

MOTHERHOOD
UNIVERSITY, Roorkee
ENLIGHTENING WORLD

A STUDY AND EVALUATION SCHEME
OF
MASTER OF SCIENCE IN ZOOLOGY
M.Sc. (ZOOLOGY)
[w.e.f Academic Session 2015-16 onwards]



Roorkee-Dehradun Road, Village Karoundi

Post Bhagwanpur, Tehsil-Roorkee

Pin-247661

District Haridwar


(Uttarakhand)


DEAN
Faculty of Sciences
Motherhood University, Roorkee
Distt. Haridwar, Uttarakhand - 247661

**A STUDY AND EVALUATION SCHEME
OF
MASTER OF SCIENCE IN ZOOLOGY
M.Sc. (ZOOLOGY)
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SUMMARY

Programme	M.Sc. (Zoology)
Duration	Two year full time (four Semesters)
Medium	English
Maximum Credits	72


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Motherhood University, Roorkee
Distt. Pantnagar, Uttarakhand - 247661

Motherhood University, Roorkee

Master in Science (Zoology)

Distribution of Different Courses in Various Semesters (2 years PG Program in Zoology) Semester-I

Sr. No.	Subject Code	Subject Name	Effective Teaching			Credit	Evaluation Scheme		
			L	T	P		Internal Assessment	End Term	Total Marks
			Hours/Week						

THEORY


1	MUMZY 101	Non Chordata & Chordata	3	-	-	3	40	60	100
2	MUMZY 102	Entomology & Fish Biology	3	-	-	3	40	60	100
3	MUMZY103	Endocrinology	3	-	-	3	40	60	100
4	MUMZY 104	Histology, Histochemistry and Biostatistics	3	-	-	3	40	60	100
5	MUMZY 151	Lab. Course-I	-	-	6	3	40	60	100
6	MUMZY 152	Lab. Course-II	-	-	6	3	40	60	100
Total			12		12	18	240	360	600

SEMESTER-II

Sr. No.	Subject Code	Subject Name	Effective Teaching			Credit	Evaluation Scheme		
			L	T	P		Internal Assessment	End Term	Total Marks
			Hours/Week						

THEORY

1	MUMZY 201	Genetics, and Molecular Biology	3	-	-	3	40	60	100
2	MUMZY 202	Biochemistry and cell Biology	3	-	-	3	40	60	100
3	MUMZY 203	Mammalian Physiology	3	-	-	3	40	60	100
4	MUMZY 204	Bio-techniques and Bioinformatics	3	-	-	3	40	60	100
5	MUMZY 251	Lab. Course-I	-	-	6	3	40	60	100
6	MUMZY 252	Lab. Course-II	-	-	6	3	40	60	100
Total			12		12	18	240	360	600


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SEMESTER-III

Sr. No.	Subject Code	Subject Name	Effective Teaching			Credit	Evaluation Scheme		
			L	T	P		Internal Assessment	End Term	Total Marks
			Hours/Week						

THEORY

1	MUMZY 301	Developmental Biology & Immunology	3	-	-	3	40	60	100
2	MUMZY302	Evolutionary Biology & Economic Zoology	3	-	-	3	40	60	100
3	MUMZY 303A	Major Elective Course I <i>Mammalian reproductive Physiology and Endocrinology</i> Paper I – Neuroendocrinology and Non-Classical hormones.	3	-	-	3	40	60	100
		Paper II – Male and Female Reproduction							
4	MUMZY 303B	Major Elective Course II <i>Fish Biology</i> Paper I – Fish Culture and Pathology	3	-	-	3	40	60	100
		Paper II – Fish Anatomy and Physiology							
5	MUMZY 351	<i>Lab. Course-I</i>	-	-	6	3	40	60	100
6	MUMZY 352	<i>Lab. Course-II</i>	-	-	6	3	40	60	100
Total			12		12	18	240	360	600

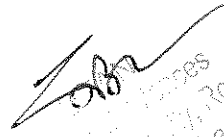
SEMESTER-IV

Sr. No.	Subject Code	Subject Name	Effective Teaching			Credit	Evaluation Scheme		
			L	T	P		Internal Assessment	End Term	Total Marks
			Hours/Week						

THEORY

1	MUMZY 401	Animal Behaviour & Environmental Biology	3	-	-	3	40	60	100
2	MUMZY402	Major Elective Course I <i>Mammalian Reproductive Physiology Endocrinology</i> Paper III – Hormone Receptors and Signaling Mechanisms.	3	-	-	3	40	60	100
3	MUMZY451	Laboratory Course	-	-	6	3	40	60	100
4	MUMZY452	*Project work/*Dissertation	-	-	-	9			300
Total			6		6	18	120	180	600

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SEMESTER I

MUMZY 101: NON CHORDATA & CHORDATA

Unit 1: Protozoa: Nucleus and reproduction; Origin of metazoans; Porifera: Canal system; Cnidaria: Polymorphism in Siphonophora. Annelida: Adaptive radiation in polychaetes, Trochophore larva.

Unit 2: Mollusca: Torsion in gastropods, larval forms; Arthropoda: Evolutionary significance of Trilobites, Crustacean larvae and their significance. Echinodermata: larval forms and their significance.

Unit 3: Salient features and affinities of Placozoa, Mesozoa, Rotifera, Phoronida, Sipuncula and Hemichordata

Unit 4: Characteristic features and affinities of Protochordata and Cyclostomata; Origin of the Fish, Amphibian, Special character of amphibian : Parental care

Unit 5: Characteristic features and affinities of Reptile, Bird, Mammal, Adaptive radiations in vertebrates: Aquatic, Terrestrial, Aerial, Arboreal, Fossorial. Special characters: Venom in ophidians, Poisonous and Non-poisonous snakes; Biting mechanisms of snakes Migration in birds Flightless birds.

Books Recommended

Jordan & Verma : Chordate Zoology (1998, S.Chand) Kotpal:

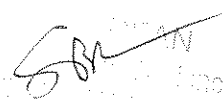
The Birds (4th ed, 1999, Rastogi Publications) McFarland *et.al* :

Vertebrate Life (1979, Macmillan Publishing) Parker &

Hashwell : Textbook of Zoology, Vol.II (1978, ELBS)

Romer & Parsons : The Vertebrate Body (6th ed 1986, CBS Publishing Japan)

Sinha, Adhikari & Ganguli : Biology of Animals Vol.II (1988, New Central Book Agency)


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MUMZY 102: ENTOMOLOGY & FISH BIOLOGY

Unit 1: Importance and taxonomic richness of insects: External anatomy: Segmentation and tagmosis; Integument: structure and functions of cuticle, sclerotization; Types of antennae and mouth parts; Sensory system: Tactile mechanoreceptor and position receptor, Compound eye, Endocrine system and function of hormones.

Unit 2: Internal anatomy and physiology: Nervous system, Circulatory system: heart and haemolymph; Respiratory system: Aerial respiration (Spiracles, Trachea and Tracheoles), Aquatic respiration; Digestive system: Structure of gut; sound production, bioluminescence

Unit 3: Excretory system and waste disposal: Malpighian tubules, nitrogen excretion. Reproductive system; Insects as friends and foes, General methods of insect pest management.

