

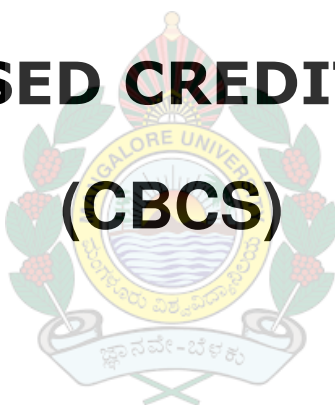
# **MANGALORE UNIVERSITY**



## **M.Sc. APPLIED ZOOLOGY**

### **CHOICE BASED CREDIT SEMESTER**

### **(CBCS)**



**Department of Applied Zoology**  
**Mangalore University**  
**Mangalagangothri – 574 199**

**Proceedings of meeting of Internal members of Board of Studies in Applied Zoology held on 28.5.2010 at 2.30 p.m in the department.**

Members:

- |                               |               |
|-------------------------------|---------------|
| 1. Prof. K.K. Vijayalaxmi     | - Chairperson |
| 2. Prof . Rajashekar K. Patil | - Member      |
| 3. Dr. Vijaymala Nair         | - Member      |
| 4. Dr. K. Bhasker Shenoy      | - Member      |

The meeting of Internal members of Board of Studies in Applied Zoology was conducted as per the University direction (U.O. No. 3/2010-11/J2 27.5.2010) to identify the choice paper in CBCS semester system to be introduced by Mangalore University.

After thorough discussion, it was decided to select the paper **Parasitology and Vector Biology** in the III semester as the choice paper. The content of syllabus of this paper is mostly of general nature and it will be easy to understand by any stream of students.

Students of Applied Zoology shall do a laboratory course in parasitic diseases in the III semester itself where they study about the parasites and vectors through practicals, demonstrations and power point presentations.

- |                               |     |
|-------------------------------|-----|
| 1. Prof. K.K. Vijayalaxmi     | - C |
| 2. Prof . Rajashekar K. Patil | -   |
| 3. Dr. Vijaymala Nair         | -   |
| 4. Dr. K. Bhasker Shenoy      | -   |

**Chairperson**

**P.G. BOS in Applied Zoology**

**SYLLABUS OF M.SC. APPLIED ZOOLOGY**  
**CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER**  
**PREAMBLE**

Mangalore University introduced the semester scheme for post graduate degree programmes during 2003-04. The University has now decided to introduce Choice Based Credit System (CBCS) semester for all the post graduate courses. Accordingly, the University has framed general guidelines for this purpose for different faculties. In view of this, The P.G. Board of Studies in Applied Zoology has prepared the syllabus and scheme of examination for CBCS.

The choice based paper to be offered by the department for the students of other courses is,

**III semester – AZ 501- Parasitology and Vector Biology**

The internal (Applied Zoology) students who opt for credits from other departments shall choose the course in lieu of this choice paper only.

The details of Scheme of Teaching and Examination are given separately.

The regulation and scheme of examination are prepared as per the guidelines issued by the University

**Chairperson**  
**P.G. BOS in Applied Zoology**

**M.Sc. Applied Zoology**  
**(CBCS Semester)**  
**Scheme of Teaching and Examination**  
**(As per University Guidelines)**

**I SEMESTER:**

| <b>Paper code &amp; Title</b>         | <b>Teaching Hrs/week</b> | <b>Exam Hrs.</b> | <b>Marks Exams.</b> | <b>Marks IA</b> | <b>Total Marks</b> | <b>Credits</b> |
|---------------------------------------|--------------------------|------------------|---------------------|-----------------|--------------------|----------------|
| AZ 401 : Animal Systematics           | 04                       | 03               | 70                  | 30              | 100                | 4              |
| AZ 402 : Biological Chemistry         | 04                       | 03               | 70                  | 30              | 100                | 4              |
| AZ 403: Comparative Physiology        | 04                       | 03               | 70                  | 30              | 100                | 4              |
| AZ 404: Molecular Cell Biology        | 04                       | 03               | 70                  | 30              | 100                | 4              |
| AZ 405: LAB - Animal Systematics      | 04                       | 03               | 35                  | 15              | 50                 | 2              |
| AZ 406 : LAB - Biological Chemistry   | 04                       | 03               | 35                  | 15              | 50                 | 2              |
| AZ 407: LAB - Comparative Physiology  | 04                       | 03               | 35                  | 15              | 50                 | 2              |
| AZ 408 : LAB - Molecular Cell Biology | 04                       | 03               | 35                  | 15              | 50                 | 2              |
| Total                                 |                          |                  |                     |                 | 600                | 24             |
| Seminar/Mini project                  | 01                       | -                | -                   | 25              | 25                 | 1              |
|                                       |                          |                  |                     |                 |                    | 25             |

**II SEMESTER:**

|                                             |    |    |    |    |     |    |
|---------------------------------------------|----|----|----|----|-----|----|
| AZ 451: Comparative Anatomy                 | 04 | 03 | 70 | 30 | 100 | 4  |
| AZ 452: Proteins and Nucleic Acids          | 04 | 03 | 70 | 30 | 100 | 4  |
| AZ 453: Adaptation Biology                  | 04 | 03 | 70 | 30 | 100 | 4  |
| AZ 454 : Toxicology and Cancer Biology      | 04 | 03 | 70 | 30 | 100 | 4  |
| AZ 455: LAB - Comparative Anatomy           | 04 | 03 | 35 | 15 | 50  | 2  |
| AZ 456: LAB - Proteins and Nucleic Acids    | 04 | 03 | 35 | 15 | 50  | 2  |
| AZ 457: LAB - Adaptation Biology            | 04 | 03 | 35 | 15 | 50  | 2  |
| AZ 458: LAB - Toxicology and Cancer Biology | 04 | 03 | 35 | 15 | 50  | 2  |
| Total                                       |    |    |    |    | 600 | 24 |
| Seminar/Mini project                        | 01 | -  | -  | 25 | 25  | 1  |
|                                             |    |    |    |    |     | 25 |

