.
- Cell and Molecular Biology: De Robertis and De Robertis, B.I. Waverly Pvt. Ltd.

MZT 104: Tools and Techniques of Biology

Unit-I

Basic principles of microscopy: Types of microscopes and their biological applications, Bright-field, microscope, numerical aperture, limit of resolution, types of objectives, ocular and stage micrometers, Dark-field, Phase-contrast, Differential interference contrast, Fluorescence, Confocal, Atomic force, Transmission and scanning electron microscopy

Unit-II

Centrifugation: Basic principle, Types of rotors, Clinical, high speed and ultracentrifuge

Electrophoresis: Agarose- and polyacrylamide gel, Two-dimensional, Iso-electrofocussing

Microbiological Techniques: Culture of bacterial cells, recombinant techniques, transformation, restriction, ligation and cloning

Unit-III

Spectroscopy: Beer-Lambert's law, molar extinction coefficient and calculation, Spectroscopy, Absorption spectrum, Colorimeter and UV-Vis, Spectrophotometer, CD, Fluorescence, NMR, Spectrofluorometry

Unit-IV

Chromatography: Paper and thin layer chromatography, Column chromatography, Gel filtration, Ion-exchange, HPLC, FPLC, MALDI (TOF), Affinity purification

Unit-V

Bioinformatics and Molecular Biology Techniques:

Introduction and scope of Bioinformatics, Data bases Nucleic acid sequences Genomes, Protein sequence and structures, Access to molecular biology data bases Entrez Sequence retrieval system (SRS) Protein identification resource (PIR) , Sequence alignments and phylogenetic trees

Southern and northern blotting, Western blotting, ELISA, PCR, FACS, *In situ* hybridization, FISH, RISH, immunostaining, Microarray, ELISA, FACS, DNA protein Interaction methods, EMSA, South Western, Protein-protein interaction methods, Pull down assay, Far western Blot, FRET-FREM, Yeast two hybrid system

SUGGESTED READINGS:

- Principles and techniques of Biochemistry and Molecular Biology, 7th Ed: K. Wilson, J. Walker, Cambridge Univ. Press. UK
- An Introduction to Practical Biochemistry, 3rd Ed : D. T. Plummer, Tata-McGraw Hill
- Modern Experimental Biochemistry and Molecular Biology 2nd Ed: R. Boyer Benjamin/Cumin
- Physical Biochemistry, 2nd Ed: D.M. Freifelder, Freeman Press.
- Analytical Biochemistry, 3rd Ed. D. Holme, J. Peck, Tata McGraw Hill.
- Experimental Biochemistry, 3rd Ed: R. L. Switzer, L.F. Garrity, Freeman Press

General Electives-1

MZG 105: Elementary Biochemistry

Unit- I

Introduction

Chemistry of living system, Scope and importance, Biomolecular organizations, Monomer and polymer concept, Chemical interactions, Configuration and conformation, H₂O as biological solvent

Unit- II

Carbohydrate and Lipids

Carbohydrates : Glucose as a photosynthetic product, Mono-, Oligo- and Polysacharides
Lipids: Properties and functions

Unit- III

Nucleic Acids

Nucleic acids: DNA and RNA: Structure and functions, Nucleosomes, Central dogma of information flow: Concept of genes, Replication, Transcription and Translation, Recombinant DNA technology and its application

Unit -IV

Proteins and Enzymes

Proteins: Functions and diversity, Structure and conformation, Primary structure: Amino acids, peptide bond,
Characteristics and mechanism of action, Ribozymes

Unit- V

Metabolism

Anabolism and catabolism of carbohydrates, proteins and Fats, Energy transduction in cells, Metabolic errors and diseases

List of recommended books:

- Conn, Stumpf, Bruening & Doi: Outline of Biochemistry, John Wiley & Sons
- Murray et al.,: Harper's Biochemistry, Prentice Hall