Unit 4: Integument: Epidermis (Mucogenic and Keratinized), Epidermal derivatives: microridges, integumentary glands; Dermis: General organization; Scales: cosmoid, gnaoid, placoid, ctenoid and elasmoid; Chromatophores: melanophores, iridophores, xanthophores and erythrophores; Factors affecting colour change; adaptive significance.

Unit 5: Ichthyology and its scope, Growth and energetics: concept of growth, determination of age and growth, correlation of growth in relation to body weight and length; role of minerals and vitamins in growth regulations, economic importance of fishes.

Books Recommended

Entomology

1. Chapman: The Insects: structure and function (4th ed, 1998, ELBS)
2. Imms: A general text book of entomology, 2 vols (1997, Asia Publishing House)
3. McGavin: Essential Entomology (2001, Oxford Univ Press)
4. Srivastava: A text book of applied entomology, Vol I & II (1993, Kalyani Publishers)
5. Wigglesworth: Principles of Insect Physiology (1972, ELBS)

Fish Biology

1. Brown: Physiology of fishes, Vols 1 and 2 (1957, Academic press)
2. Gupta and Gupta: General and applied Ichthyology (Fish and Fisheries) (2006, S. Chand)
3. Hoar and Randall: Fish Physiology, Volumes I-XV (1969-onwards, Academic Press)
4. Khanna and Singh: A textbook of Fish Biology and Fisheries (2003, Narendra Publishing House)
5. Norman and Greenwood: A History of Fishes (3rd ed 1975, Ernest Benn Limited)
6. Srivastava: A Textbook of Fishery Science and Indian Fisheries (1985, Kitab Mahal)
7. Srivastava: Fishes of U.P. and Bihar (2002, Vishwavidyalaya Prakashan)
8. Parihar: Fish Biology and Indian fisheries (1999, Central publishing House Allahabad)



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**MUMZY 103:
ENDOCRINOLOGY**

Unit 1: Mechanism of hormone action: Protein hormones, Membrane receptors, G-proteins, Cyclic AMP signaling cascade, PKC signaling pathway, Steroid hormones (genomic and nongenomic pathways)

Unit 2: Hypothalamo-hypophysial System: General organization, Neurohypophysial hormones: oxytocin and vasopressin, Neural control of adenohypophysis: hypophysiotropic hormones and actions, Adenohypophysial hormones: chemistry and physiological roles of somatotropin and prolactin, Glycoprotein hormones: FSH, LH and TSH and Pro-opiomelanocortin: ACTH, MSH.

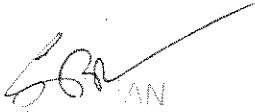
Unit 3: Thyroid hormones: biosynthesis, control of secretion and physiological role of thyroid hormones. Parathyroid: Parathormone, calcitonin and vitamin D in calcium homeostasis; Endocrine pancreas: biosynthesis and physiological actions of insulin and glucagon.

Unit 4: Gonadal hormones: Steroid hormone biosynthetic pathways, Testis: organization and physiological role of androgens, Ovary: organization and physiological role of estrogen, progesterone, relaxin and inhibin.

Unit 5: Adrenal cortex: Organization Mineralocorticoid and glucocorticoid hormone: control of secretion and physiological role. Adrenal medulla: catecholamine biosynthesis, release and physiological role.

Books Recommended

1. Bentley: Comparative Vertebrate Endocrinology (1998, Cambridge University Press)
2. Norris: Vertebrate Endocrinology (4th ed 2007, Academic press)
3. Hadley: Endocrinology, Prentice Hall (6th ed. 2007)
4. Brooks and Marshall: Essentials of Endocrinology (1995, Blackwell Science)
5. Turner and Bagnara: General Endocrinology (1984, Saunders)
6. Larson: Williams Textbook of Endocrinology (10th ed 2002, Saunders)


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MUMZY 104: HISTOLOGY, HISTOCHEMISTRY AND BIOSTATISTICS

Unit 1: Fixation and tissue processing: Types of fixatives, Chemistry of fixation, Choice of fixatives, Dehydration, Clearing and embedding. Microtomy: Types of microtome, Sectioning of paraffin blocks. Staining of paraffin sections: Principle and methods of staining, Histological stains: haematoxylin and eosin

Unit 2: Principles and methods of histochemical localization and identification of: Carbohydrate moieties: Glycogen and glycoproteins by periodic acid Schiff's method. Glycoproteins by alcian blue methods. General lipids by Sudan black B method Neutral lipids by Sudan III and Sudan IV methods; Nucleic acids: Methyl green pyronin-Y for DNA and RNA, Feulgen reaction for DNA.

Unit 3: Protein end groups: General protein localization by bromophenol blue method; $-NH_2$ groups by Ninhydrin-Schiff method. Detection of enzyme activity: Principles of enzyme histochemistry: Acid and alkaline phosphatases by metal precipitation or azo dye methods. Basic principles of immunohistochemistry and fluorescence staining

Unit 4: Measures of central tendency: Definition, Characteristics of satisfactory averages, types of averages, their merits and demerits; Measures of dispersion: Range, Mean deviation, Standard deviation, Standard error of mean,

Unit 5: Variance, Coefficient of variation, Correlation and Regression and their coefficients; Test of significance: Z-Test, Student t- test, Chi-square test; ANOVA; Elementary idea of probability.

Books Recommended

Histology & Histochemistry

1. Bancroft & Stevens: Theory and Practice of Histological techniques (2002, Churchill- Livingstone)
2. Casselman: Histochemical techniques (1959, John Wiley)
3. Pearse: Histochemistry: Theoretical and Applied (Vol. I, II & III) (4th ed 1980-1993, Churchill-Livingstone).

Biostatistics:

1. James L. Bruning, B. L. Kintz, Computational Handbook of Statistics (4th Edition).
2. Helmut Fritz Van Emden, Statistics for Terrified Biologists. WileyBlackwel (2008).
3. Rebecca W - Bremer, Martina . Statistics at the Bench- A Step-by-Step Handbook for Biologists (09) by Doerge, (2009).

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**MUMZY 151:
LABORATORY COURSE-I**

. Non Chordata: Preparation of permanent slides. Protozoa: *Paramecium* (whole mount) and demonstration of food vacuoles. Cnidaria: *Bougainvillea*, *Sertularia*, Arthropoda: Cyclops, Megalopa/Zoea, spiracles of cockroach. Mollusca: Glochidium larva, Echinodermata: Spheredium, pedicellaria, tubefeet.

2. Dissections: Arthropoda: Salivary glands of cockroach, Mollusca: nervous system of *Mytilus* and *Aplysia/Sepia*, Study of museum specimens of Porifera, Cnidaria, Annelida, Arthropoda, Mollusca, Echinodermata.