**IA = Internal Assessment**

### III SEMESTER:

| Paper code & Title                                            | Teaching Hrs/week | Exam. Hrs. | Marks Exams | Marks IA  | Total Marks | Credits  |
|---------------------------------------------------------------|-------------------|------------|-------------|-----------|-------------|----------|
| <b>AZ 501: Parasitology and Vector Biology (Choice paper)</b> | <b>04</b>         | <b>03</b>  | <b>70</b>   | <b>30</b> | <b>100</b>  | <b>4</b> |
| AZ 502 : Genetics and Quantitative Biology                    | 04                | 03         | 70          | 30        | 100         | 4        |
| AZ 503: Biology of Immune System                              | 04                | 03         | 70          | 30        | 100         | 4        |
| AZ 504: Fishery Biology and Animal Breeding                   | 04                | 03         | 70          | 30        | 100         | 4        |
| AZ 505 : LAB - Parasitic diseases                             | 04                | 03         | 35          | 15        | 50          | 2        |
| AZ 506: LAB - Genetics and Quantitative Biology               | 04                | 03         | 35          | 15        | 50          | 2        |
| AZ 507: LAB - Biology of Immune System                        | 04                | 03         | 35          | 15        | 50          | 2        |
| AZ 508: LAB - Fishery Biology and Animal Breeding             | 04                | 03         | 35          | 15        | 50          | 2        |
| Total                                                         |                   |            |             |           | 600         | 24       |
| Seminar/Mini project                                          | 01                | -          | -           | 25        |             | 1        |
|                                                               |                   |            |             |           |             | 25       |

### IV SEMESTER:

|                                             |    |    |    |    |     |    |
|---------------------------------------------|----|----|----|----|-----|----|
| AZ 551: Animal Cell Biotechnology           | 04 | 03 | 70 | 30 | 100 | 4  |
| AZ 552: Nutrition and Metabolism            | 04 | 03 | 70 | 30 | 100 | 4  |
| AZ 553: Neurobiology and Behaviour          | 04 | 03 | 70 | 30 | 100 | 4  |
| AZ 554: Biodiversity and Conservation       | 04 | 03 | 70 | 30 | 100 | 4  |
| AZ 555: LAB- Animal Cell Biotechnology      | 04 | 03 | 35 | 15 | 50  | 2  |
| AZ 556: LAB- Nutrition and Metabolism       | 04 | 03 | 35 | 15 | 50  | 2  |
| AZ 557: LAB- Neurobiology and Behaviour     | 04 | 03 | 35 | 15 | 50  | 2  |
| AZ 558: LAB - Biodiversity and Conservation | 04 | 03 | 35 | 15 | 50  | 2  |
| Total                                       |    |    |    |    | 600 | 24 |
| Seminar/Miniproject                         | 01 | -  | -  | 25 |     | 1  |
|                                             |    |    |    |    |     | 25 |

**IA = Internal Assessment**

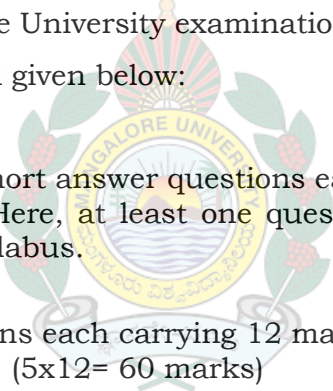
**M.SC. APPLIED ZOOLOGY**  
**CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER**

**SCHEME OF EXAMINATION AND EVALUATION:**

**1) Theory:**

Each theory course shall carry a maximum of 100 marks out of which 30 marks shall be for internal assessment. The remaining 70 marks shall be for University examination. University examination shall be conducted as per the rules and regulations prescribed by the University.

Question paper for the University examination is of three hours duration shall be set as per the model given below:

- 
- i) Five compulsory short answer questions each carrying 2 marks (5x2= 10 marks). Here, at least one question should be chosen from each unit of the syllabus.
  - ii) Five other questions each carrying 12 marks, selecting one question from each unit (5x12= 60 marks)

Here, the choice shall be given within the unit only.

**2) Internal assessment (Theory):** It shall be based on 3 compulsory tests. Two of which are objective tests (10X2 =20 marks) and 1 descriptive test (70 marks). Total marks obtained shall be reduced to 30, the actual component of internal assessment. Test papers shall be set and evaluated by concerned teachers.

**3) Laboratory /field work ( Practicals):**

Each practical/ field work shall carry a maximum of 50 marks. Out of this 35 marks shall be allotted for University examinations and 15 marks for internal assessment.

At the end of each semester there shall be a University examination in each laboratory course jointly evaluated by one external and one internal examiner.

The question paper for practical shall contain 3 questions of 12, 10 and 8 marks respectively. 5 marks allotted for viva –voce in each practical.