M.Sc. ZOOLOGY
SECOND SEMESTER EXAMINATION

Title of the Paper	Credits	Contact Hrs./ Week	Maximum Marks	Sessional Marks		End Semester Examination Marks	Min. Pass Marks in End Sem. Exam.
				40			
MZT 201: Chordates: Structure, Function and Evolutionary Significance	4	4 hrs.	100	10x2 test Average 20	(10 assignment+10 attendance 20	60	30
MZT 202: Prokaryotes and Virology	4	4 hrs.	100	20	20	60	24
MZT 203: Biochemistry and Biophysics	4	4 hrs.	100	20	20	60	24
MZT 204: Molecular Endocrinology	4	4 hrs.	100	20	20	60	24
MZL 201: Laboratory Exercises III	2	6 hrs.	50			50	20
MZL 202: Laboratory Exercises IV	2	6 hrs.	50			50	20
MZG 205: Fundamentals of Physiology	3	3hrs	100	20	20	60	24
MZGL 205: Laboratory Exercises 2	1	3hrs	50			50	20
Total	24		650	200		450	

M.Sc. ZOOLOGY

II SEMESTER

MZT 201: Chordates: Structure, Function and Evolutionary Significance

Unit-I

Origin of Chordates, Retrogressive metamorphosis

Endostyle: Structure, function and evolution in higher Chordates, Affinities and systematic position of Hemichordates, Agnatha and gnathostomata

Unit-II

Pisces: Dipnoi, Accessory respiratory organs, Lateral line system, migration

Amphibian: Origin of tetrapods, Metamorphosis, Neoteny and paedogenesis, Parental care

Unit-III

Reptiles: Origin, Affinities of *Seymouria* and *Sphenodon*, Adaptive radiation, Skull, Poisonous and non-poisonous snakes, Biting mechanism, Venoms and anti-venoms

Unit-IV

Aves: Flightless and flying birds, Flight adaptation, Migration, Distribution of flightless and flying birds, *Archeopteryx* as connecting link

Unit-V

Mammals: Origin and evolution, Dentition, Egg laying mammals, Pouched mammals, Placental mammals, Toothless mammals, Aquatic mammals, Flying mammals, Primates

List of recommended books:

- The Biology of Hemichordates and Protochordates: E.J.W. Barrington, Oliver and Boyd, Edinburgh
- The Vertebrate Body, 6th Ed: A.S. Romer, T. Parsons, Saunders
- Biology of the Vertebrates: H.E. Walter, L.P. Sayles, Macmillan
- The Life of Vertebrates: J.Z. Young, Clarendon
- Evolution of Vertebrates: E.H. Colbert, John Wiley and Sons Inc.
- The Chordata: R.M. Alexander, Cambridge University Press, London
- Comparative Anatomy of Chordates: C.G. Kent

MZT 202: Prokaryotes and Virology

Unit-I

Prokaryotes: Systematics, Phylogeny, Diversity, Major groups, Typical prokaryotic cell, Cell wall, Growth, Metabolism, Prokaryotes in industry

Unit-II

Prokaryotic Genome: Organization of prokaryotic genome, Regulation of gene expression in prokaryotes, The *lac* Operon, Catabolic repression, The *trp* operon, Bacterial expression system

Unit-III

Viruses: Structure, Taxonomy, Proteins and nucleic acids, Culture and growth, Assay, Replication, Infection, Vaccines, Prions

Bacteriophages: Phage life cycle, T₄ Lytic pathway, λ Lysogenic pathway, M₁₃ Phage, Gene expression in lytic and lysogenic infection, Viral infections

Unit-IV

Microbial Cosmos: Infection and its consequences, Microbe habitat and immune defense, Pathogen protective mechanism, Damage caused by pathogens

Unit-V

Immunity to Bacteria and Viruses: Role in autoimmune disorders, Polyclonal activation by microbial antigens, Modification of cell surface by microbes, Pathogen defense strategies, Defense mechanism, Evasion of immune response

Vaccination: Antigen preparation, Adjuvant, Bacterial and viral vaccines, DNA vaccines, Recombinant vaccines, Cytokines, Antiviral chemotherapy

List of recommended books:

- The Prokaryotes: A Handbook on the Biology of Bacteria, 3rd Ed : M. Dworkin, Springer
- The Physiology and Biochemistry of Prokaryotes, 4th Ed : D. White, J. Drummond, C. Fuqua, Oxford University Press, USA
- Microbiology, 7th Ed: L. Prescott, J.P. Harley, D.A. Klein, McGraw Hill
- Microbiology, An Introduction, 10th Ed: G.J. Tortora, B.R. Funke, C.L. Case, Benjamin-Cummings
- Principles of Molecular Virology, 4th Ed: A.J. Cann, Academic Press, London
- Basic Virology, 2nd Ed.: E. Wagner, M.J. Hewlett, Blackwell Scientific, Oxford

MZT 203: Biochemistry and Biophysics

Unit-I

Bioenergetics: Laws of thermodynamics, Concept of free energy, Standard free energy, ATP as energy currency and its hydrolysis

Water: Hydrogen bonding and structure of water molecule, Ionization of water, Concept of pH and pOH, Colligative properties

Unit-II

Carbohydrates: Classification and structure, glycosaminoglycans and proteoglycans, Glycolysis, TCA cycle, Electron transport system

Unit-III

Amino acids: Structure, Zwitter ionic properties and titration curves

Proteins: Various levels of structural organization of proteins, Peptide bonds, disulphide and other types of cross-links, α -helix and other helices, Helix-coil transition, parallel and anti-parallel β -pleated sheets, Ramachandran plot and its significance

Unit-IV

Lipids: Simple and complex lipids, Glycerophospholipids, Sphingolipids, Gangliosides, Eicosanoids and prostaglandins

Cholesterol: Structure and biosynthesis

Unit-V

Nucleic acids and Nucleotides: Biosynthesis of purines and pyrimidines, *de novo* and Salvage pathway, various conformations of nucleotides, Glycosidic bond rotation, Base-stacking

List of recommended books:

- Lehninger's Principles of Biochemistry 6th Ed.: Nelson and Cox, McMillan Worth Publishers.
- Biochemistry 4th Ed.: Voet and Voet, John Wiley and Sons, Inc. USA.
- Biophysical Chemistry Vol. I, II and III: Cantor and Schimmel, Freeman.
- Biochemistry: Zubey, WCB.
- Harper's Illustrated Biochemistry 29th Ed.: R.K. Murray et al., Prentice-Hall International Inc.
- Biochemistry 4th Ed.: Christopher K. Mathews, Pearson Education.

MZT 204: Molecular Endocrinology

Unit I

Chemistry of Hormones

Chemical nature of hormones, Hormone secretions (apocrine, holocrine, and merocrine), Hormone delivery, Hormonal feedback in homeostasis, hormones in sexual behaviour, reproductive pheromones

Unit II

Hypothalamus : Anatomy and physiology

Anatomy and physiology of endocrine hypothalamus: Hypothalamic nuclei, Hypophysiotropic hormones (TRH, GnRH, CRH, Somatostatin, Nitric oxide, Monoamines, Endorphin)

Pituitary gland: Adenohypophysial hormones: Chemistry and physiological roles of Somatotropin and Prolactin, Glycoprotein hormones (FSH, LH and TSH), Pro-opiomelanocortin (ACTH, MSH, β -LPH & β -endorphin)

Pineal gland – Melatonin synthesis, rhythms and photoperiodic measurement. Pineal and biological clock

Unit III

Mechanism of hormone action: Structure and function of Plasma membrane receptors, Kinase cascade receptors, G-protein, Second messengers of hormones, cyclic AMP – protein kinase A, PLC-protein kinase C, Tyrosine kinase and Nitric oxide signaling pathway, Eicosanoids and hormone action

Intracellular receptors: Thyroid hormone receptors, Calmodulin, Steroid hormones signaling (genomic and nongenomic pathways)

Pathophysiology of hormone receptors and hormone analogues as drugs

Unit IV

Thyroid Gland: Biosynthesis of thyroid hormones, Control of secretion, Physiological roles Role of parathormone, Calcitonin and vitamin D in calcium homeostasis

Endocrine Pancreas: Biosynthesis and physiological actions of Insulin and Glucagon

Unit V

Steroid hormone biosynthesis and pathways

Testis: Organization, Control of secretion and Physiological roles of androgens, Inhibin