3. Chordata: Study of external features of *Branchiostoma*. Study of whole mount preparations of following protochordates. *Doliolum*, *Pyrosoma*, *Salpa* and *Oikopleura*. T.S. through pharynx, gonads and post anal region of *Branchiostoma*. T.S. and L.S. through proboscis of *Balanoglossus*.

4. Study of adaptations: Fossorial adaptation and urino-genital system of rat. Study of adaptive features of: Amphibians, Reptiles, Birds, Mammals through Chart.

Entomolog

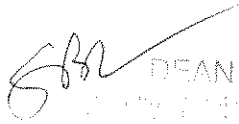
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1. Study of external morphology of cockroach:
2. Internal anatomy of cockroach: Alimentary canal, Salivary apparatus: dissection and *in toto* stained preparation.
3. Dissection of frontal ganglion, brain, corpora cardiac (CC), corpora allata (CA) and recurrent nerve.
4. Dissection and mounting of prothoracic gland
5. Dissection of male and female reproductive systems of cockroach
6. Study of external morphology of honey bee and dissection of sting apparatus
7. Study of following using permanent slides/specimens: L.S. of teleotrophic and polytrophic ovarioles, T. S. of testis, and brain showing median neuro secretory cells (MNSC), whole mount of head of louse, CC & CA, and *Chironomous* larva.

Fish

Biology

1. Classification of the following locally available fishes using key: Carps: *Catla catla*; *Labeo rohita*, *Cirrhina mrigala*; Catfishes: *Heteropneustes fossilis*, *Clarias batrachus*..
2. Dissection and display of accessory respiratory organs of *Clarias batrachus*, *Channa sp*, *Heteropneustes fossilis*.
3. Study of larvivorous fishes through museum specimens.
4. Mounting of respiratory epithelium of accessory respiratory organs of *H. fossilis* and air bladder epithelium of carp.
5. Study of museum specimens of fishes having electric organs, venomous organs and air breathing organs.
6. Study of T.S. of gills, accessory respiratory organs and swim bladder from prepared slides.


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**MUMZY 152:
LABORATORY COURSE-II**

1. Paraffin sectioning: Fixation of tissue (intestine and stomach of rat), dehydration, clearing and embedding of tissue. Sectioning and spreading of sections. Histological staining of paraffin sections using haematoxylin and eosin method.
2. Histochemical staining of paraffin sections for demonstration of acidic glycoproteins by Alcian Blue pH 2.5 method. Histochemical staining for lipids using: Sudan black B method, Sudan III method, Sudan IV method.

Biostatistics

1. Analysis of Mean, Median and Mode in given exercise.
2. Analysis of Standard Deviation and Standard Error in given exercise.
3. Analysis of Variance in given exercise.
4. Exercise to find out statistical significance of an experimental data using T-Test, Newmann Keuls and Tukey's test for significance.

Endocrinology

1. Handling, sexing, numbering and maintenance of rat.
2. General survey of endocrine glands in rat
3. Study of vaginal smear preparation in rat
4. Demonstration of the following surgical operations in rat: orchidectomy, ovariectomy
5. Study of histological slides of the following endocrine glands in rat: pituitary, thyroid, adrenal, endocrine pancreas, testis and ovary Demonstration of endocrine glands in cockroach
6. Demonstration of frog metamorphosis by models and charts

SEMESTER II

MUMZY 201: GENETICS AND MOLECULAR BIOLOGY

Unit 1. Mendel's laws and their chromosomal basis: Extensions of Mendelism, Dominance relationships, Epistasis, Pleiotropy, Expressivity and penetrance. Methods of gene mapping: 3-point test cross in *Drosophila*, Gene mapping in human by linkage analysis in pedigrees, Tetrad analysis in *Neurospora*, Gene mapping in bacteria by conjugation, transformation and transduction.

Unit 2. Gene mutation and DNA repair: Types of gene mutations, Methods for detection of induced mutations, P-element insertional mutagenesis in *Drosophila*, DNA damage and repair. Generation of Somatic clones and Knockouts

Unit 3. Nature of the gene and its functions: Evolution of the concept of gene, Fine structure of gene (*rII* locus), Regulation of gene activity in *lac* and *trp* operons of *E.coli* Introduction to gene regulation in eukaryotes, Organization of a typical eukaryotic gene, Transcription factors, enhancers and silencers, Transcriptional and post-transcriptional Regulation, Non-coding genes,

Unit 4. Introduction to structural and functional genomics: Chromatin organization, Nucleosomes and higher order structures, Epigenetic modifications. Post transcriptional processing and regulation: RNA editing, Post transcriptional gene silencing (RNA interference). Human genome: mapping, characteristics and implications.

Unit 5. Organization and function of mitochondrial DNA, Quantitative inheritance, Applications and implications of genetic engineering: Restriction enzymes, Cloning vectors, strategies for gene cloning; Preparation and screening of cDNA and genomic DNA libraries, Application: transgenic organisms and genetically modified organisms (GMOs), animal cloning, site-directed mutagenesis, generation of knock-out animals, Detection of genetic disorders, Gene therapy.

Books Recommended

1. Lewin: Genes X (2010, Jones and Bartlett)
2. Brown: Genomes (3rd ed 2006, Garland Science)
3. Lodish et al: Molecular Cell Biology (6th ed 2007, Freeman)
4. Alberts et al: Molecular Biology of the Cell (2008, Garland)
5. Gardner et al: Principles of Genetics (2006, John Wiley)
6. Griffith et al: Modern Genetic Analysis (2008, Freeman)
7. Karp: Cell and Molecular Biology (2010, John Wiley & Sons)
8. Krebs et al: Lewin's Genes X (2011, Jones & Bartlett)
9. Lodish et al: Molecular Cell Biology (2008, Freeman)
10. Pierce: Genetics – A Conceptual Approach (2012, Freeman)

MUMZY 202: BIOCHEMISTRY & CELL BIOLOGY

Unit 1: Laws of thermodynamics and their applications: Concept of free energy and calculations based on free energy change; Protein structure; Primary structure, peptide bond, Secondary structure, α -helix, β -pleated sheet and bends, Ramachandran plot, Tertiary structure, Forces stabilizing tertiary structure, Domains and motifs-Quaternary structure

Unit 2: Enzymes: Enzyme kinetics, Lowering of activation energy, Derivation of Michaelis-Menten equation, related calculations and Michaelis-Menten and Lineweaver-Burk plots, Mechanism of action, Active site, substrate binding, transition state analogues and abzyme: Acid-base and covalent catalysis (chymotrypsin, carboxypeptidase); Concepts of regulation of enzyme activity; Metabolism: Concept of metabolic pathways; Energy transduction: glucose and fatty-acids as energy source.