**4) Internal assessment (Practicals):**

- i) Practical test - 10 marks
- ii) Practical Records - 05 marks

Practical test shall be conducted at the end of semester for each paper by the concerned teachers

**5) Compulsory seminar:**

There shall be one compulsory seminar in each semester

Marks allotted: 25

- i) Marks for write up - 10 marks
- ii) Presentation - 15 marks



Chairperson,  
P.G. BOS in Applied Zoology

**I - SEMESTER  
THEORY  
AZ 401- ANIMAL SYSTEMATICS**

**Teaching hrs - 12 hrs/Unit**

**UNIT – I**

Importance of Systematics and Taxonomy  
Goals, task & problems of a taxonomist – challenges in taxonomy  
Taxonomic characters –modern approaches  
Taxonomic ranks

**UNIT- II**

ICZN – origin of the code; major rules governing nomenclature  
Biocode –the integrated biological nomenclature  
Phylocode  
Methods for collection, preservation and cataloguing of insects  
Types of identification keys

**UNIT -III**

Biological classification – From Linnaeus to New systematic  
Higher order taxonomy - Aristotle to Whittaker's five kingdoms and  
Woese's six kingdom and three domains  
Major schools of taxonomy (Phylogenetics, Evolutionary and Phenetics) –  
Limitations  
Phylogenetic trees –types, construction and limitations

**UNIT-IV**

Major concepts of species – (Ernest Mayr, phylogenetic, biological,  
ecological, evolutionary and morphological)-  
Taxonomic diversity within species- subspecies, races & varieties  
Speciation- Natural (Allopatric, peripatric, parapatric &  
sympatric speciation) and artificial speciation (Isolating mechanisms);  
Pattern of speciation (Anagenesis and cladogenesis; gradual and  
punctuated); Causes of speciation- chromosomal, hybrid & symbiotic

**UNIT-V**

Methods for inferring phylogenies - Maximum parsimony, Maximum  
likelihood, Neighbor-joining, UPGMA and Bayesian inference –  
limitations. Biometric techniques in taxonomy  
Molecular phylogenetics –DNA barcoding  
Phylogenetics software used to produce phylogenetic trees  
Interpretation of phylogenetic trees.

## REFERENCES:

1. Kapoor V. C. (2008) Theory And Practice Of Animal Taxonomy Oxford & IBH Pub.Co Pvt Ltd , New Delhi
2. Simpson G. G (1961) Principles of Animal Taxonomy, Columbia University Press
3. Pollard J. W. (1985) Evolutionary Theory Paths into the future, John Wiley & Sons
4. Freeman S. and Herron J. C ( 1998) Evolutionary Analysis, Prentice Hall, New Jersey
5. Michael White J. D. ( 1978) Modes of Speciation , W.H Freeman
6. Cleveland P.H. Roberts L. S (Jr) and Allan L. (1995) Integrated Principles o Zoology, 9<sup>th</sup> Edition WBC Brown publishers
7. Armugam N. ( 1986) Essentials of Evolution, Saras Publication
8. Ernst Mayr (1982) Systematics and the Origin of Mayr and Ashlock (1991) Principles of Systematic Zoology-
9. G.G. Simpson (1962) Principles of Animal Taxonomy
10. Forey et al (1992) Cladistics, A Practical Course in Systematics
11. Kitching et al. (1998) Cladistics, The Theory and Practice of Parsimony Analysis
12. Panchen (1992) Classification, Evolution, and the Nature of Biology
13. Li and Graur (1991) Fundamentals of Molecular Evolution
14. Miyamoto and Cracraft (1991) Phylogenetic Analysis of DNA Sequences
15. Judith Winston (1999) Describing species-practical taxonomic procedures for biologists., Columbia University press
16. Minelli A (1993) Biological systematics, The state of the art. First edition, Chapman & Hall

**AZ 402: BIOLOGICAL CHEMISTRY**  
**Teaching hrs - 12 hrs/Unit**

**UNIT - I**

History and scope of Biochemistry  
Chemical bonds (Covalent, Coordinate, ionic and hydrogen bonds)  
Van der Waals force, Hydrophobic interactions.  
Functional groups in biochemistry (-OH,-CHO,-COOH,-NH<sub>2</sub>, Guanidino and phenyl groups).  
Isomerism with examples.  
Biological significance of pH -Determination of pH - Handerson-Hasselbalch equation, Buffer solutions – Blood buffer.

**UNIT - II**

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 - III**

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

**UNIT- IV**

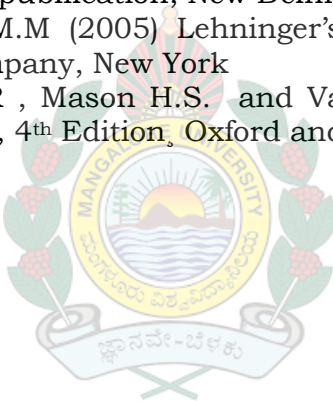
Determination of normality and molarity of solutions.  
Chromatography – thin-layer, ion-exchange, affinity, gel-filtration and gas chromatography – Methods and applications.  
Electrophoresis – polyacrylamide, agarose, SDS- PAGE, isoelectric focussing and immunoelectrophoresis – Principle, Methods and applications.

**UNIT -V**

Colorimetry and Spectrophotometry – UV and Visible (Biophysical Methods) – Principle, Methods and Applications  
Radioactive isotopes and their uses,  
Centrifugation and Ultra centrifugation- Principle, Methods and Applications  
Fluorimetry, NMR, Flame photometry and AAS.

