MADHYANCHAL
PROFESSIONAL UNIVERSITY

Draft Rules & Syllabus
for the

Master of Science in Zoology

(M.Sc. Zoo.) Course

MADHYANCHAL PROFESSIONAL UNIVERSITY

DEPARTMENT OF ZOOLOGY

Semester I

S.No.	Subject Code	Subject Name & Title	Maximum Marks Allotted								Hours per week.			Total Credits	Remarks
			Theory				Practical								
			End Sem	Mid Sem. MST	Quiz, Assignment	Total Marks	Lab Work	Assignment /Quiz/Term paper	End Sem	Total Marks	L	T	P		
1	MSc101	Animal Taxonomy and Evolution	60	20	20	100	-	-	-	-	3	1	-	4	One credit refers to one hour teaching in theory, Tutorial
2	MSc 102	Biological Chemistry	60	20	20	100	-	-	-	-	3	1	-	4	
3	MSc 103	Comparative Anatomy	60	20	20	100	-	-	-	-	3	1	-	4	
4	MSc 104	Tools and Techniques in Biology	60	20	20	100	-	-	-	-	3	1	-	4	
5	MSc 105	Animal Taxonomy and Evolution and Comparative Anatomy (Lab)	-	-	-	-	40	20	40	100	-	-	4	2	
6	MSc 106	Biological Chemistry and Tools & Techniques (Lab)	-	-	-	-	40	20	40	100	-	-	4	2	
	Total		240	80	80	400	80	40	80	200	12	4	8	20	600

Semester II

S.No.	Subject Code	Subject Name & Title	Maximum Marks Allotted								Hours per week.			Total Credits	Remarks
			Theory				Practical								
			End Sem	Mid Sem. MST	Quiz, Assignment	Total Marks	Lab Work	Assignment /Quiz/Term paper	End Sem	Total Marks	L	T	P		
1	MSc 201	Comparative Physiology	60	20	20	100	-	-	-	-	3	1	-	4	One credit refers to one hour teaching in theory, Tutorial
2	MSc 202	Animal Cell Biotechnology	60	20	20	100	-	-	-	-	3	1	-	4	
3	MSc 203	Adaptation Biology	60	20	20	100	-	-	-	-	3	1	-	4	
4	MSc 204	Molecular Cell Biology	60	20	20	100	-	-	-	-	3	1	-	4	
5	MSc 201 P	Animal Cell Biotechnology and Molecular Cell Biology	-	-	-	-	40	20	40	100	-	-	4	2	
6	MSc 202 P	Adaptation Biology and Developmental Biology	-	-	-	-	40	20	40	100	-	-	4	2	
	Total		240	80	80	400	80	40	80	200	12	4	8	20	600

Chapter-II Syllabus

101: ANIMAL TAXONOMY AND EVOLUTION

Unit I

- Definition and basic concepts of biosystematics taxonomy and classification.
- History of Classification
- Trends in biosystematics: Chemotaxonomy cytotaxonomy and molecular taxonomy
- Dimensions of speciation and taxonomic characters.
- Species concepts: species category, different species concepts, subspecies- and other infra-specific categories. Theories of biological classification: hierarchy of categories.

Unit II

- Taxonomic Characters. Different kinds.
- Origin of reproductive isolation, biological mechanism of genetic incompatibility.
- Taxonomic procedures: Taxonomic collections, preservation, curetting, process of identification.
- Taxonomic keys, different types of keys, their merits and demerits.
- International code of Zoological Nomenclature (ICZN):
- Operative principles, interpretation and application of important rules: Formation of Scientific names of various Taxa.

Unit III

- Taxonomic categories. Evaluation of biodiversity indices. Evaluation of Shannon - Weiner Index. Evaluation of Dominance Index. Similarity and Dissimilarity Index. Data collection methods, GPS, GIS and mapping

Unit IV

- Concepts of evolution and theories of organic evolution.
- Neo Darwinism and population genetics: Hardy-Weinberg law of genetic equilibrium. Detailed account of destabilizing forces: Natural selection, Mutation, Genetic Drift, Migration, Meiotic Drive.
- Trends in Evolution. Molecular Evolution- Gene evolution, Evolution of gene families, Assessment of molecular variation

Unit V

- Origin of higher categories. Phylogenetic. Gradualism and punctuated equilibrium.
- Major trends in the origin of higher categories. Micro and macro evolution.
- Molecular population genetics- Pattern of changes in nucleotide and amino acid sequence.
- Ecological significance of molecular variations (genetic polymorphism)
- Species concept: Phylogenetic and biological concept of species.

- Patterns and mechanism of reproductive isolation.

- Modes of speciation (allopatry & sympatry). - Genetics of Speciation

- Origin and Evolution & Economically important microbes and animals.

REFERENCES

1. M. Koto-The. Biology of biodiversity-Springer

2. E.O. Wilson-Biodiversity-Academic Press Washington.

3. G.G.-Simpson-Principle of animal taxonomy Oxford IBH Publication Company.

4. E-Mayer-Elements of Taxonomy

5. Bastchelet-F-Introduction to mathematics for life scientists Springer Verlag, Berling.

6. Skoal R.R. and F.J.Rohiff Biometry-Freeman, San-Francisco.

7. Snecdor, G.W. and W.G. Cocharan Statisical Methods of affiliated-East-West Press, New Delhi.

8. Murry J.D. Mathematical Biology-Springer, Verlag, Berlin

102: BIOLOGICAL CHEMISTRY

UNIT - I

- Carbohydrates-Classification, structure and properties.
- Monosaccharides – Glucose, Fructose and Galactose.
- Disaccharides – Maltose, Lactose, Sucrose, Cellobiose and Trehalose
- Polysaccharides – Glycogen, Starch, Cellulose and Inulin.
- Heteropolysaccharides – Hyaluronic acid, chitin, heparin, chondroitin and keratin sulfate. Physiologically important carbohydrates.