Ovary: Organization and Physiological roles of Estrogen, Progesterone and Relaxin and inhibin

Adrenal Cortex: Control and Physiological roles of mineralocorticoid and glucocorticoid secretions

Adrenal Medulla: Catecholamine biosynthesis, release and its physiological roles

List of recommended books:

- General Endocrinology C. Donnell Turner Pub- Saunders Toppan
- Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.Oxford: BIOS Scientific Publishers; 2001.
- Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition

General Electives-2

MZG 105: Fundamentals of Physiology

Unit - I

Introduction and Expectations: Evolution of multicellularity. What is physiology? How many times did multicellularity evolve?

Diversity: Tree of life

Unit - II

Respiration

Mechanism of breathing, respiratory quotient

Circulation

Blood buffers, blood groups, cardiac cycle and its regulation

Unit - III

Nutrition and Digestion

Nutrient acquisition in animals, balanced diet, digestion and absorption of carbohydrates, proteins and fats, hormonal regulation of gastrointestinal function

Excretion

Structure of kidney and nephron, Urine formation, hormonal control of renal function

Unit - IV

Sensing and responding

Nervous System: Organization, myelinated and non-myelinated nerve fibres, resting and action potential, initiation and conduction of nerve impulse, types of synapses and chemical transmission

Vision and Hearing: Structure of eye, Retinal components, photoreceptors

Structure and functioning of ear, Mechanoreceptor: ionic basis of potential generation

Unit - V

Muscles

Types and functional diversity, ultra structure of skeletal muscle, muscle proteins, neuromuscular junction, chemistry of muscle contraction, elementary knowledge of muscle twitch, tetanus and fatigue, isotonic and isometric contractions

Reproduction: Reproductive strategies in animals

List of recommended books:

- Ganong: Review of Medical Physiology (22nd ed. 2005, Lange Medical)
- Guyton and Hall: A text book of Medical Physiology (11th ed. 2006, Saunders).
- Keele & Neil: Samson Wright's Applied Physiology (13th ed. 1989, Oxford)

M.Sc. ZOOLOGY
THIRD SEMESTER EXAMINATION

Title of the Paper	Credit	Contact Hrs./ Week	Maximum Marks	Sessional Marks		End Semester Examination Marks	Min. Pass Marks in End Sem. Exam.
				40			
MZT 301: Developmental and Gamete Biology	4	4 hrs.	100	10x2 test Average 20	(10 assignment+10 attendance 20	60	24
MZT 302: Animal Physiology	4	4 hrs.	100	20	20	60	24
MZT 303: Genetics and Evolution	4	4 hrs.	100	20	20	60	24
MZE 304: Mammalian Reproductive Endocrinology and Toxicology-I & Medical Biochemistry and Clinical Genetics-I (Major Electives)	4	4 hrs.	100	20	20	60	24
MZP 301: Laboratory Exercises V	2	6 hrs.	50			50	20
MZP 302: Laboratory Exercises VI (Major Electives)	2	6 hrs.	50			50	20
Total	20		500	160		340	

M.Sc. ZOOLOGY
III SEMESTER

MZT 301: Developmental and Gamete Biology

Unit-I

Principles of Developmental Biology: Potency, commitment, specification, induction, competence

Fertilization in mammals: Gametogenesis, Recognition of gametes and acrosomal reaction, Prevention of polyspermy and gamete fusion

Unit-II

Embryonic early development: Cleavage: patterns, gastrulation: Fate maps, cell movement and formation of germ layers

General concept of induction: mesoderm development

Determination: Imaginal discs of insects

Differentiation: Formation of fruiting bodies in *Dictyostellium*, Body pattern formation

Unit-III

Metamorphosis and organogenesis in model animal system: Origin of anterior-posterior and dorsal-ventral polarity in *Drosophila*, Involvement of maternal, segmentation and homeotic genes, Organization of HOX gene in vertebrates, Axis formation in amphibians: Nieuwkoop Centre and primary organizer, Axis formation in birds and mammals: involvement of pattern forming genes