## REFERENCES:

1. Conn. E.E. Stumpf P.F. Bruening G. and Dooi R. H (1995) Outlines of Biochemistry, John Wiley and Sons, Singapore.
2. Garrett R.H. and Grisham C.M. (1995) Biochemistry, Saunders College Publishing, Florida.
3. Murray R.K., Granner D.K., Mayes P.A. and Rodwell (1988) Harper's Biochemistry XXI edn. Prentice Hall International Inc. Connecticut.
4. Sadasivam S. and Manickam (1996) Biochemical Methods, New Age International Publishers, New Delhi.
5. Varely H.(1980) Practical Clinical Biochemistry VI CBS Publishers
6. Devlin T.M. (1993) Text Book of Biochemistry with clinical Correlations, Wiley-Liss, Inc., New York.
7. Wilson K. and Kenneth H. Goulding, (1987) A Biologist's Guide to principles and Techniques of Practical Biochemistry , 3<sup>rd</sup> Edition, English Language Book Society.
8. Vasudevan P. M and Kumari S.S (2001) Text book of Biochemistry (3<sup>rd</sup> edn.) Jaypee Brother publication, New Delhi
9. Nelson D.L & Cox M.M (2005) Lehninger's Principle of Biochemistry, W.H. Freeman & Company, New York
10. West E.S , Todd W.R , Mason H.S. and Van Bruggen J.T. (1974) Text Book of Biochemistry, 4<sup>th</sup> Edition, Oxford and IBH Publishing Co. Pvt. Ltd.



## **AZ 403: COMPARATIVE PHYSIOLOGY**

**Teaching hrs - 12 hrs/Unit**

### **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<sub>2</sub> and CO<sub>2</sub>  
Role of Blood as a buffer  
Haemodynamics

### **UNIT-III**

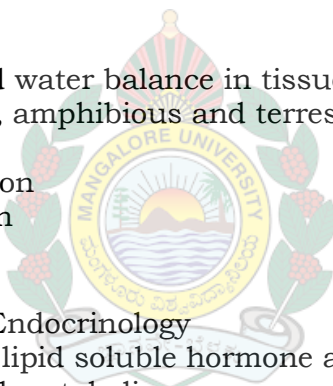
Osmoregulation- Ionic and water balance in tissues  
Osmoregulation in aquatic, amphibious and terrestrial animals  
Patterns of N<sub>2</sub> excretion  
Urine formation in a nephron  
Regulation of renal function

### **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. Verne 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<sup>th</sup> Edn. Blackwell Scientific Publications, Oxford.
5. Dacie I.V. and Lewis S.M. (1984) Practical Haematology, 6<sup>th</sup> 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.
9. Louco G.N. (1993) Physiological Animal Ecology, Longman Scientific and Technical, Essex.
10. Oser B.L. (1976) Hawkins Physiological Chemistry 14<sup>th</sup> 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<sup>th</sup> edn. Cambridge University Press, New York.
13. Shepherd G.M. Neurobiology- Oxford University Press.
14. Wilson I.A. (1979) Principles of Animal Physiology 2<sup>nd</sup> edn. Macmillan Pub. Co. Inc. New York.

## **AZ 404: MOLECULAR CELL BIOLOGY**

**Teaching hrs - 12 hrs/Unit**

### **UNIT- I**

Introduction: Historical highlights, cell theory, organization of prokaryotic and eukaryotic cells.

Viruses – Structure and classification of animal viruses, Reverse transcription (Teminism). Bacterial viruses – structure, lysogenic and lytic life cycle, transformation experiment.

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, RNA interference(RNAi), Si RNA

### **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, Active transport, ion pumps, uniports, symports and antiports, membrane potential.

Cell-cell signalling – cell surface receptors, second messenger system signalling from plasma membrane to nucleus, signal transduction.

Structure, origin and evolutionary significance of Mitochondria, Mitochondrial genetic system.

### **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

Cytoskeleton – microfilaments, microtubules and intermediate filaments – structure and functions, cilia and flagella.

Endomembrane systems – Structure and functions of endoplasmic reticulum. Golgi complex and lysosomes – Structure and biogenesis of ribosomes.

### **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.

Cell differentiation – Definition, General characteristics of cell differentiation, Cytoplasmic control (Morphogenetic determinants), Intrinsic interactions (nucleocytoplasmic), Inductive interactions with neighboring cells – extrinsic (environmental) effects on differentiation .

Biology of ageing, Apoptosis – definition, mechanism and significance.

## UNIT - V

Microscopy – Bright and dark field microscopy, phase contrast, fluorescence, scanning & transmission electron microscopy – Principle, methods and applications

Cytological and histochemical techniques- Fixatives and stains. Hematoxylin-Eosin staining, staining techniques for the localization of proteins and carbohydrates in tissue sections.

Southern, Northern and Western blot techniques, DNA finger printing, Fluorescent in situ Hybridization( FISH), Chromosome painting.- Principle, methods and applications

Polymerase chain reaction, DNA sequencing, Autoradiography - Principle, methods and applications