UNIT - II

- Lipids-Classification, structure and properties of fatty acids, triglycerides.
- Oxidation of fatty acids – β oxidation, regulation and disorders.
- Palmitate biosynthesis and its regulation.
- Bile salts and bile pigments. Ketone bodies and their importance.
- Prostaglandins and their significance.

UNIT - III

- Amino acids- classification, chemical nature and properties. Classification of proteins, physical-chemical properties, structure- primary, secondary, tertiary and quaternary.
- Methods for determining amino acid sequences – N-terminal, C- terminal and amino acid analysis of proteins.
- Protein synthesis and its inhibitors; Metabolism of aromatic amino acids. Laboratory synthesis of peptides. Protein Targeting and Degradation Protein folding - Diseases of protein mis-folding, Introduction to proteomics.

UNIT - IV

- Classification of enzymes. Enzyme Kinetics, Factors affecting enzyme catalysed reactions. Enzyme inhibition.
- Allosteric regulations of enzyme activity Co-enzymes, metalloenzymes, iso-enzymes and Multienzyme complexes, Ribozymes.
- Clinical applications of enzymes. Blood clotting proteins, Plasma proteins and their importance

UNIT - V

- Nucleic acids – Classification and chemistry.
- Nucleosides, nucleotides, nucleoside analogs and polynucleotides.
- Biosynthesis and break down of purines and pyrimidines.
- Salvage pathway. Disorders of nucleic acid metabolism.

REFERENCES

1. Conn. E.E. Stumpf P.F. Bruening G. and Dooi R. H (1995) Outlines of Biochemistry, John Wiley and Sons, Singapore.

2. Daniel, L.J. (1987) Laboratory Experiments in Biochemistry, Academic Press, New York. 11

3. Devlin T.M. (1993) Text Book of Biochemistry with clinical Correlations, Wiley-Liss, Inc., New York.

4. Elliott W.H. and Ellioot D.C. (2001) Biochemistry and Molecular Biology, Oxford University Press, Oxford.

5. Emil Smith et.al., (1983) Principles of Biochemistry: General Aspects (7th Edition) Acukland, McGraw Hill book, Kogakusha

6. Garrett R.H. and Grisham C. M (1995), Biochemistry, Saunders Publishers, New York.

7. Jayaraman J. (1996) Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi

8. Lehninger A.L. (1997) Biochemistry, current edn. W.H. Freeman and Co., San Francisco.

9. Murray R.K., Granner D.K., Mayes P.A. and Rodwell (1988) Harper's Biochemistry XXI edn. Prentice Hall International Inc. Connecticut.

10. Nelson D.L & Cox M.M (2005) Lehninger's Principle of Biochemistry, W.H. Freeman & Company, New York

11. Page M.I. and Williams A. (1993) Enzyme Mechanisms, The Royal Society of Chemistry, Cambridge

12. Sadasivam S. and Manickam (1996) Biochemical Methods, New Age International Publishers, New Delhi.

13. Stryer L. (1994) Biochemistry, W.H. Freeman and Co., San Francisco.

14. Varely H.(1980) Practical Clinical Biochemistry VI CBS Publishers

15. Vasudevan P. M and Kumari S.S (2001) Text book of Biochemistry (3rd edn.) Jaypee Brother publilcation, New Delhi

16. West E.S, Todd W.R, Mason H.S.and Van Bruggen J.T. (1974) Text Book of Biochemistry, 4th Edition, Oxford and IBH Publishing Co. Pvt. Ltd.

17. Wilson K and Walker J.M. (1995) Principles and Techniques of Practical Biochemistry, Cambridge University Press, Cambridge.

18. Zubay G. (1983) Principles of Biochemistry: General Aspects, VIIth Edition. McGraw Hill Book Co.,Kogakusha

103: COMPARATIVE ANATOMY

UNIT- I

- Historical perspective and general concepts of Comparative Anatomy, Anaplasy, Homoplasy.
- Body plan of animals-evolutionary perspectives
- Body plan of protochordates –their affinities with invertebrates and chordates
- Origin of vertebrates – major life forms
- Methods and tools used to study animal body

UNIT- II

- Excretory organs- Organs of excretion among invertebrates; Gross anatomy development and evolution of kidneys. Structure of the nephron in relation to excretion and osmoregulation.
- Respiratory structures - General structure and types of internal gills; External gills; Lungs and gas bladder of fishes; Evolution of lungs from amphibians to mammals. Respiratory structures among invertebrates. Reproductive system of vertebrates

UNIT- III

- Circulation - Heart of vertebrates-evolutionary modifications; Evolution of major aortic and venous channels of vertebrates. Organization of the vascular system in invertebrates.
- Digestive tract- General organization and microscopic structure of the gut of vertebrates. Adaptive features of the digestive tract of vertebrates- evolutionary perspectives; General organization of the digestive tract of invertebrates.

UNIT - IV

- Integument- Gross anatomy of Integument of vertebrates and their derivatives.
- Skeleton - Components of the head skeleton; Principal types of jaw suspensions; Cranial kinesis; General structure of vertebrae; Evolution of the spine; evolution of paired appendages, pectoral and pelvic girdles of vertebrates ; Ribs and sternum of fishes and tetrapods.
- Muscles- Gross structucture of muscles; muscles of primary swimmers.
- Axial, Hypobranchial, Appendicular and Branchial muscles of tetrapods.