Unit-IV

Late embryonic development: Vulva formation in *Caenorhabditis*, Formation of neural tube in vertebrates, Development of limb in vertebrates, Involvement of HOX and, other pattern forming genes

Unit-V

Aging, Senescence and Regeneration: Mitochondrial control of aging, Insulin pathway control of ageing and possible relation to oxygen radicals, “Ageless” animals and environmental control of aging, Senescence and cell death, Hormonal control of metamorphosis in amphibians, Regeneration of Salamander limbs, Polar coordinate model, Embryonic stem cells and their applications

List of recommended books:

- Developmental Biology, 10th Ed, S. F. Gilbert, Sinauers Press.
- Molecular Biology of the Cell, 5th Ed, B. Alberts, Garland Press.
- Analysis of Biological Development, 2nd Ed, K. Kalthoff, McGraw-Hill.
- Principles of development, 4th Ed, L. Wolpert, Oxford .

MZT 302: Animal Physiology

Unit I

Outline of cellular physiology: Homeostasis, osmo-thermoregulation

Membrane physiology: Membrane potentials, Propagation of impulse, Rythmicity, Skeletal muscle contraction, Excitation, Neuromuscular transmission

Nervous system: Basic architecture, Synapse and transmission, Neuronal circuits, Information processing

Unit II

Blood: RBC and WBC, Haemoglobin, Neonatal and adult haemopoises, Physiology of blood clotting

Lymphatic system: Capillary fluid exchange, Interstitial fluid and lymph flow

Circulatory physiology: Physiology of cardiac muscle, Cardiac cycle, Regulation, Nervous control, Effect of Ions and temperature on heart function, Functions of arterial and venous System, Coronary circulation, Atrial natriuretic factor

Unit III

Respiratory physiology: Mechanism of pulmonary ventilation, Physiology of gaseous Exchange, Tidal volume, Expiratory and inspiratory reserve volume, Vital capacity of lung, Residual volume, Total lung capacity, Respiratory quotient, Bohr's effect, Haldane's effect, Hering-breuer reflex, Caisson's disease

Digestive physiology: Fate of food in the digestive tract, Secretory functions of digestive tract, Digestion and absorption

Unit IV

Physiology of excretion: Extracellular, Intracellular and interstitial fluid

Urine formation: Glomerular filtration, Renal blood flow, Tubular processing of glomerular filtrate, Control

Osmoregulation, Outline of micturition, Diuretics and kidney disorders

Unit V

Physiology of pregnancy and lactation: Adaptation of neonate to extra-uterine life, Onset of breathing, Nutrition, Premature development physiology

Respiration in Hyperbaric condition: Aviation, High altitude, Deep sea diving, Space

List of recommended books:

- Text Book of Medical Physiology, 11th Ed : A.C. Guyton, J.E. Hall, Elsevier Saunders
- Physiology of Mammals and Vertebrates, 2nd Ed : P.T. Marshall, C.M. Hughes, Cambridge
- Ganong's Review of Medical Physiology, 24th Ed : K.E. Barret, et. al., Lange Basic Science

MZT 303: Genetics and Evolution

Unit-I

Mendelian genetics: Mendel's experimental design; Mendel's laws, Mendelian principles in human genetics; Modification of dominance relationships

Extensions of Mendelism: Dominance relationship- simple dominance, co-dominance and incomplete dominance, pleiotropism, penetrance and expressivity

Gene interactions and modified Mendelian ratios: epistasis, mechanism of epistasis, lethals and sub-lethals

Multiple allelism: ABO blood groups in humans, pseudoalleles- Rh blood group incompatibility

Unit-II

Linkage and crossing over: Types of linkage, Linkage groups, Mechanism of crossing over, Tetrad analysis in *Neurospora crassa*, genetic mapping and centromere location

Mutations: Chromosomal aberrations: structural and numerical

Unit-III

Cytoplasmic inheritance: Mitochondria and infective inheritance

Transposable genetic elements: Transposons among prokaryotes and eukaryotes: Insertion sequences, composite and complex transposons, replicative and non-replicative transposons, Mechanism and applications of transposition