## REFERENCES:

1. Swanson C. P (1989) Cell: V edition, Prentice-Hall Publishers, New Delhi.
2. Cooper M. G(1997) The Cell: The Molecular approach, ASM Press, Washington.
3. De Robertis E. D. P, De Robertis E. M.F (1995) Cell and Molecular Biology, VIII edition, Indian edition.
4. Sheeler P. and Bianchi D.E. (1987) Cell and Molecular Biology, III edition, John Wiley New York.
5. Karp G (1996) Cell and Molecular Biology: Concepts and experiments, John Wiley, New York.
6. Ashwerth J. M. (1975) Cell differentiation, Chapman and Hall Publishers, London.
7. Swanson C. P. and Webster P. L. (1989) The Cell, V Edition, Prentice Hall of India, New Delhi.
8. Bray B. A. D, Lewis J, Raff M, Roberts K and Watson J.D (1995) Molecular biology of the cell, II edition, Garland Publishing Company Ltd. New York and London.
9. Avers C. J. (1986) Molecular Cell biology, Addison Wasley Publishing Co., England.
10. Brachet J. (1985) Molecular Cytology, Vol.I and Vol.II The Cell Cycles, Academic press Inc.,
11. Celis J. E. (1994): Cell Biology – a laboratory hand book, Vol.I, II and III, Academic press.
12. J. H. Darnell J. H, Lodish and Baltimore D. (1995) Molecular Cell Biology, Scientific American Books, New York.
13. Friefelder D. (1987) Molecular Biology, II Edition, Jones and Barlett Publishers Inc., Boston.
14. Kleinsmith L. J. and Kish V. M (1995) Principles of Cell and Molecular Biology, II edition, Harper Collins College publishers.

15. Lewin B (Ed) 1996) Genes, VII edition, John Wiley and Sons, New York.
16. Sadava D. E (1993) Cell Biology – Organelles, Structure and function, Jones and Bartlett publication.
17. Schlieff R (1986) Genetics and Molecular Biology, Addison WasleyPublishing
18. Watson J. D, Hopkins N. H, Roberts J. W, Steitz J. A and Weiner A. M(1987) Molecular Biology of the Gene, Vol.I & II general principles, IV edition, The Benjamin Cummings Publishing Co., Inc.,
19. Watson J. D, Gilman M, Witkowski J and Zooler M (1992) Recombinant DNA, II edition, Scientific American Books, Freeman & Company, New York.

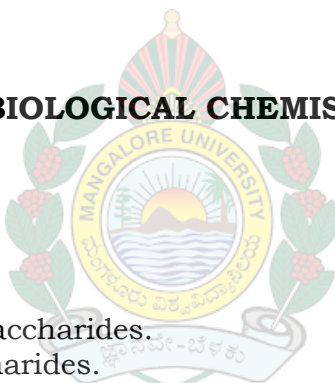


## **I - SEMESTER PRACTICALS**

### **AZ 405 - ANIMAL SYSTEMATICS - LAB** **4 Hours /Week**

1. Construction of dichotomous key
2. Construction of phenogram
3. Construction of cladogram
4. Identification of major groups of Formicidae -using identification key
5. Identification of major Elasmobranchs -using identification key
6. Identification of major adult insects -using identification key
7. Major methods to collect and preserve insects
8. Identification of major groups of aquatic insects
9. Mouth parts of insects- adaptive radiation
10. Assessment of the taxonomic diversity in a given habitat

### **AZ 406 - BIOLOGICAL CHEMISTRY - LAB**



**4 Hours /Week**

1. Color reactions of monosaccharides.
2. Color reactions of disaccharides.
3. Color reactions of polysaccharides.
4. Identification of unknown carbohydrate.
5. Colorimetry.
6. Estimation of blood glucose.
7. Estimation of free fatty acids.
8. Estimation of cholesterol.
9. Flourimetry
10. Flame photometry
11. Paper chromatography for sugars.
12. Column chromatography

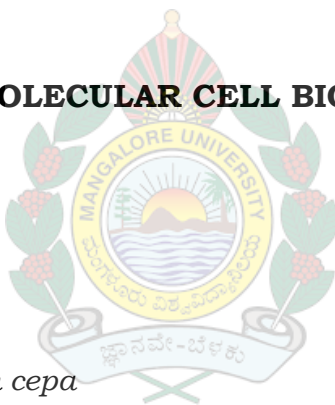
### **AZ 407 – COMPARATIVE PHYSIOLOGY –LAB**

**4 Hours /Week**

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

### **AZ 408 - MOLECULAR CELL BIOLOGY – LAB**

**4 Hours /Week**



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.

**II SEMESTER  
THEORY  
AZ 451: COMPARATIVE ANATOMY**

**Teaching hrs - 12 hrs/Unit**

**UNIT- I**

Historical perspective and General concepts of Comparative Anatomy, Anaplasia, Homoplasia.  
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 structure 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 system and electroreceptors of vertebrates. Photoreceptors and chemoreceptors of insects.

Endocrine organs- Thyroid, pancreas, pituitary and adrenal gland of vertebrates. Neurohormonal organs of insects and crustaceans.

### **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.
3. Hyman L. H. (2004) Anatomy of Comparative Vertebrates. Reprint. Satish Serial Publishing, Delhi,
4. Milton H. (1995) Analysis of vertebrate structure. John Niley & Sons Inc, New York
5. Cleveland H.P, Roberts, Larry S (Jr) and Larson A. (1995) Integrated Principles of Zoology. 9<sup>th</sup> Edition, WBC Brown publishers
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, 5<sup>th</sup> 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, 5<sup>th</sup> edition, Sinauer Associates,Inc

## **Teaching hrs - 12 hrs/Unit**

### **UNIT -I**

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.  
Introduction to proteomics.

### **UNIT - II**

Protein synthesis and its inhibitors  
Metabolism of aromatic amino acids.  
Laboratory synthesis of peptides.  
Protein Targeting and Degradation  
Protein folding - Diseases of protein misfolding

### **UNIT - III**

Structure and composition of Keratin and Collagen.  
Blood clotting proteins.  
Hemoglobin and myoglobin – Structure and function  
Plasma proteins and their importance  
Prostaglandins and their significance.