UNIT- V

- Nervous system- General organization of the nervous system in animals; Comparative account of brain and evolution of telencephalon; Cranial nerves of vertebrates.
- Sense organs- Eye, ear, olfactory organs, Lateral line. Nervous system and electroreceptors of vertebrates. Photoreceptors and chemoreceptors of insects.

REFERENCES

1. Kenneth V. K (2006) Vertebrates: Comparative Anatomy, Function, Evolution. 4th Edition. McGraw-Hill, New York, NY.
2. Saxena R.K. and Sumitra S (2008) Comparative Anatomy of Vertebrates. New Delhi, Viva Books, 479 p., ISBN 81-309-0402-0.
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4. Milton H. (1995) Analysis of vertebrate structure. John Niley & Sons Inc, New York
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6. Barnes R .S .K (1993) The invertebrates , a new synthesis, Blackwell Scientific Publication
7. Kulshrestha S. K (2004) Comparative Anatomy of Vertebrates
8. Romer A.S and Parsons T. S (1978) The Vertebrate body, 5th edition, W.B. Saunders Co & Toppan Co, Ltd

9. Gardiner M. S (1972). The Biology of Invertebrates, Mc. Graw Hill Book Co.
10. William K P.(1998) Life- The Science of Biology, 5th edition, Sinauer Associates,Inc

104: TOOLS AND TECHNIQUES IN BIOLOGY.

Unit I

- Microsocopy, principle & applications
- Light microscope and phase contrast microscope, Fluorescence microscope, Electron microscope, confocal microscopy
- General Principle and applications of Colorimeter, Spectrophotometer, Ultra centrifuge, Flame photometer, Beer and Lambert.s law.
- Microbiological techniques
- Media Preparation and sterilization, Inoculation and growth monitoring, Microbial assays.
- Microbial identification (cytological staining methods for bacterial and fungal strains) Use of fermenters

Unit II

- Computer aided techniques for data presentation data analysis, statistical techniques.
- Cryotechniques
- Cryopreservation of cells, tissues, organs and organisms, Cryosurgery, Cryotomy, Freeze fracture and freeze drying.
- Separation techniques.
- Chromatography, principle type and applicants, Electrophoresis, Principles, types and applications PAGE and agarose gel electrophoresis. Organelle separation by centrifugation.

Unit III

- Radioisotope and main isotope techniques in biology.
- Sample preparation for radioactive counting b. Autoradiography.
- Immunological techniques
  - Immunodiffusion (Single & Double) and Immuno electrophoresis
- Techniques immuno detection
  - Immunocyto / histochemistry, Immunoblotting, immunodetection, immunofluroscence.
- Surgical techniques.
  - Organ ablation (eg. Ovariactomy, adrenalectomy), Perfusion techniques, Stereotaxy, Indwelling cathethers, Biosensors.

Unit IV

- Histological techniques
- Principles of tissue fixation, Microtomy, Staining, Mounting, Histochemistry
- Cell culture techniques.
- Design and functioning of tissue culture laboratory, Culture media, essential components and Preparation. Cell viability testing.

Unit V

- Cytological techniques
  - Mitotic and meiotic chromosome preparations from insects and vertebrates.
  - Chromosome banding techniques (G.C.Q. R. banding), Flowcytometry.
- Molecular cytological techniques
  - In site hybridization (radio labelled and non-radio labelled methods)
  - FISH, Restriction banding
- Molecular biology techniques
- Southern hybridization, Northern hybridization, DNA Sequencing
  - Polymerase chain reaction (PCR)

REFERENCES

1. Introduction to instrumental analysis-Robert Braun-McGraw Hill.
2. A biologist Guide to principles and Techniques of Practical Biochemistry- K, Wilson and K.H. Goulding ElBS Edn.
3. Clark & Swizer. Experimental Biochemistry. Freeman, 2000.
4. Locquin and Langeron. Handbook of Microscopy. Butterwaths, 1983
5. Boyer. Modern Experimental Biochemistry. Benjamin, 1993
6. Freifelder. Physical Biochemistry. Freeman, 1982.
7. Wilson and Wlaker. Practical Biochemistry. Cambridge, 2000.
8. Cooper. The Cell-A Molecular Approach. ASM, 1997
9. John R.W. Masters. Animal Cell culture- A practical approach. IRL Press.
10. Robert Braun. Introduction to instrumental analysis. McGraw Hill

101: ANIMAL TAXONOMY AND EVOLUTION- LABORATORY

1. Construction of dichotomous key
2. Construction of phenogram
3. Construction of cladogram

4. Identification of major groups of Formicidae

5. Identification of major Elasmobranchs -

6. Identification of major adult insects

7. Methods to collect and preserve insects- demonstration

8. Identification of major groups of aquatic insects

9. Mouth parts of insects- adaptive radiation

10. Methods to collect and preserve amphibians

11. Assessment of the taxonomic diversity in a given habitat - Field observations on Morphological evolutionary characters

102: BIOLOGICAL CHEMISTRY- LABORATORY 4 Hours/Week

1. Color reactions of monosaccharides and disaccharides.

3. Color reactions of polysaccharides.

4. Color reactions of proteins.

5. Precipitation reactions of proteins.

6. Identification of an unknown protein.

6. Estimation of blood glucose.

8. Estimation of cholesterol.

10. Paper chromatography for sugars.

11. Estimation of total serum proteins by biuret method

12. Determination of urine creatinine by Jaffe's method.

13. Estimation of blood urea by diacetyl monoxime method.

103: COMPARATIVE ANATOMY –LABORATORY

1. Microscopic anatomy of artery, vein, lung, kidney, oesophagus, stomach, intestine , liver, testis and ovary of frog

2. Fixation of tissue and preparation of paraffin block

3. Preparation of paraffin slides

4. Staining of paraffin slides

5. Study of embryological slides- chick

6. Temporary mounts – to exhibit the structure of gizzard and trachea of cockroach; cross striation and nuclei of muscle fibre