Unit IV

Evolutionary genetics: Evolutionary theories

Population genetics: Hardy-Weinberg equilibrium (HWE)

Elemental forces of evolution: Mutation, Natural selection, Random genetic drift, Migration

Species concepts and modes of speciation (Sympatric and Allopatric), Isolating mechanisms

Unit V

Genetic polymorphism: Chromosomal, DNA and Allozyme polymorphism, balanced polymorphism, Genetic co-adaptation and linkage disequilibrium

Molecular evolution: Genomic and proteomic changes, Neutral theory, Molecular phylogeny, Molecular clock

List of recommended books:

- iGenetics: A Mendelian Approach 2nd Ed.: P.J. Russel, Pearson Education.
- Principles of Genetics 6th Ed.: Snustad and Simmons and, John Wiley & Sons.
- Genetics 5th Eds.: D.L. Hartl and E.W. Jones, Jones and Barlett.
- An Introduction to Genetic Analysis 10th Ed.: Suzuki, Griffith, Miller & Lewonith.
- Concepts of Genetics 7th Ed. : William S. Klug, Pearson Education
- Principles of Genetics: R.H. Tamarin, Tata McGraw Hill.
- Genetics-From Genes to Genomes : Hartwell, McGraw Hill
- Genetics: P.K. Gupta, Rastogi Publications.

MAJOR ELECTIVE-I

MZE- 304 MAMMALIAN REPRODUCTIVE ENDOCRINOLOGY AND TOXICOLOGY-I

Unit I

Neuroendocrinology of Reproduction: Hypothalamic control of pituitary hormone secretion with relevance to reproduction, GnRH as Hypothalamic pulse generator and distribution, Gonadotropes and Lactotropes, biosynthesis and physiological role Gonadotropic hormones and prolactin

Unit II

Regulation of reproductive cycles in mammals: Menstrual cycle in humans, estrous cycle in rat

Role of environmental factors in seasonal reproduction in mammals: Photoperiod, Temperature, Rainfall, Food Supply, Social Impact

Unit III

Endocrinology of female sex hormone: Structure of Ovary, Biosynthesis and metabolism of ovarian hormones, Agonists and antagonists, Follicular development and selection, Oocyte maturation, Mechanism of ovulation, Physiological roles of ovarian steroids, Cellular and endocrine events of fertilization and implantation

Endocrine physiology of gestation, parturition and lactation

Unit-IV

Introduction to Toxicology: The concept and history of toxicology, different branches of toxicology, Mammalian reproductive toxicology with reference to humans.

Unit-V

Laboratory Assessment of Male Reproductive Toxicity: Semen Analysis, Testicular Biopsy, Endocrine Assessment, Sperm Nuclear Integrity Assessment, Y Chromosome Deletion and Gene Microarray Technology

Unit-VI

Toxicants of Male Reproductive systems: Environmental/Occupational Agents, Pharmacological Agents, Biological Conditions and Recreational Agents

List of recommended books:

- Endocrinology, 6th Ed, ME Hadley, Prentice hall. International Edition.
- Developmental Biology, 10th Ed, S. F. Gilbert, Sinauers Press.
- Brooks and Marshall: Essentials of Endocrinology, Blackwell Science. 1995
- Larson: Williams Text Book of Endocrinology, 10th edition. W. B. Saunders Company, Philadelphia. 2002.
- Handbook of Toxicology, 2nd Edition. Michael J. Derelanko, Manfred A. Hollinger, editors. Taylor & Francis, 2002
- A Textbook of Modern Toxicology. 3rd edition Hodgston and Levi's Willey & Sons, 2004

MZE 304: Medical Biochemistry and Clinical Genetics- I

Unit I

Biochemical basis of diseases/disorders, diagnosis and treatment

Molecular deficiency disorders

Disorders of enzyme deficiency: Alkaptonuria, Arginino succinic acidemia, Galactosuria, Hartnup's disease, Histidinemia, Phenylketonuria, Lesh-Nyhan syndrome

Unit II

Disorders of protein deficiency/defects: Cystic fibrosis, sickle cell anaemia, Thalassaemia, Hemophilia, Pernicious anaemia, Diabetes and obesity