Unit 3: Nucleic acids: Structure, folding motifs, conformational flexibility and supercoiling; Mechanism of DNA replication: DNA polymerases, Origin of replication and formation of primosome, Replication fork and replisome, Termination of replication; Mechanism of transcription: RNA polymerases, Formation of pre-initiation complex at RNA *pol* II promoter, Processing of hnRNA, Genetic code and mechanism of translation

Unit 4 : Cell structure and function of Viruses: structure and replication; Bacteriophage (Lambda phage, phi x 174); Animal DNA virus (SV 40); Retroviruses (HIV); Bacteria: Structure and reproduction of *E. coli*, Plasmid and their functions; Eukaryotes: cell Membrane, Lipid bi-layer and membrane proteins, Transport across the cell membrane, Channels and transporters, Diffusion, osmosis and measurement of osmotic pressure, Active transport: mechanism and related calculations.

Unit 5: Targeting and sorting of proteins: Signal peptide and SRP dependent targeting of translational complex; Processing of proteins in RER; Processing through Golgi complex: targeting to plasma membrane and lysosome; Targeting of nuclear and mitochondrial proteins; Mitochondria: Structure, assemblies of respiratory chain and F_0F_1 -ATPase; Oxidative phosphorylation: mechanism and chemiosmotic concept, Bioenergetics of ATP and other high energy phosphate compounds; Nucleolus: structure and biogenesis of ribosomes, Cytoskeleton: organization of microtubules, microfilaments and intermediary filaments.

Books Recommended

1. Nelson et al: Lehninger Principles of Biochemistry (3rd ed 2004, Pearson)
2. Zubay et al: Principles in Biochemistry (2nd ed 1995, WCB)
3. Strayer : Biochemistry
4. Lodish et al: Molecular Cell Biology (6th ed 2007, Freeman and Company)
5. Voet and Voet: Biochemistry (2004, John Wiley)
6. Alberts et al: Molecular Biology of the Cell (4th ed 2002, Garland)
7. Kooper : Cell biology

MUMZY 203: MAMMALIAN PHYSIOLOGY

Unit 1: Digestion: Role of salivary glands, liver, pancreas and intestinal glands; Digestion and absorption of carbohydrate, fat and protein; Regulation of digestion and absorption; Digestion and absorption of macronutrients and their regulation. Nutrition, balanced diet and vitamins.

Unit 2: Circulation: Blood, Haemopoiesis, Haemostasis; Lymph: composition and dynamics; Heart: Origin and conduction of cardiac impulse, ECG and cardiac cycle, Myocardial infarction;

Unit 3: Respiration: Pulmonary ventilation; Respiratory centers: organization and function, Surfactant; Gaseous Exchange: Haemoglobin and gaseous transport, Basal metabolic rate and its measurement, Respiratory adjustments, Hypoxia and oxygen therapy, Dyspnea.

Unit 4: Excretion: Urine formation and regulation, Acid-base balance and homeostasis, Renal function tests. Muscle: Types of contraction, Muscle proteins, Mechanism and energetics of muscle contraction.

Unit 5: Nervous system: Brain structure Neurons and glia, Cerebrospinal fluid, Neural network, Blood brain barrier, Autonomic nervous system; Axonal and synaptic transmission: Types of neurons, Membrane potential and action potential, Types of synapses, Excitatory and inhibitory post-synaptic potential, Chemical transmission, neurotransmitters (acetylcholine, catecholamines, serotonin and GABA), neuropeptides.

Books Recommended

1. Ganong: Review of Medical Physiology (22nd Ed 2005, Lang Medical Publications)
2. Guyton and Hall: Text Book of Medical Physiology (11th Ed 2006, W.B. Saunders)
3. Keel et al: Samson Wright's Applied Physiology (13th Ed 1989, Oxford Press)
4. Murray et al: Harper's Illustrated Biochemistry (27th Ed 1989, Appleton & Lange)


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MUMZY 204: BIOTECHNIQUES AND BIOINFORMATICS

Unit 1: Centrifugation: Basic principle, Types of rotors, Clinical, high speed and ultracentrifuge. Spectrophotometry: Types of spectrophotometer, Beer-Lambert's law, molar extinction coefficient, Absorption spectrum, Principles of UV- Vis spectrophotometry. Chromatography: Principle and types, Column chromatography, Gel filtration, Ion exchange, Affinity, Introduction to FPLC and HPLC.

Unit 2: Microscopy: Basic principle, Types of microscope and their biological applications. Bright-field microscope: numerical aperture, limit of resolution, types of objectives, ocular and stage micrometers, Dark-field microscope, Phase contrast microscope, Differential interference contrast microscope, Fluorescence microscope, Confocal microscope, Atomic force microscopy, Transmission and scanning electron microscope.

Unit 3: Detection of proteins, DNA-protein and protein-protein interactions: Electrophoresis: Principle, Agarose and polyacrylamide gel, Isoelectro focusing. Western blotting, DNA foot printing, EMSA, Yeast two-hybrid. Hybridization based detection of Nucleic acids: Preparation of probes, Southern, Northern hybridization; Characterization of clones: immuno-screening, Sequencing, Microarray, Radio-tracer techniques: Unit of radioactivity and half-life, Measurement of radioactivity (β and γ emission), Applications of radioisotopes, Safety measures.


Unit 4: Introduction and scope of bioinformatics: concept of digital laboratory, Basics of computers (CPU, I/O units), operating systems (Windows, UNIX), networks (LAN, WAN) and information technology, Concept of hypertext and internet protocol (HTTP, TCP/IP), Basics of home-pages, web-pages and uniform resource locators (URL), Introduction to data archiving systems (FASTA format, Accession, and GI-Number).

Unit 5: Basic features and management systems of: Nucleic acid sequences databases, Genome databases, Protein sequence, structures and interacting proteins databases, Literature databases, Biodiversity and ecosystem based databases. Introduction to data retrieval systems: Search engines, Entrez, sequence retrieval system (SRS) and protein identification resource (PIR). Introduction to molecular sequence analysis software packages and tools: Prediction of motifs, folds and domains, Sequence alignments (BLAST and Clustal W) and phylogenetic trees (PHYLIP). Applications of bioinformatics: Clinical informatics, Cheminformatic resources and pharmacoinformatics.

Books Recommended

Biochemical & Molecular Techniques

1. Boyer: Modern Experimental Biochemistry and Molecular biology (2nd ed 1993, Benjamin/Cumin)
2. Freifelder: Physical Biochemistry (2nd ed 1982, Freeman)
3. Plummer: An Introduction to Practical Biochemistry (3rd ed 1990, Tata-McGraw Hill)
4. Wilson and Walker: Principles of Biochemical and Molecular Biological Techniques (6th ed. 2006, Cambridge University Press)


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Microscopy

1. Alberts et al: Molecular Biology of the Cell (2002, Garland)
2. Karp: Cell and Molecular Biology (2007, Wiley)
3. Lodish et al: Molecular Cell Biology (2007, Freeman)
4. Pollard & Earnshaw: Cell Biology (2002, Saunders)
5. Ruthman: Methods in Cell Research (1970, Bell & Sons)

Bioinformatics

1. Campbel: Discovering Genomics, Proteomics and Bioinformatics (2006, LPE)
2. Pevzner, P.A. Computational Molecular Biology: An Algorithmic Approach. PHI Learning, 2010.
3. Rastogi, Mendiratta & Rastogi. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery, 3rd Ed. PHI Learning, 2011.