7. Dissection- Study of external and internal features of mouse

8. Dissection- Study of external and internal features of cockroach

9. Types of beaks and feet of birds

10. Types of feathers of a bird

11. Demonstration of skeletal muscle fibre types

12. Changes in the organs of mouse during development

13. Types of feathers of a bird

14. Demonstration of skeletal muscle fibre types

15. Changes in the organs of mouse during development

14. Determination of DNA content.

15. Estimation of RNA content.

16. Paper chromatography for amino acids.

104: TOOLS AND TECHNIQUES IN BIOLOGY- LABORATORY

1. To familiarize in the use of pH meter and Colorimeter.

2. One-dimensional Ascending & Descending Paper chromatography of Amino acids & sugars.

3. Two-dimensional Ascending & Descending Paper chromatography of Amino acids.

4. One-dimensional Ascending & Descending TLC of Amino acids & sugars.

5. Fractionation of Sugars from fruit juice using TLC.

6. Microscopy and Microphotography.

7. Column Chromatography for Proteins, Pigments, aminoacids.

8. Paper Electrophoresis of Amino acids.

9. Paper Electrophoresis of Proteins.

10. Agar Gel Electrophoresis of Proteins.

11. Polyacrylamide Gel Electrophoresis (PAGE).

12. SDS- Polyacrylamide Gel Electrophoresis (PAGE).

13. To perform image analysis using CCD camera of Microscopic dynamic Images.

14. Microphotography.

Semester II

201 COMPARATIVE ANIMAL PHYSIOLOGY

UNIT- I

Digestion - Digestive Enzymes

Digestion and absorption of carbohydrates, proteins and lipids Regulatory mechanisms of digestion

Gastro-intestinal motility

Gastro-intestinal disorders

UNIT- II

Respiration- Comparative study of aquatic and terrestrial respiration Respiration in insects and birds

Transport of O_2 and CO_2 Role of Blood as a buffer Haemodynamics

UNIT-III

Osmoregulation- Ionic and water balance in tissues

Osmoregulation in aquatic, amphibious and terrestrial animals Patterns of N2 excretion

Urine formation in a nephron Regulation of renal function

UNIT- IV

Hormones - Principles of Endocrinology

Mechanisms of water- and lipid soluble hormone action Hormonal regulation of fuel metabolism

Estrous cycle and its hormonal basis

Endocrine regulation of insect metamorphosis

UNIT - V

Reproductive Physiology-

Spermatogenesis and oogenesis in mammals

Molecular mechanisms of fertilization in mammals. Oral contraceptives and their hormonal basis.

Insect reproductive systems

Hormonal regulation of reproduction in insects

REFERENCES

1. Schmidt-Nielsen K. (1995) Animal Physiology, Adaptation and Environment. Cambridge University Press.
2. Kay I. (1998) Introduction to Animal Physiology, Bios Scientific Publishers, UK
3. Berne R.M. and Levy M.N (Eds) (1990) Principles of Physiology, C.V. Mosby Company, St. Louis.
4. Campbell et.al (1984) Clinical physiology 5^{th} Edn. Blackwell Scientific Publications, Oxford.
5. Dacie I.V. and Lewis S.M. (1984) Practical Haematology, 6^{th} Edn.(International student Edition) Churchill Livingstone, Edinburgh.
6. Ganong U.F. (1989) Review of Medical Physiology, Lange, California.
7. Guyton A.C. (1991) Text Book of Medical Physiology, VIII edn. Saunders Co., Jovanovich
8. Jensen D. (1976) The Principles of Physiology, Appleton Century Crafts, New York.
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10. Oser B.L. (1976) Hawkins Physiological Chemistry 14^{th} edn. (Indian Edition) Tata McGraw-Hill Pub.Co, New Delhi.
11. Paganelli C.V. and Farhi L.E. (1989) Physiological Function in Special Environments, Springer Verlag, New York.
12. Schmidt Nilsen K. (1994) Animal Physiology, 4^{th} edn. Cambridge University Press, New

York.

13. Shepherd G.M. Neurobiology- Oxford University Press.
14. Wilson I.A. (1979) Principles of Animal Physiology 2nd edn. Macmillan Pub. Co. Inc. New York.

COMPARATIVE PHYSIOLOGY- LABORATORY

1. Determination of glucose by glucose oxidase method
2. Detection of excretory products in urine
3. Active uptake of indigo carmine by Malpighian tubules
4. Starvation and liver glycogen levels
5. Determination of Respiratory quotient
6. Reproductive systems of insects
7. Collection of insect eggs and study of their development
8. Neuroendocrine cells of insects.
9. Ascorbic acid and its metabolites in urine
10. Hydrolysis of starch
11. Enzyme action on lipids (lipase)
12. Diagnosis of H. Pylori.

202 TOXICOLOGY AND CANCER BIOLOGY

UNIT- I

Introduction- Definitions, What toxicologist study? Major subdivisions of toxicology. Dose-response relationships and their importance, basic components of tests generating dose-response data, Frequency response and cumulative response. Factors influencing toxicity- Route of administration, host factors-species, strain, age and sex, Biological factors- Accumulation and storage of chemicals in the organism. Biotransformation reactions. Role and mechanisms of xenobiotic metabolizing enzymes.