### **UNIT - IV**

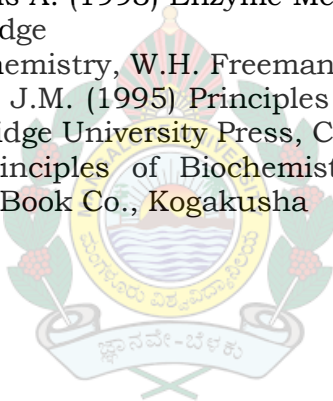
Classification of enzymes.  
Enzyme Kinetics  
Factors affecting enzyme catalyzed reactions.  
Enzyme inhibition.  
Allosteric regulations of enzyme activity  
Co-enzymes, metalloenzymes, isoenzymes and Multienzyme complexes,  
Ribozymes.  
Clinical applications of enzymes.

### **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. Elliott W.H. and Elliot D.C. (2001) Biochemistry and Molecular Biology, Oxford University Press, Oxford.
2. Daniel, L.J. (1987) Laboratory Experiments in Biochemistry, Academic Press, New York.
3. Emil Smith et.al., (1983) Principles of Biochemistry: General Aspects (7<sup>th</sup> Edition) Acukland, McGraw Hill book, Kogakusha
4. Garrett R.H. and Grisham C. M (1995), Biochemistry, Saunders Publishers, New York.
5. Jayaraman J. (1996) Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi
6. Lehninger A.L. (1997) Biochemistry, current edn. W.H. Freeman and Co., San Francisco.
7. Page M.I. and Williams A. (1993) Enzyme Mechanisms, The Royal Society of Chemistry, Cambridge
8. Stryer L. (1994) Biochemistry, W.H. Freeman and Co., San Francisco.
9. Wilson K and Walker J.M. (1995) Principles and Techniques of Practical Biochemistry, Cambridge University Press, Cambridge.
10. Zubay G. (1983) Principles of Biochemistry: General Aspects, VIIth Edition. McGraw Hill Book Co., Kogakusha



**AZ 453: ADAPTATION BIOLOGY**  
**Teaching hrs - 12 hrs/Unit**

**UNIT-I**

Introduction- Definition, Types of adaptation; physical and behavioral  
Environmental variables.  
Environmental conditions of aquatic, terrestrial and xeric habitats.  
Light conditions - eclosion in insects,  
Biological rhythms including circadian rhythms.

**UNIT-II**

Inter-tidal animals and their adaptations.  
Concepts of homeostasis, acclimation and acclimatization.  
Basic mechanisms of Biochemical Adaptations.  
Adaptations during physical exercise.

**UNIT-III**

Depleted Oxygen availability and its effects  
Anhydrobiosis and hibernation  
Adaptations to deep sea living and diving.  
Physiology of insect- diapause

**UNIT-IV**

Temperature relations, Adaptations to temperature variations, molecular  
Mechanisms of adaptations.  
Endothermy and ectothermy  
Mechanisms of body temperature regulation, fever.  
Heat shock proteins

## UNIT-V

Alterations and adaptations in maternal physiology during pregnancy.

Maternal and fetal prolactin.

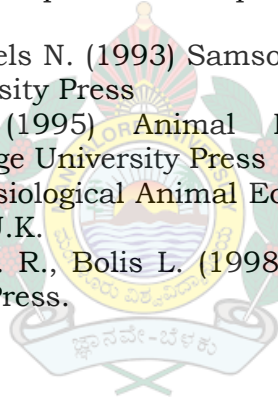
Placenta: Endocrine functions, transport mechanisms,

Foetal physiology, growth and metabolism, Neonatal physiology

Lactation and Lactogenesis.

## REFERENCES:

1. Prosser C L. (1986) Adaptational Biology: Molecules to organisms. John Wiley and Sons
2. Anon., Environmental physiology of Desert organisms
3. Hochachka P. L. and Somero G. N. (1994) Biochemical adaptations, Princeton University Press
4. Dejours P. (1985) Principles of Comparative Respiratory Physiology, Academic Press NY
5. Keele C. A., Neil E., Joels N. (1993) Samson Wright's Applied Physiology, 14<sup>th</sup> Edn Oxford University Press
6. Schmidt-Nielsen K. (1995) Animal Physiology, Adaptation and Environment. Cambridge University Press
7. Louw G. N. (1993) Physiological Animal Ecology, Longman Scientific and Technical Publishers. U.K.
8. Weibel E. R., Taylor C. R., Bolis L. (1998) Principles of Animal Design, Cambridge University Press.



## **AZ 454: TOXICOLOGY AND CANCER BIOLOGY**

**Teaching hrs - 12 hrs/Unit**

### **UNIT -I**

Introduction - Basic Definitions and terminology, What toxicologists 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, balance between bioactivation and detoxification.

Role and mechanisms of xenobiotic metabolizing enzymes.

### **UNIT- II**

Toxicologic testing methods – Acute and chronic toxicity tests, LD<sub>50</sub>, LC<sub>50</sub>, ED<sub>50</sub>, Teratogenicity testing. Reproductive toxicology- Effect of xenobiotics on male and female reproductive organs/cells in mammals.

Organ/ tissue specific toxicity

Toxicity of metals (lead, mercury, arsenic, cadmium)

Pesticide toxicity – Acute and chronic effects of organophosphate, organochlorine and carbamate insecticides, toxicity of pyrethroids.

Biomagnification

Natural toxins – Important microbial, plant and animal toxins.