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**MUMZY 251:
LABORATORY COURSE-I**

Genetics:

1. Handling of *Drosophila* and study of its life cycle
2. Study of meiosis in grasshopper testes by squashing method
3. Temporary squash preparation of polytene chromosomes from salivary glands of *Drosophila* larvae
4. Study of colchicinated metaphase chromosomes in bone marrow of rodent by air dry method
5. Preparation of human karyotype
6. Study of sex chromatin in human female from buccal epithelial and hair bud cells
7. Examination of wild type (males and females) and mutants of *Drosophila*
8. Sex linked inheritance in *Drosophila melanogaster*
9. Linkage and crossing over in *Drosophila melanogaster*

Biochemistry:

1. Preparation of extract for enzyme assay (alkaline phosphatase)
2. Study of alkaline phosphatase activity
3. Standard curve preparation
4. Effect of enzyme concentration and determination of total and specific activity
5. Effect of temperature on enzyme activity
6. Effect of time on enzyme activity
7. Effect of substrate concentration on enzyme activity
8. Determination of K_m and V_{max} by Michaelis-Menten and Lineweaver-Burk Plot

**MUMZY 252:
LABORATORY COURSE-II**

Mammalian Physiology:

1. Differential leucocytes counting in blood
2. Determination of blood groups (ABO and Rh factor)
3. Estimation of ascorbic acid content in lemon extract using titration method
4. Preparation of casein from milk

Biotechniques


1. Principle and working of Centrifuges.
2. Principle and working of Chromatography (Paper chromatography)
3. Principle and working of colorimeter and spectrophotometer
4. Cell counting using haemocytometer (by using suitable stain)
5. Working and principle of Ocular micrometer
6. Measuring of pH using a pH meter
7. Electrophoresis: Nucleic acid and Protein electrophoresis.

Bioinformatics

1. Familiarization with computer operations and TCP/IP
2. Data archiving systems: FASTA format, BankIT, Accession and GI numbers
3. Use of search engines (Google, Altavista, Dogpile, Meta-crawler)
4. Demonstration of web-pages related to biological information (NCBI, ExPasy)
5. Hands on practice to features of following databases GenBank, PDB, DIP, PubMed, Toxnet, OMIM, Fly Base, AceDB, MGDB, HGMD, LSD, KEGG, RNAdb
6. Hands on practice to features of following software packages/tools: BLAST, Clustal-W, PHYLIP, M-fold

Comparative endocrinology & endocrine disorders

1. Preparation and study of distribution of pituitary cell types and functions (teleost model).
2. Study of endocrine control of colour change in amphibians with charts and models.
3. Study of Comparative anatomy of thyroid gland from pre-stained slides.
4. Study of Comparative anatomy of adrenocortical and medullary homologues.
5. Bioassay of Pituitary gonadotropins.
6. Study of endocrine disorders by charts and models.



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SEMESTER III

MUMZY 301: DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

Unit 1: Fertilization: Fertilization in Sea urchin and mammals, Acrosomal reaction and gamete interaction. Prevention of polyspermy and egg activation Early development: Cleavage, Formation of blastula, fate maps, Gastrulation: cell movement and formation of germ layers, General concept of potency, commitment, specification, induction, competence and determination,

Unit 2: Differentiation and pattern formation, Stalk and fruiting body formation in *Dictyostellium*, Origin of anterior-posterior and dorsal-ventral polarity in *Drosophila*; role of maternal, segmentation and homeotic genes; HOX gene in vertebrates, Axis formation in frog (Nieuwkoop Centre and primary Organizer), chick and mammals.

Unit 3: Late embryonic development: Vulva formation in *Caenorhabditis*. Formation of neural tube in vertebrates. Development of limb in vertebrates: role of HOX and other pattern forming genes. Regeneration of Salamander limbs: Polar coordinate model; Stem cells and differentiation.

Unit 4: The Immune system: Innate and adaptive immunity, Immune cells: types and production, Immune tolerance, Humoral immunity: Antigen and hapten, Primary and secondary response, Immunoglobulins: types, structure and functions, Generation of antibody diversity, Class switching, somatic hypermutation, Concept of clonal selection.

Unit 5: Cell mediated immunity: T cell receptor, Major Histocompatibility Complex (MHC), Complement system; Antigen: processing and presentation, T helper cell and lymphocyte activation, Role of cytotoxic T cell, perforin and granzymes; Concept of Vaccination, Regulation of immune responses and Hypersensitivity, Autoimmunity.

Books ecommended

Developmental Biology

1. Alberts et al: Molecular Biology of the Cell (5th ed 2008, Garland)
2. Balinsky: An introduction to Embryology (5th ed 1981, Saunders)
3. Gilbert: Developmental Biology (8th ed 2006, Sinauers)
4. Kalthoff: Analysis of Biological development (1996, McGraw)
5. Wolpert: Principles of Development (3rd ed 2007, Oxford)

Immunology

1. Abbas et al: Cellular and Molecular Immunology, 6th ed, 2000, Saunders.
2. Albert et al; Molecular Biology of the Cell, 4th ed, 2002, Garland.
3. Acharya *et al.*: Immunology, 2nd ed. 2011, Kalyani.
4. Elgert: Understanding the Immune System, 1996, Wiley.
5. Kenneth et al: Janeway Immunobiology, 7th ed, 2009, Garland.
6. Kuby: Immunology, 7th ed, 2007, Freeman.
7. Roitt: Essential Immunology, 10th ed, 2006, Mosby.

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MUMZY 302: EVOLUTIONARY BIOLOGY AND ECONOMIC ZOOLOGY

Unit 1: An overview of evolutionary thoughts, development and the concept of synthetic theory.

Population genetics: Gene frequencies in Mendelian population, Hardy-Weinberg equilibrium Conditions for the maintenance of genetic equilibrium. Elemental forces of evolution: Mutation, Selection (types of selection and selection coefficient), Random genetic drift, Migration.

Unit 2: Chromosomal, allozyme and DNA polymorphisms: Adaptive genetic polymorphism, Balanced polymorphism and heterosis, Genetic coadaptation and linkage disequilibrium. Isolating mechanisms: Concepts of species and models of speciation: allopatric, sympatric and stasipatric,

Unit 3: Evolution at molecular level: Genomic and proteomic changes, Molecular phylogenies, Neutral theory, Molecular clock.

Unit 4: Beneficial and harmful insects, including insect vectors of human diseases. Pests of sugar cane (*Pyrilla perpusilla*), oil seed (*Achaea janata*) and rice (*Sitophilus oryzae*). Insects in forensic investigations; Industrial fish, prawn and molluscs of India. Apiculture, sericulture, lac culture, carp culture, pearl culture, prawn culture.

Unit 5: Major infectious and communicable diseases (small pox, plague, malaria, tuberculosis, cholera and AIDS) their vectors, pathogens and prevention. Cattle and livestock diseases, their pathogens (helminths) and vectors (ticks, mites, *Tabanus*, *Stomoxys*).