Unit- II

Toxicologic testing methods-Acute and chronic toxicity tests, LD_{50}, LC_{50} and ED_{50}. Teratologenicity testing. Reproductive toxicology– Effect of xenobiotics on male and female reproductive organs/cells in mammals. Organ/tissues specific toxicity. Toxicity of metals (Lead, Mercury, Arsenic, Cadmium). Pesticide toxicity- Acute and Chronic effects of organophosphate, Organo-chlorine and Carbamate insecticides, Toxicity of pyrethroids. Bio-magnification. Natural toxins- Import microbial, plant and animal toxins. Treatment of

toxicity- Antidotal therapy.

Unit- III

Foundations of Forensic Toxicology- classification of poisons, sign and symptoms of common poisons, antidotes, collection of samples. Drugs: Drugs of abuse, classification and identification. Nacro analysis and brain mapping. Explosives: Classification, composition and characteristics of explosives, pyrotechinques, IEDs, explosion process and affects, types of hazards, effect of blast waves on structure Courtroom Testimony, Investigation of Toxicity-Related Death/Injury, Documentation Practices, Considerations for Forensic Toxicological Analysis, Drug Concentrations and Distribution.

Unit IV:

Mutagenesis and genetic toxicology- Test systems of genotoxicity testing, Genotoxicty testing in mammals –Bone marrow chromosal aberration, Micronucleus test, sperm abnormality assay, comet assay. Occupational and environmental exposure -Endosulphan tragedy. What is cancer?, classification of human cancers, Growth characteristics of cancer cells, tumor angiogenesis. Tumor staging. Causes of cancers-chemical carcinogenesis; Steps involved in chemical carcinogenesis. Radiation carcinogenesis-ionizing radiation, UV radiation.

Unit: V

Oncogenes-. Functional class of oncogenes (proto-oncogenes), Mechanisms of carcinogenic transformations by oncogenes. Viral oncogenes. Tumor suppressor genes- mechanisms of tumor suppressor in cancer induction (P53).Patient – tumor interactions- Pain, nutritional effects, hematological effects, fever and infection hormonal effects, neurological and dermatological effects. Tumor immunology-mechanisms of immune response to cancer, natural killer cells, 'Danger theory'.

REFERENCES

1. Dekant W and Neumann H.G (1992): Tissue –specific Toxicity: Biochemical mechanisms, Academic Press. Harcourt Brace Fovanovich, Publishers, London.
2. Loomis T.A. and AWallace Hayes (1996): Loomis's Essentials of Toxicology, IV edition, Academic Press Ltd, London.
3. Sharma P.D, (1999): Toxicology, Rostogi Publihers, Meerut.
4. Fan A.M and Chang L.W(Ed) (1996): Toxicology and Risk assessment: Principles and methods and applications, Marcell Dekker publishers, New York.
5. Hayer W. J.Jr, Laws E.RJr (Eds) (1991): Vol.1, 2 and 3, Hand book of pesticide

toxicology, Academic Press Inc, California.

6. Habermehl.G.G. (1981) Venomous animals and their toxins, Springer-Verlag, Benlin.

7. Urayuchi.K, Yamazaki M (Ed) (1978) Toxicology, Biochemistry and pathology of mycotoxins. Halsted Press book Kadansh Ltd., Tokyo.

8. U.S. FDA: *Toxicologic Principles for the Safety Assessment of Direct Food Additives and Color Additives Used in Food*. Washington, DC: U.S.Food and Drug Administration, Bureau of Foods, 1982.

9. Prakash R (Ed) (1998): Recent trends in Toxicology, Agarwal Printers, Meerut, India.

10. Moriarty F (1983). Ecotoxicology II edition, Academic Press, London. Tyson C. A and Frazier J.M (1983) Methods in Toxicology Vol.1.Acdamic Press, London.

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12 Duffus J.A (1980): Environmental Toxicology, Edward Arnold, Publishers, London.

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14. Watson J.D, Gilman M, Witkowskyi, J.Zoller M (1992): Recombinant DNA, 2nd Edition,

Scientific American Books, New York.

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17. Becker F .F (Ed) 1975): Cancer, Vol.1-3, Plenum Press, New York.

18. Souhani R (1986): Cancer and its management, Blackwell Publishers, Oxford.

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21. Darnell J.H, Lodish and D. Baltimore (1995): Molecular Cell Biology, Scientific American Books, New York.

22. Lewin B. (Ed) (1996): Genes,VII edition, John Wiley and Sons, New York

23. Ernest Hodgson, (2010): A Textbook of Modern Toxicology, 4th Edition, ISBN: 978-0-470- 46206-5, 672 pages, Wiley Publications. New Jersey.

.24.Tiwari, S.N., 1987. Analytical Toxicology. Govt. of India, Publications, New Delhi

25. Curry, A.S., 1976. Poison detection in human organs

26. Curry, 1986. Analytical Methods in Human Toxicology

27. Modi, J.K., 1988. Medical Jurisprudence and Toxicology. Tripathi N.M. Press Ltd., Allahabad.

28. Curtis D. Klaassen, (2001): Casarett and Doull's Toxicology: the basic science of poisons, 6th edition, Mc-Graw-Hill Medical Publishing Division, New York.

TOXICOLOGY AND CANCER BIOLOGY- LABORATORY

1. Determination of LC50

2. Determination of LD50

3. Detection of Organo-phosphates by Chromatographic Methods.

4. Estimation of Catalse activity.

5. Effect of heavy metals on enzyme activity.

6. Transpalntal teratogenesis.

7. Detection of mercury chloride by enzyme inhibition technique. 8 Detection of adulterants in food samples.

9. Analysis of presence of toxicants like pesticides etc. from samples Visit to Forensic Science laboratory and preparation of report.