Septicemia: Biochemical and molecular mechanisms, Therapeutic management

Unit III

Storage and transport associated disorders: Glycogen storage disorders, Hypercholesterolemia and atherosclerosis, AB lipoproteinemia, Tay -Sachs disease, Gout

Unit IV

Human cytogenetics

Techniques in human chromosome analysis

Human karyotype: banding, nomenclature, aberrant karyotypes, common chromosomal abnormalities

Unit V

Genomics: structural genomics and genome projects, human genome, organization of human genome, mitochondrial genome, gross base composition of nuclear genome, gene density, CpG islands

Functional genomics: Transcriptome and its analysis, proteome and proteomics, gene silencing

Unit VI

Nomenclature of mutations, loss-of-function and gain-of-function mutations in diseases, pathogenicity associated with repeat sequences

DNA testing and profiling: establishing identity and relationships, population screening, Ethics, organization and advantages

List of Recommended Books

- Murray et al, : Harper's Biochemistry (26th Ed.), Appleton & Lange, 2003
- Ganong: Review of Medical Physiology (21st Ed.), Lange Medical Publications, 2003
- Alberts et al: Molecular Biology of the Cell (4th Ed.) , Garland,2002
- Goldsby et al.: Immunology (5th Ed.), Freeman & Co.,2003
- Bhagvan: Medical Biochemistry (4th Ed.), Hap, 2004
- Basic Human Genetics: Mange and Mange, Sinauer Assoc
- The Principles of Clinical Cytogenetics: Gersen & Keagle , Humana
- Human Molecular Genetics 4th Ed.: Strachan and Read, Wiley
- An Introduction to Molecular Human Genetics: Pasternak , Fritzgerald
- Molecular Biology in Medicine: Cox and Sinclair, Blackwell
- Genes in Medicine: Rasko and Downes, Kluwer
- Principles & Practice of Medical Genetics : Rimoin et al, Churchill
- Clinical Genetics Handbook: Robinson and Linden, Blackwell

M.Sc. ZOOLOGY
FORTH SEMESTER EXAMINATION

Nomenclature of Paper	Credit	Contact Hrs./ Week	Maximum Marks	Sessional Marks		End Semester Examination Marks	Min. Pass Marks in End Sem. Exam.
				40			
MZE 401: Mammalian Reproductive Endocrinology and Toxicology-1 / Medical Biochemistry and Clinical Genetics-1 (Major Electives)	6	4 hrs.	100	10x2 test Average 20	(10 assignment+10 attendance 20	60	30
MZL 401: Dissertation	10	6 hrs.	100			100	40
MZL 401: Presentation	4	6 hrs.	100			100	40
Total	20		300	40		260	

M.Sc. ZOOLOGY

IV SEMESTER

MAJOR ELECTIVE-II

MZE- 401 MAMMALIAN REPRODUCTIVE ENDOCRINOLOGY AND TOXICOLOGY-II

Unit I

Endocrinology of male sex hormone: Structure of Testis, Biosynthesis and metabolism of androgens, Spermatogenesis, Hormonal control of spermatogenesis, sertoli-spermatid interaction, Male accessory sex glands

Endocrine malfunction induced male and female infertility

Unit II

Sex determination and differentiation: Mechanism of sex determination, Sexual differentiation: Gonadal differentiation, Differentiation of genital tract, Brain differentiation, Evidences in support of sexual dimorphism of brain, Sexual dimorphism of brain in humans, Role of gonadal steroids

Unit III

Sexual Behaviour & Reproductive Technologies: Hormones in sexual behaviour, Sites of action of sex hormones, Reproductive pheromones

Estrous cycle disruption, Male induction of estrus (the Whitten effect), Male induced pregnancy block (the Bruce effect), Hormone Replacement Therapy (HRT), Ovulation Induction: Treatment of infertility, Assisted Reproductive Technology (ART)

Unit IV

General concepts of female reproductive system

Reproductive Life Span in women, Puberty and Menopause, Hypothalamic/Pituitary/Ovarian Axis, Ovarian Steroids and Regulation of Gonadotropin Release, Ovarian Physiology and Follicular Development, Female Gametogenesis and Release of egg.