Books Recommended

Evolution

1. P A Moody: Introduction to Evolution
2. Rastogi: Organic Evolution (2007, Kedarnath & Ramnath)
3. Strickberger's Evolution
4. Verma and Agrawal, Ecology – 2000, S Chand
5. Kormondy, E.J. Concepts of Ecology, 4th Ed. PHI Learning, 2011.

Economic Zoology:

1. Shukla and Upadhyaya : Economic Zoology (Rastogi Publishers, 1999-2000)
2. Shrivastava: Test book of Applied Entomology, Vol. I & II (Kalyani Publishers, 1991)
3. Mani: Insects, NBT, India, 2006.
4. Jabde: Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture,
5. Agricultural Pests and their control, 2005 Discovery Publishing House.

MUMZY 303 (A): MAMMALIAN REPRODUCTIVE PHYSIOLOGY AND ENDOCRINOLOGY

Paper I: Neuroendocrinology and Non-classical Hormones

Unit 1: Neuroendocrinology- Hypophysiotropic hormones: localization, secretion and mechanism of action, TRH, GnRH, CRH, GHRH and PACAP, Somatostatin, Monoamines

Unit 2: Adenohypophysis -Role of transcription factors in pituitary differentiation, Paracrine/autocrine secretions, Neural control of ACTH, TSH, prolactin and growth hormone

Unit 3: Pineal gland- Pineal, biological clock and calendar, Melatonin and photoperiodic measurement

Unit 4: Non - classical hormones - Growth factors: cellular origin, secretion and functions, Epidermal growth factor family (EGF and TGF α), Transforming growth factor β family (TGF β , anti-Mullerian hormone, inhibins and activins) Platelet-derived growth factor family, Fibroblast growth factor family, Insulin family (IGF-1 and IGF-II), Nerve growth factor family

Unit 5: Hematopoietic growth factors (erythropoietin, thrombopoietin and colony stimulating factor), Immunoinflammatory hormones (interleukines, TNF α and TNF β), Eicosanoids (prostaglandins, thromboxanes and leukotrienes), Leptin.

Books Recommended

1. Bolander: Molecular Endocrinology (3rd ed 2006, Elsevier)
2. DeGroot and Jameson: Endocrinology (5th ed 2006, Vol 1, Elsevier-Saunders)
3. Larson. Williams Textbook of Endocrinology (10th ed 2002, Saunders
4. Norman and Litwack. Hormones (2nd ed 1997, Academic press)
5. Henson and Castracane: Leptin and Reproduction (2003, Plenum, Publishers)

Neuroendocrinology and Non-classical Hormones

1. Norris and Lopez: Vertebrate Endocrinology (5th ed, Vol 5, 2011, Academic press)
2. Brooks and Marshall: Essentials of Endocrinology (1995, Blackwell Science)
3. Bolander: Molecular Endocrinology (3rd ed 2006, Elsevier)
4. DeGroot and Jameson: Endocrinology (5th ed 2006, Vol 1, Elsevier-Saunders)
5. Larson. Williams Textbook of Endocrinology (10th ed 2002, Saunders)
6. Norman and Litwack. Hormones (2nd ed 1997, Academic press)
7. Henson and Castracane: Leptin and Reproduction (2003, Plenum Publisher).

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MUMZY 303 (A): MAMMALIAN REPRODUCTIVE PHYSIOLOGY AND ENDOCRINOLOGY

Paper II: Male and Female Reproduction

Unit 1: Reproductive cycles- Menstrual cycle- Control of seasonal reproductive cycle Photoperiod and temperature, Food supply, Hormonal control of puberty and pregnancy

Unit 2: Gonadotropins- structure, secretion and regulation Sexual differentiation and behavior, Gonadal differentiation, Brain differentiation, Copulatory patterns, Hormones in sexual behavior, Sites of action of sex hormones

Unit 3: Testis- Spermatogenesis and hormonal regulation, Sertoli cell, Leydig cell, Cell – cell interactions Epididymis: organization and function, Male accessory sex glands, Structural organization and endocrine regulation of prostate, Functions of accessory sex glands

Unit 4: Regulation of ovarian function, Follicular development and selection, Oocyte maturation, Mechanism of ovulation, Hormonal and molecular changes during periovulatory period, Factors involved in follicular rupture, Follicular atresia, Regulation of steroidogenesis,

Unit 5: Fertilization and Implantation -Hormonal control of gamete interaction, Role of zona proteins, Gamete activation, Sperm-egg fusion; Biology of implantation- Cellular aspects, Molecular aspects, Markers of developing embryo, Cross-talk between embryo and uterus

Books Recommended

Male Reproduction

1. Adashi et al: Reproductive Endocrinology, Surgery and Technology (1996, Lippincott- Raven publishers)
2. Knobil & Neill: The Physiology of Reproduction, Vol. I & II (1994 Raven Press)
3. Knobil & Neill: Encyclopedia of reproduction, Vol. 1-4, Academic Press, 1998.
4. Lamming: Marshall's Physiology of Reproduction (1984, Longman)
5. Mann & Lutwak-Mann: The Male Reproductive Function and Semen (1998, Springer)
6. Paulson et al: Andrology: Male Fertility and Sterility (1986, Academic Press)
7. Setchell: The Mammalian Testis (1992, Cornell University Press)
8. Yen et al: Reproductive Endocrinology (1999, Saunders)

**MUMZY 303 (B):
FISH BIOLOGY**

Paper I: Fish Culture and Pathology

Unit 1: Fish culture systems: Ponds, Fish farm: Lay out and construction of different types of ponds, Formulation and operation of different types of hatcheries, Hatchery management and hatchery breeding, Brood pond management for cultivable indigenous and exotic carps. Fish culture in paddy fields, Sewage-fed fisheries, Larvivorous fishes, Weed fishes, Hill stream adaptations in fishes.

Unit 2: Pond management: Physico-chemical properties of pond water and soil and their maintenance, Manuring (organic and inorganic) and liming, Composite fish farming and polyculture, Predatory and weed fishes and their eradication, Other systems: cage, raft, pens, raceways.


Unit 3: Chemical composition and nutritional value of fish, Fish by-products: Production and utilization: Liver oils, Fish meal, Fish silage, Fish protein, Shark fins and fin rays, Fish roes, Isinglass, Fish skin, Pearl essence.

Unit 4: Fish pathology, prophylaxis and therapy: Protozoan diseases: Cyclochaetiasis, Costiasis, (sliminess of skin), Helminth parasites: *Gyrodactylus*, *Dactylogyrus*,

Unit 5: Crustacean parasites: *Ergasilus*, Fungal diseases: branchiomycosis (gill rot), Bacterial diseases: tail and fin rot, furunculosis, Viral diseases: papillomatosis (cauliflower disease), Nutritional diseases: avitaminoses.