11. Study of life history of insects of Forensic importance.

12. Experiments to study the genotoxicity of chemicals in mouse.

13. Transplantation and induction of mouse ascites tumor and studies on the characteristic of tumour cells.

14. Induction of solid tumor in mice and study the chromosomal abbreations in cancer.

15. Histological observation of different types of cancers (Permanent slides).

203 ANIMAL CELL BIOTECHNLOLGY

UNIT- I

Introduction, Historical perspective, advantages and limitations of animal tissue culture. Major differences in vitro .Types of tissue culture.

Biology of cultured cells- Culture environment, cell adhesion, cell proliferation, differentiation, Initiation of culture, cell senescence, continuous cell lines.

Design and layout of laboratory,-Construction, sterile handling area, incubation, room,

service bench, Preparation, wash up, maintenance of sterile condition.

Equipment- Essential, beneficial and useful equipments, consumable items.

Culture medium- Physico-chemical properties, complete media, serum, serum free media, balanced salt solutions, selection of medium and serum. Preparation and sterilization- Apparatus, Reagents and media, storage Contamination- Source and types of contamination

UNIT- II

Primary culture- types of primary culture, Isolation of tissues – mouse and chick embryos, human biopsy material, Explant culture, primary cell culture, disaggregation- enzymatic, mechanical. Suspension culture. Cell lines: Definition, Evolution of cell lines, continuous cell lines, cell line designation, maintenance, subculture, maintenance records. Cell line banking, cryopreservation, cell viability assays. Lymphocyte culture technique and its applications

UNIT- III

Culture and maintenance of human and mouse embryonic stem cells.

Stem cells in gene therapies, stem cell based therapies for autoimmune diseases

Hybridoma technology – Cell hybrids, Production and Application of Monoclonal antibodies Use of animal cells as replacement for whole animal in toxicity testing.

Commercial application of animal tissue culture – Uses of animal cells in vaccine production

UNIT- IV

Genetic engineering- General introduction and concept, Transduction and transfection, C-DNA, Recombinant DNA techniques, Restriction enzymes, Salient features of cloning vectors, Different types of cloning vectors, Plasmids, Cosmids, Phagemids, Shuttle vectors, Viral vector. Outline of gene cloning, gene cloning procedures, C-DNA cloning, Gene libraries, Chromosome Walking and jumping, Recombinant selection and screening- genetic methods, immunochemical methods, South-western screening, nucleic acid hybridization, product recovery.

UNIT-V

Methods to introduce genes into animal cells, electroporation, viral vectors, retroviruses, lipofection, calcium phosphate co precipitation.

Transferring genes into animal oocytes, Eggs and embryos – Transgenic animals. Use of transgenic technology in research, knock-out mice.

Production of human disease equivalents in the mouse, Novel therapies for human diseases. Transgenic technology in the improvement of farm animals, transgenesis in animal cloning.

Genetically modified (GM) plants and foods.

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20. Glick B.R. and Pasternak J.J. (1998) Molecular Biotechnology, Principles and Applications of Recombinant DNA, II edition, Library of Congress– cataloging in publication data, USA

ANIMAL CELL BIOTECHNOLOGY- LABORATORY

1. Introduction to general requirements of animal tissue culture laboratory.
2. Cleaning, washing, Preparation and sterilization methods for tissue culture work.
3. Preparation of media, serum, BSS, PBS, trypsin etc.,
4. Trypan blue dye exclusion test for cell viability
5 Lymphocyte culture technique, Preparation of human metaphase Chromosomes.
6. Growth and maintenance of tumor cell lines.
7. Cell proliferation test using MTT assay
8. Separation of peripheral blood mononuclear cells (PBMCs) - Histopaque method.
9. Mouse macrophage and lymphocyte culture
10. Primary explant culture of mouse pup/adult/ chick embryo organs
11. Mouse bone marrow/hemopoetic cell cultures
12. Contamination of cultures
13. Study of restriction sites in □ DNA – Demonstration
14. Western blot technique -Demonstration.

204 ADAPTATION BIOLOGY

UNIT- I

Introduction- Definition, Types of adaptation; Physical and behavioral. Environmental variables. Environmental conditions of aquatic, terrstial and xeric habitats.Light condition-eclosion in insects. Biological rhythms including circadian rhythms:-Milestones in clock research; Chronobiology in 21st century; Evolution of biological timing system; Clocks, genes and evolution; Adaptive functional significance of biological clocks, Phase shift, Phase response curves (PRC) and phase transition curves (PTC);

Unit- II

Photoreception and photo-transduction; The physiological clock and measurement of day length; Role of photic and non-photic cues in seasonality; Reversal of roles of principal and supplementary cues; The relevance of biological clocks for human welfare - Clock function (dysfunction); Inter tidal animals and their adaptations. Concepts of homeostasis, acclimation and acclimatization. Basic mechanisms of Biochemical adaptation. Adaptation during physical exercise.

Unit- III

Diversity and complexity of the clock system- Melatonin, Depleted Oxygen availability and its effects. Anhydrobiosis and hibernation. Adaptation to deep sea living and diving. Physiology of insect –diapauses. Circadian pacemaker system in vertebrates with particular reference to rodents; Suprachiasmatic nucleus (SCN) as the main vertebrate clock; concept of core and shell.

Unit- IV

Temperature relations, Adaptations to temperature variations, molecular mechanisms of adaptations. Endothermy and ectothermy. Exstemophiles varieties and their adaptations. Mechanisms of body temperature regulation, fever. Heat shock proteins. Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.