Unit-V

Ovarian Toxicants

Chemotherapeutic Agents, Cigarette Smoking, Polycyclic Aromatic Hydrocarbons, Occupational Chemicals, Phthalates, Halogenated Aryl Hydrocarbons and other Ovotoxic Agents. Mechanisms of Ovotoxicity.

Unit-VI

Maternal and Developmental Toxicology

Fertilization, Migration in *Utero*, Implantation and Embryological Development.
Developmental Toxicology study guidelines, Teratogenicity and Teratogens

List of recommended books:

- Endocrinology, 6th Ed, ME Hadley, Prentice hall. International Edition.
- Developmental Biology, 10th Ed, S. F. Gilbert, Sinauers Press.
- Brooks and Marshall: Essentials of Endocrinology, Blackwell Science. 1995
- Larson: Williams Text Book of Endocrinology, 10th edition. W. B. Saunders Company, Philadelphia. 2002.
- Handbook of Toxicology, 2nd Edition. Michael J. Derelanko, Mannfred A. Hollinger, editors. Taylor & Francis, 2002
- A Textbook of Modern Toxicology. 3rd edition Hodgston and Levi's Willey & Sons, 2004

MZE 401: Medical Biochemistry and Clinical Genetics- II

Unit I

Neurological disorders: Parkinsonism, Huntington's disease, Alzheimer diseases

Immunity and human health: Autoimmunity, Immune system and AIDS, Cancer and the immune system, Transplantation immunity

Unit II

Drug action: Mechanisms, Drug addiction, alcohol toxicity, Catabolism of drugs Drug delivery and targeting

Unit III

Recent trends in therapy: Clinical applications of enzymes as diagnostic markers, analytical reagent and therapeutic agents , Biochemistry of aging and medical gerontology

Unit IV

Clinical genetics

An overview of genetic basis of syndromes and disorders

Monogenic diseases with well known molecular pathology: Cystic fibrosis

Genome Imprinting Syndromes: Prader-Willi and Angelman syndromes, Beckwith-wiedeman syndrome

Unit V

Disorders of muscle: Dystrophies (Duchenne muscular dystrophy and Becker muscular dystrophy)

Disorders of haemopoietic systems: Sickle cell anemia, Thalassemias, Hemophilias

Disorders of eye: Cataract, Glaucoma, Colour blindness

Multifactorial Disorders: Diabetes Mellitus

Unit VI

Neurogenetic disorders

Alzheimer's disease, Parkinson's disease

Medical genetic evaluation: Pedigrees: pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees, patterns of inheritance, risk assessment and counseling in common Mendelian and multifactorial disorders

List of Recommended Books

- Murray et al, : Harper's Biochemistry (26th Ed.), Appleton & Lange, 2003
- Ganong: Review of Medical Physiology (21st Ed.), Lange Medical Publications, 2003
- Alberts et al: Molecular Biology of the Cell (4th Ed.) , Garland,2002
- Goldsby et al.: Immunology (5th Ed.), Freeman & Co.,2003
- Bhagvan: Medical Biochemistry (4th Ed.), Hap, 2004
- Goodman et al.: The Pharmacological Basis of Therapeutics (7th Ed.), Macmillan Publishers, 1991
- Fogy: Principles of Medicinal Chemistry, Lea and Febinger Publications, 1981
- Kanungo: Biochemistry of Aging, Academic Press, 1980
- Kanungo: Genes and Aging, Cambridge University Press, 1994.Human Molecular Genetics 4th Ed: Strachan and Read, Wiley
- An Introduction to Molecular Human Genetics: Pasternak, Fritzgerald
- Human Molecular Genetics: Sudbery, Prentice Hall
- The Human Genome: Hawley and Mori, Academic
- Principles & Practice of Medical Genetics: Rimoin et al , Churchill
- Molecular Biology in Medicine: Cox and Sinclair, Blackwell
- Behavioral Genetics: Plomin et al, Freeman
- Introduction to Risk Calculation in Genetic Counseling: Young, Oxford
- Practical Genetic Counseling: Harper, Arnold