Books Recommended

1. Bentley: Comparative Vertebrate Endocrinology (2000, Cambridge University Press)
2. Gorbman et al: Comparative Endocrinology (1978, John Wiley)
3. Hadley: Endocrinology Prentice Hall (2011, International Editions)
4. Norris: Vertebrate Endocrinology (2nd ed 2009, Academic Press)
5. Bond: Biology of Fishes (1979, Saunders)
6. Brown: The Physiology of Fishes Vol I, II (1953 & 1957, Academic Press)
7. Evans: The Physiology of Fishes (2006, CRC Press)
8. Hall: Ponds and Fish Culture (1994, Agro Botanical Publishers)
9. Hoar & Randall: Fish Physiology, Series Vol. I – XIV (Academic Press)


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**MUMZY 303 (B):
FISH BIOLOGY**

Paper II: Fish Anatomy and Physiology

Unit 1: Integument: Epidermis: general organization, Dermis: general organization of scaly and non-scaly fishes. Aquatic respiration: Gills, Mechanisms of respiration, Counter current principle, Water flow across the gills, Respiratory pump, Gas exchange, Transport of respiratory gases.

Unit 2: Nervous system: Brain and cranial nerves, Receptors, Eye: structure, photoreception, formation of image, functional adaptations, Acoustico-lateralis system: labyrinth, lateral line organs, Chemoreceptors: gustatory, olfactory, electroreceptors.

Unit 3: Digestion: Alimentary canal and its modifications in relation to food and feeding habits,

Digestion and absorption of lipid, protein and carbohydrate. Gastrointestinal motility control. Excretion and osmoregulation: Glomerular and aglomerular kidneys, Excretion of nitrogenous wastes, water and ion balance, Stenohaline teleosts, Euryhaline teleosts, Migratory teleosts.

Unit 4: Circulation: General organization and circulation, Composition of swim bladder gas, its secretion, maintenance and removal, Functions of swim bladder. Heart and aortic arches, Regulation of cardiac activity, Hemodynamics, Cardiac output, Circulation time, Blood pressure, Fish hemoglobin.

Unit 5: Fish Endocrinology: Hypothalamo-hypophyseal system: neurosecretory system and hypophyseal hormones, Functional morphology of pituitary, Hypothalamic control of pituitary,

Structure and function of the following: Thyroid, Ultimobranchials, Pancreas, Adrenal,

Corpuscles of Stannius, Urophysis and Pineal.

Books Recommended

1. Hughes: Comparative Physiology of Vertebrate Respiration, Heinemann Educational (1967, Books)
2. Khanna and Singh: Textbook of Fish Biology and Fisheries (2003, Narendra Publishing House)
3. Lagler, Bardach, Miller and May Passino, Ichthyology (2003, John Wiley)
4. Nilsson & Holmgren: Fish Physiology Recent Advances (1986, Croom Helm)
5. Singh: Advances in Fish Research; Vol. I and II (1993 and 1997, Narendra Publishing House)
6. Srivastava: A Textbook of Fishery Science and Indian Fisheries (1985, Kitab Mahal)

**MUMZY 351:
LABORATORY COURSE-I**

Developmental Biology

1. Study of frog embryonic development through models
2. Collection of frog spawns and observation of different developmental stages
3. Study of spiral cleavage in eggs of snail
4. Effect of vitamin A in tadpole tail regeneration
5. Study of embryonic development in chick through slides
6. Window preparation to study chick embryo development
7. Whole mount preparation of chick embryos at various stages of development
8. Study of expression of developmental genes in larval imaginal discs.

Immunology

1. Separation of macrophages from mice and their identification on the basis of non-specific esterase staining
2. Immunization of rabbit and collection of antisera
3. Demonstration of antigen-antibody reaction by immunodiffusion
4. Demonstration of direct ELISA

Evolutionary Biology

1. Study of quantitative inheritance in *Drosophila*: sternopleural bristle phenotypes in *D. melanogaster*
2. Demonstration of natural selection under laboratory conditions by making competition between red eyed and white eyed *D. melanogaster*
3. Demonstration of Hardy-Weinberg equilibrium in human populations by taking examples of MN and ABO blood group systems
4. Study of inversion polymorphism in *Drosophila*
5. Study of sexual isolation between two closely related and sympatric species of *Drosophila*: *D. bipectinata* and *D. malerkotliana*.

Economic Zoology

1. Study of life cycle of silkworm through chart/specimens
2. Study of life cycle of honey bee through chart/specimens
3. Study of external morphology of different castes of honey bee
4. Dissection of sting apparatus of honey bee
5. Study of life cycle of lac insect through chart.
6. Visit to the local dairy farm to study the pests of cattle
7. Visit to the local dairy farm to study the dairy management
8. Visit to local poultry to study the rearing methods
9. Visit to local fish culture site to study the fish culture methods

MAJOR ELECTIVE LABORATORY COURSE -II
MUMZY 352 (A): MAMMALIAN REPRODUCTIVE PHYSIOLOGY AND
ENDOCRINOLOGY Neuroendocrinology and Non-classical Hormones

1. Study of pituitary and pineal cell types through prepared slides
2. *In situ* study of pituitary gland for portal circulation
3. Transplantation of pituitary in kidney capsule
4. *In situ* study of pineal gland and associated epithalamic complex
5. Anatomical mapping of hypothalamic centres (SON, PVN, AR, VMO, mammillary nucleus, median eminence)
6. Ascorbic acid depletion bioassay for LH
7. ELISA/RIA of TSH or gonadotropins

Male Reproduction

1. Preparation and study of permanent slides of reproductive organs: testis, epididymis (caput, corpus, and cauda), seminal vesicle and prostate
2. Study of stages of spermatogenesis and spermiogenesis using histological slides of testis
3. Biochemical estimation of fructose and alkaline and acid phosphatases in seminal vesicle and prostate
4. Androgen bioassay by sialic acid assay
5. Biochemical estimation of 3 β -hydroxysteroiddehydrogenase
6. Operations in rat: induction of cryptorchidism; vasectomy
7. Study of sperm motility, sperm morphology, and sperm count in rat
8. Effect of cadmium chloride treatment on testis

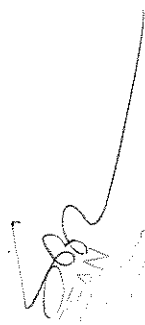
Female Reproduction

1. Studies on permanent slides of female reproductive organs (ovary, uterus, oviduct and vagina)
2. Tubectomy and hysterectomy
3. Induction of superovulation in mouse/rat
4. Induction of PCOS condition in rat
5. Biochemical estimation of succinate dehydrogenase and catalase activity
6. Study of rat oestrous cycle using vaginal smear preparations
7. Isolation of large antral follicle and corpus luteum
8. Isolation of egg, granulosa and theca cells
9. Demonstration of implantation sites by pontamine blue (blue dye reaction) in mouse
10. Demonstration of SDS-PAGE for ovarian proteins

MAJOR ELECTIVE LABORATORY COURSE -II
MUMZY 352 (B): FISH BIOLOGY

Fish Physiology and anatomy

1. Dissection and display of afferent and efferent branchial vessels of a carp and a catfish
2. Study of available histological slides of: gills, accessory respiratory organs, skin. Kidneys, liver and digestive organs of a teleostean fish
3. Determination and comparison of hemoglobin content of water-breathing and air breathing fish
4. Study of ventilation rate and surfacing activity of a air-breathing fish under different experimental conditions.
5. Determination of feeding habit of important edible fishes by morphological analyses of their buccopharyngeal region
6. Determination of feeding habit of carps and catfishes by analyses of their gut contents
7. Dissection of carp showing interrelationship between the gas (swim or air) bladder and Weberian ossicles.