Treatment of toxicity – Antidotal therapy.

### **UNIT-III**

Mutagenesis and Genetic toxicology – Test systems for genotoxicity testing, Genotoxicity testing in mammals- Bone marrow chromosomal aberration, Micronucleus test, Sperm abnormality assay, comet assay.

Occupational and Environmental exposure to toxic agents, related diseases. Endosulphan tragedy.

Cancer- What is cancer? Definitions and description of cancer, terminology, Hallmarks of malignant diseases, benign and malignant tumors , tumor progression( metastasis). Classification of human cancers, macroscopic and microscopic features of neoplasm.

Growth characteristics of cancer cells, cellular changes, tumor angiogenesis

Grades and stages of neoplasm – Histologic grade of malignancy. Tumor staging.

#### **UNIT-IV**

Causes of cancer – Chemical carcinogenesis; definition, historical perspectives, Types of chemical carcinogens. Steps involved in chemical carcinogenesis, initiation, promotion and progression.

Radiation carcinogenesis- ionizing radiation, UV radiation

Biological carcinogens- bacteria and helminthes. Viral carcinogenesis, Human carcinogenic viruses and their mechanisms

Molecular genetics of cancer –Somatic mutation theory, Inherited cancers

Chromosomal and molecular genetic changes in cancer. Mismatch repair defects.

Oncogenes – Historical aspects, provirus, protovirus and oncogene hypothesis

Functional class of oncogenes( proto oncogenes) Mechanism of carcinogenic transformation by oncogenes, viral oncogenes.

Tumor suppressor genes- properties, Mechanism of tumor suppressor in cancer induction with special reference to P53 gene.

#### **UNIT-V**

Patient – tumor interactions- Pain, nutritional effects, hematological effects, fever and infection, hormonal effects, neurological and dermatologic effects.

Tumor immunology –Introduction, Mechanism of immune response to cancer, natural killer cells, cell mediated cytotoxicity, 'Danger' theory,

Immunotherapy of cancer – Rationale of immunotherapy, Tumor necrosis factor, interleukins, cytokines, interferons, vaccines, monoclonal antibodies.

Chemotherapy and radiotherapy strategies.

Lifestyle related cancers.

Diet and cancer prevention, chemoprevention, anticarcinogens.

#### **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 A. Wallace Hayes (1996) Loomis's Essentials of Toxicology, IV edition, Academic Press Ltd., London.
3. Sharma P. D, (1999) Toxicology, Rastogi Publishers 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.R Jr (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 Kadansha Ltd., Tokyo.
8. Prakash R (Ed) (1989) Recent trends in Toxicology, Agarwal Printers, Meerut, India.
9. Tyson C. A and Frazier J. M (1993) Methods in Toxicology Vol.1 Academic Press, London.
10. Moriarty F (1983) Ecotoxicology, II edition, Academic Press, London.
11. Kanth S (1989) Trends in environmental pollution and pesticide toxicology, Jagmandar Book Agency, New Delhi
12. Duffus J. H. (1980) Environmental Toxicology, Edward Arnold Publishers, London.
13. Goldsmith A, Aronow L, Kalman S. M (1974) Principles of drug action: The basis of Pharmacology, A Wiley Biomedical Health publication, New York
14. Watson J. D, Gilman M, Witkowski J, Zoller M (1992) Recombinant DNA, 2<sup>nd</sup> edition, Scientific American Books, New York.
15. Heim S, Mitelman F (1987) Cancer Cytogenetics, Alan R. Liss, Inc., New York.
16. Raymond W. R (2007) Cancer Biology, Oxford University Press, New York.
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.
19. Alberts B, Bray D, Lewis J, Raff M, Roberts K. and Watson J.D. (1995) Molecular Biology of the Cell, II edition, Garland Publishing Company Ltd. New York and London.
20. Kleinsmith L. J. and Valeri M. K. (1995) Principles of Cell and Molecular Biology, II edition, Harper Collins College publishers.
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.

## II SEMESTER

### PRACTICALS

#### **AZ 455 – COMPARATIVE ANATOMY –LAB      4 Hours/Week**

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

#### **AZ 456 – PROTEINS AND NUCLEIC ACIDS –LAB      4 Hours/Week**

1. Color reactions of proteins.
2. Precipitation reactions of proteins.
3. Identification of an unknown protein.
4. Qualitative analysis of milk.
5. Estimation of total amino acids by ninhydrin method
6. Estimation of proline.
7. Determination of urine creatinine by Jaffe's method.
8. Estimation of blood urea by diacetyl monoxime method.
9. Determination of DNA content.
10. Estimation of RNA content.
11. Estimation of total serum proteins by biuret method
12. Determination of molecular weight of carboxyl amino acid by formal titration method
13. Analysis of dipeptides for amino acids
14. TLC for amino acids.
15. Serum electrophoresis.