Unit-V:

Alterations and adaptations in maternal physiology during pregnancy. Material and fetal prolactin. Placenta: Endocrine functions, transport mechanisms, Foetal physiology, growth and mechanisms. Foetal physiology, growth and metabolism, Neonatal physiology. Lactation and Lactogenesis

REFERENCES

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2. Anon, Environmental physiology of Deseart organisms

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4. Dejours P. (1985) Principles of Comparative Respiratory Physiology, Academic Press NY

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University Press.

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9. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA

10. Insect Clocks D.S. Saunders, C.G.H. Steel, X., afopoulou (ed.) R.D. Lewis. (3rd Ed) 2002 Barens and Noble Inc. New York, USA

11. Biological Rhythms: Vinod Kumar (ed 2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany

ADAPTATION BIOLOGY- LABORATORY

1. Assay of circadian rhythms using animal model systems.
2. Assay of circadian activity rhythms in human.
3. Effect of physical exercise on hematological parameters and cardiac activity.
4. Experiments demonstrating the photoperiodic clock
5. Regulation of eclosion rhythm in *Drosophila*.
6. Excretion of chloride as a function of salinity in fish.
7. Seasonal and daily variations in salinity, temperature and tides.
8. Haemolymph ions during aestivation in mollusks (*Pila*)
9. Effect of temperature on physiological functions.
10. Study of parasitic adaptations.
11. LDH isozymes in fetal tissues.
12. Food consumption and assimilation by pregnant and normal mice.

205 MOLECULAR CELL BIOLOGY

UNIT- I

Introduction: Historical highlights, cell theory, organization of prokaryotic and eukaryotic cells. DNA as a data storage medium, c-value paradox, evidences for DNA as genetic material transformation experiment. Structure of DNA and RNA, Replication of DNA in prokaryotes and eukaryotes. Transcription in prokaryotes and eukaryotes, RNA processing, spliceosomes.

UNIT- II

Molecular composition and models of membrane architecture – Davson – Danielli model, Fluid mosaic model, cell-cell adhesion, Cell Junctions. Transport across cell membrane – Diffusion and Active transport. Cell-cell signalling – cell surface receptors, second messenger system signalling from plasma membrane to nucleus, signal transduction.

UNIT- III

Structural organization of nucleus and nucleolus. Morphology and functional elements of eukaryotic chromosomes-Centromere, nucleolar organizers, Telomere, heterochromatin and euchromatin. Molecular organization of chromatin, Nucleosome model. Structure and functions of endoplasmic reticulum and Golgi complex.

UNIT- IV

Cell-cycle and cell division: Phases of cell-cycle, cyclins and cyclin dependent kinases, Regulation of Cdk-cyclin activity. Molecular aspects of cell division, Meiotic division and genetic recombination, Mitotic poisons. Biology of ageing, Apoptosis – definition, mechanism and significance.

UNIT- V

Microscopy – Bright and dark field microscopy, phase contrast, confocal, two photon, scanning & electron microscopy. Staining techniques for the localization of proteins and carbohydrates. Southern, Northern and Western blot techniques, DNA finger printing, Fluorescent in situ Hybridization (FISH). Polymerase chain reaction and DNA sequencing.

REFERENCES

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19. Watson J. D, Gilman M, Witkowski J and Zooler M (1992) Recombinant DNA, II edition, Scientific American Books, Freeman & Company, New York.

MOLECULAR CELL BIOLOGY- LABORATORY

1. Microscopy
2. Study of mitosis in *Allium cepa*
3. Meiosis in grasshoppers
4. Preparation of mitotic chromosomes from bone marrow cells of rodents.
5. Sperm abnormality assay in mice
6. Staining of blood cells to study the types of blood cells and differential counting of blood cells.
7. Micrometry – Calibration of microscope and measurement of cell dimensions.
8. Isolation of RNA from yeast
9. Isolation of DNA from liver/spleen, Thymus of rodents
10. Reading of DNA sequence from autoradiogram.
11. Hematoxylin- Eosin staining of histology sections.

206 DEVELOPMENTAL BIOLOGY

UNIT- I

Gametogenesis and early development-Physiological, chemical and molecular events during a) Oogenesis & b) Spermatogenesis c) Fertilization d) Cleavage e) Competence and induction f) Primary, secondary and abnormal inductions g) Mesoderm induction in amphibians h) Totipotency and nuclear transplantation experiments.

Unit- II

Embryonic and body plan- Embryonic polarity – Drosophila and Ampihibia, b) Gastrulation in Amphibia and Mammal c) Epithelial morphogenesis, cytoskeleton components, microtubules, microfilaments and intermediate filaments. Teratology and its significance in histogenesis. d) Erythropoiesis, pancreogenesis and myogenesis

Unit- III

Regeneration-Physiological changes during regeneration in planarians and amphibians, Life cycles and Evolution of Developmental pattern a) The frog lifecycle, b) The life cycle of Zebra

fish c) Developmental pattern of Metazoan, d) Multicellularity – Evolution of differenciation.

Unit- IV

Early development-Early development of vertebrates- a) Fish b) Birds c) Mammals. Early development of Invertebrates- a) Seaurchin b) Snails c) Tunicates d) Nematodes

Unit-V

Developmental defects: Birth Defects and Endocrine Disruptors. Ecological Developmental Biology: Biotic, Abiotic, and Symbiotic regulation of Development. Gene expression and human disease– inborn errors of nuclear RNA processing, inborn errors of translation; teratogenesis- environmental assaults on human development- teratogenic agents like alcohol, retinoic acid etc. Pluripotent stem cells and its application in embryology studies.

REFERENCES

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2. Scott F. Gilbert (2014): Developmental Biology 10th Edition, Sinauer Associates-Publishers, USA.