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SEMESTER IV

MUMZY 401: ANIMAL BEHAVIOUR AND ENVIRONMENTAL BIOLOGY

Unit 1: Introduction to behaviour: proximate and ultimate causation, Patterns of behavior, Genetic basis of behavior: Development of bird song.

Unit 2: Biological rhythms, Habitat selection and foraging behavior, Animal signals and communication, Social dominance and concept of territoriality. Sexual selection, Social organization: Theories of social behavior, Altruism in eusocial animals.

Unit 3: Introduction to environmental biology: Concept of ecosystems, Energy flow in Ecosystem. Energy and environment: conventional and non-conventional energy sources.

Unit 4: Population ecology: Population dynamics, Population growth form, r- and k- selections and carrying capacity, Biological communities and species interactions, Types of interactions between two species, Interspecific competition

Unit 5: Human impact on the environment and sustainable development: Concept of sustainable development, Environmental degradation (habitat destruction, fragmentation, biological invasions) and management, Forest, water & mineral resources, Biodiversity conservation and concept of ecosystem services, Global environmental changes (ozone depletion, acid deposition, green house gas emissions and global warming), Environmental impact assessment.

Books Recommended

Animal Behaviour

1. Alcock: Animal Behaviour: An Evolutionary Approach (9th ed 2009, Sinauer Asso.)
 2. M P Kaushik: Animal Behaviour, Kalyani Publication
 3. Shukla G, Upadhyay V, Mathur R. Economic Zoology Biostatistics & Animal Behaviour (2011, Rastogi Publication).
 4. Mathur Reena: Animal Behaviour (Rastogi Publications, December 1, 2005)
- ##### Environmental Biology
1. Primack: A Primer of Conservation Biology (4th Ed., Sinauer Associ, 2008).
 2. Raven, Berg, Johnson: Environment. Harcourt College Pub; 2nd edition 1997
 3. Turk and Turk: Environmental Science (4th Ed., Atlantic Books; 1988)
 4. Wright and Nebel: Environmental Science (8th Ed., Prentice Hall, 2002).
 5. Rastogi: Organic Evolution (2007, Kedarnath & Ramnath)
 6. Das, M.C. Fundamental of Ecology- Tata McGraw Hill Publication 2001
 7. Verma and Agrawal, Ecology – 2000, S Chand

MUMZY 402: MAMMALIAN REPRODUCTIVE PHYSIOLOGY AND ENDOCRINOLOGY

Hormone Receptors, and Signaling Mechanisms

Unit 1: Control of hormone secretion- Synthesis, processing, and sorting of prehormone Precursor, Sequential stages of the regulated secretory pathway, Dense-cored granule Exocytosis, Regulation of exocytosis by calcium and protein kinase C

Unit 2: Receptors - Nuclear receptors, Structure, Families (glucocorticoid, thyroid and estrogen), Metabolism, Activation and recycling


Unit 3: Membrane receptors, Enzyme-linked receptors, Cytokine receptors, G-Protein coupled receptors, Ligand-gated ion channels

Unit 4: Hormone signaling- Receptor tyrosine kinase pathway, Cytokine receptors pathway, Cyclic AMP pathway, Phospholipid/calcium- protein kinase C pathway, Nitric oxide signaling pathway, MAP kinase pathway, Hormonal control of gene expression

Unit 5: Molecular basis of hormone synergism and antagonism, Glycogen metabolism Smooth muscle contraction, Termination of hormone action Pathophysiology of hormone receptors, hormone analogues as drug and xeno-estrogens

Books recommended:

1. Bolander: Molecular Endocrinology (3rd ed 2006, Elsevier)
2. DeGroot and Jameson: Endocrinology, Vol 1 (5th ed 2006 Saunders)
3. Larson: Williams Textbook of Endocrinology, (10th ed 2002, Saunders)
4. Alberts et al: Molecular Biology of the Cell (4th ed 2002, Garland)
5. Squires: Applied Animal Endocrinology (2003, CABI publications)


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LABORATORY COURSE-I
MUMZY 451: MAMMALIAN REPRODUCTIVE PHYSIOLOGY AND
ENDOCRINOLOGY

Hormone Receptors and Signaling Mechanisms

1. Study of exocytotic cycle by photomicrographs
2. Demonstration of gonadotropin receptors in the ovary by Western blot/ICC
3. Demonstration of growth factors in the ovary by Western blot/ICC
4. Estrogen bioassay in female rat
5. Effect of glucagon and insulin on liver glycogen
6. Effects of hormones on lipid metabolism
7. Biochemical estimation of nitric oxide by nitrate/nitrite assay


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Paper Code:-

The course shall comprise of the following:-

- (1) **Concept of Property vis- Intellectual Property:-** Concept of Property and Theories of Property- An Overview, Theories of Intellectual Property Rights, Social and Economic Development and Role of Intellectual Property System, Need for Protecting Intellectual Property- Policy Consideration- National Perspectives and International Demands , Types of Intellectual Property- Origin and Development – an overview, Intellectual Property Rights as Human Right.
- (2) **Role of International Institutions:-** World Intellectual Property Organization (WIPO), Function of WIPO , Membership of WIPO , Agreement between the WIPO and the WTO, Dispute Settlement –New Treaties.
- (3) **Copyright- National Perspective:-** Copyright:- What and Why.? Term of Copyright, Assignments and Licensing , Registration and Regulatory Authority , Procedure, Infringements and Remedies- Contractual, Civil, Criminal and Administrative, An Overview of International Perspective
- (4) **Trademarks:-** Need and Emergence of Trade Mark Law, The Register and Conditions for Registration ,Procedure for and Duration of Registration , Effect of Registration, Passing-Off and infringement of Trade Mark, Assignment and Transmission, Use of Trade Mark and Registered Users, Rectification, Correction of the Register and Certification of Trademarks, Appellate Board , Offences, Penalties and Procedure.
- (5) **Patent:-** Meaning of Patent –Inventions- Concept of Novelty, Inventive step and Utility- Inventions not Patentable –Process and Product, Patents- TRIPS Agreement (Article 27) Implications to Indian Patents System, Acquisition of Patent, Right of patents and other- Term, Exclusive Marketing Right , Surrender, Licenses, Revocation, Functionaries Under the Patent Act, Infringement of Patents and Remedies.

BOOK RECOMMENDED:-


Narayanan P, Law of Copy Right and Industrial Designs.

Narayanan P, Intellectual Property Law.

Copinger, Law of Copy Right. Lyenger,

Narayanan P., Patent Law.

(Dr.) Faizan Mustfa . Copy Right Law (A Comparative Study)


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