3. Jonathan.M.W.Slack (2012): Essential Developmental Biology 3rd Edition, Wiley-Blackwell Publication.USA.

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eBookIt.com. 12Balinsky.B.L. 1971 Introduction to Embryology
(Saunders College pub.)
13 Beril N.J. and Karpotata.G. 1972 Development (Mc Graw Hill Publications)
14. Browder L.W. Erickson Co-ordinator A and Jeffery N.R. Developmental Biology
(Saunders College publications)
15. Carlson.B.M. 1998 Pattern's foundations of Embryology (Mc Graw Hill publications: New York)

DEVELOPMENTAL BIOLOGY- LABORATORY

1. Observation of slides of the early development of fish, frog, chick
2. Preparation of whole mount of chick blastoderm.
3. Morphogenetic movements of cells in-vitro during development of chick
4. Observations of sections of testis and ovary of fish, frog and rat.
5. Organogeny in chick and pig – observation of sections
6. Demonstration of live observation of drosophila embryogen
7. Study of life cycle of *Drosophila melanogaster*
8. Study of regeneration in *Hydra*
9. Influence of temperature and teratogenes on animal development
10. Study of embryogenesis in *Drosophila* and pattern of gene expression in embryogenesis by *in situ* hybridization technique.

207 PARASITES AND DISEASES

UNIT- I

General Introduction, different types of animal association- parasitism and types of parasites, primary and secondary hosts, transmission of parasitic infection. Parasitic zoonosis, epidemiology of parasitic zoonosis, transmission. Host- parasitic interactions – parasitic effects benefiting the parasites, parasitic effects benefiting the host.

UNIT- II

Prasitic protozoans- Life cycle and Biology of (pathology and control measures also) Mastigophora – *Trypanosoma, Leishmania, Giardia, Trichomonas*

Sarcodina- *Entamoeba, Lodamoeba*

Chilophora- *Balantidium*

Sporozoa- *Toxoplasma, Plasmodium,*

UNIT-III

Helminth parasites -

Life cycle and Biology (pathology and control measures also).

Nematoda- *Ancylostoma, Ascaris, Enterobius, Wuchereria, Onchocerca, Loa, Trichiuris.*

Trematoda- *Polystoma, Schistosoma, Echinostoma, Fascioloa*

Cestoda- *Taenia, Echinococcus, Dipylidium.*

UNIT-IV

Morphology, life history and medical importance of disease transmitting vectors- Diptera- Culicoides, *Aedes, Culex, Anopheles,* House fly.
Siphonoptera: *Xenophylla, Ctenocephalides, Echidnophaga, Tunga*

Phthirptera – *Pediculus, Pthirus*

Hemiptera _ *Cimex, Triatoma*

Malaria, Chikungunya, Dengue fever (Transmission cycle).

UNIT-V

Morphology, life history and importance of
Acarines- Ticks: *Argas, Rhipicephalus, Boopilus,*
Haemaphysalis

Mites: *Sarcoptes, Leptotrombidium, Psoroptes, Demdex, Dermanyssus*

Myasis- Venomous, Utricating and allergic arthropods- control measures. Vecto status of Cockroach.

REFERENCES

1. Asa C. Chandler, (7th ed.), Introduction to Parasitology, With Special Reference to the Parasites of Man, New York: Wiley, 1944. 716 pp.
2. Despommier, Gwadz, Hotez, Knirsch: Parasitic Diseases (5th Ed). Apple Trees Productions, LLC. 2005. 375 pp.
3. William M. Samuel Margo J. Pybus A. Alan Kocan (2nd Ed). Parasitic Diseases of Wild Mammals, Iowa State University Press, Ames, Iowa, USA, 2008.
4. Stephen A. Berger, John Marr, Human Parasitic Diseases Sourcebook, Jones & Bartlett Learning, 2006. 537pp.
5. D Molyneux, Advances in Parasitology- Control of Human Parasitic Diseases, (1st Ed). Academic Press. 690 pp.
6. Jeremy Farrar & Peter Hotez & Thomas Junghanss & Gagandeep Kang & David Lalloo & Nicholas J. White. Manson's Tropical Diseases, (23rd Ed). Elsevier publication. 2013. 1360 pp.

PARASITES AND DISEASES- LABORATORY

1. Parasitism and types of parasites, primary and secondary hosts, transmission of parasitic infection. Host- parasitic interactions – parasitic effects benefiting the parasites, parasitic effects benefiting the host.
2. Protozoal diseases

Life cycle, pathology, clinical manifestations and control measures for- *Trypanosoma, Leishmania, Giardia, Entamoeba, Plasmodium*

Demonstration of life cycle stages through charts, CD's, power point presentation and permanent slides.

3. Blood smear preparation for identification of malarial parasite

4. Fluorescent dye detection of malarial parasite

5. Helminth parasites

Life cycle, pathology, clinical manifestation of diseases and control measures for *Ancylostoma, Ascaris, Wuchereria, Trichiuris. Polystoma, Schistosoma, Echinostoma,*

Fascioloa Cestoda- *Taenia, Echinococcus.* Demonstration of life cycle stages through charts, CD's, power point presentation and permanent slides. Important plant nematodes.

6. Parasites- Intestinal, Lymphatic system, Hepatic, Blood, Ectoparasites - Lab specimens

7. Habitat specificity – Intestinal parasites of cockroach.

8. Morphology, life history and medical importance of disease transmitting vectors-

Culicoides, *Aedes, Culex, Anopheles,* House fly. Malaria, Chikungunya, Dengue fever (Transmission cycle). Demonstration of life cycle stages through charts, CD's, power point presentation and permanent slides.

9. Identification of mosquitoes

10. Classification of blood meal from mosquito gut content

11. Field collection of vectors – types and dominance

12. Rat fever (*Leptospirosis*) Histopathology