**AZ 457: ADAPTATION BIOLOGY - LAB****4 hours/week**

1. Effect of physical exercise on hematological parameters and cardiac activity
2. Study of circadian rhythms: body temperatures in humans
3. Regulation of eclosion rhythm in *Drosophila*
4. Excretion of chloride as a function of salinity in fish.
5. Seasonal and daily variations in salinity, temperature and tides.
6. Food consumption and assimilation by pregnant and normal mice
7. Role of nutrients on body weight of mouse pups.
8. Haemolymph ions during aestivation in molluscs (*Pila*)
9. Effect of temperature on physiological functions (Q10)
10. LDH isozymes in faetal tissue.
11. Study of parasitic adaptations

**AZ 458: TOXICOLOGY AND CANCER BIOLOGY - LAB****4 hours/week**

1. Determination of  $LC_{50}$ .
2. Determination of  $LD_{50}$  of a pesticide in mice (Probit analysis).
3. Detection of organo-phosphates by chromatographic methods.
4. Estimation of catalase activity
5. Residual analysis
6. Effect of heavy metals on enzyme activity
7. Transplacental teratogenesis
8. Detection of mercuric chloride by enzyme inhibition.
9. Experiments to study the genotoxicity of chemicals in mouse.
10. Transplantation and induction of mouse ascites tumor and studies on the characteristic of tumor cells.
11. Induction of solid tumor in mice
12. Preparation of chromosome from ascites tumor to study the chromosomal aberration in cancer.
13. Histological observation of different types of cancers (Permanent slides)

### III SEMESTER

#### THEORY

### AZ 501 - PARASITOLOGY AND VECTOR BIOLOGY (Choice paper)

Teaching hrs - 12 hrs/Unit

#### 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

Parasitic 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*, *Fasciola*

Cestoda - *Taenia*, *Echinococcus*, *Dipylidium*.

Important plant nematodes

#### UNIT-IV

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

Diptera- *Culicoides*, *Aedes*, *Culex*, *Anopheles*, House fly.

Siphonoptera: *Xenophylla*, *Ctenocephalides*, *Echidnophaga*, *Tunga*

Phthiraptera – *Pediculus*, *Pthirus*

Hemiptera – *Cimex*, *Triatoma*

Malaria, Chikungunya, Dengue fever (Transmission cycle).

#### UNIT-V

Morphology, life history and importance of Acarines-

Ticks: *Argas*, *Rhipicephalus*, *Boophilus*, *Haemaphysalis*

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

Myiasis- Venomous, Urticating and allergic arthropods- control measures.

Vector status of Cockroach.

## REFERENCES:

1. Katz M, Despommier D. D and Gwadz R. W (1982) Parasitic diseases, Springer-Verlag, Newyork
2. Cox F. E. G (1996) Illustrated History of Tropical diseases, Wellcome Trust London
3. Cable R. L (1963): An Illustrated Manual of Parasitology
4. Chappell L. H (1980): Physiology of Parasites, Blackie, Glasgow
5. Solusby E. J. L (1982): Helminthes, Arthropods and Protozoa of Domestic Animals, ELBS
6. Smith J. D (1985): Introduction to Animal Parasitology, Hedder and Staughton, London
7. Cheng T. C (1986): General Parasitology, Academic Press, College Division, New York
8. Melhorn H (Ed) (1988): Parasitology in Focus- Facts and Trends, Springer\_Verlag, Berlin
9. Targer, William (1988): Living Together- The Biology of Animal Parasitism, Plenum Publishing Corporation, New York
10. Hyde J. E (1990): Molecular Parasitology, Milton Keyner, Open University Press
11. Parija S. Ch (1990): Review of Parasitic Zoonosis, A. I. T. B. S, Publishers, Delhi
12. Kettle D. S (1990): Medical and Veterinary Entomology, CAB, International, UK
13. Walker A (1994): Arthropods of Human and Domestic Animals. A Guide to preliminary Identification, Chapman and Hall
14. Marr J (1995): Biochemistry and Molecular Biology of Parasites
15. Gillespies S. H and Hawkey P. N (1995): Medical Parasitology-A Practical Approach, Oxford University Press, New York
16. Wall R and Shearer D (1997): Veterinary Entomology, Chapman and Hall
17. Mathews B. E (1998): An Introduction to Parasitology, Academic Press
18. Bogitsch B. J and Cheng T. C (1999): Human Parasitology, Academic Press
19. Service M. W (2000): Medical Entomology for Students, Cambridge University Press
20. Robert L. S and J. Janovy (2006): Foundations of Parasitology (McGraw Hill)

## **AZ 502- GENETICS AND QUANTITATIVE BIOLOGY**

**Teaching hrs - 12 hrs/Unit**

### **UNIT - I**

Historical highlights - Development of the gene concept. Elements of heredity and variation .

Mendelian Genetics - Mendelian principles ; Mendelian inheritance and probability.

Modified genetic ratios – Co-dominance – incomplete dominance – Lethal alleles, Interaction between different genes – Duplicate genes, Complementary genes, penetrance and expressivity, pleiotropy, Epistasis, Extra chromosomal inheritance.

Sex determination – sex linked inheritance in Drosophila and man, sex limited and sex influenced traits.

Multiple alleles – Genetics of Blood group inheritance.

### **UNIT - II**

Genetic code, molecular structure of gene, transposable elements, gene mutations and DNA repair.

Regulation of gene expression in prokaryotes and eukaryotes, Operon concept, attenuation and antitermination, Giant chromosomes, Environmental regulation of gene expression

Linkage, recombination and gene mapping: Linkage groups, complete and partial linkage. Construction of linkage maps in Drosophila,

Genetic basis of development in Drosophila- Genes involved in Drosophila development and their functional role.

### **UNIT -III**

Human karyotype; International System for Human cytogenetic Nomenclature (ISCN) ; Chromosome aberrations- structural and numerical variations- Chromosomal syndromes; Human genome project ; Genetic counseling ; Genetic Screening- Amniocentesis, Chorionic Villus Sampling, Cardiocentesis; Chromosome banding techniques – G-,C-, Q-; Dermatoglyphics.

### **UNIT -IV**

Genome imprinting ; Genetics of behavior- twins in genetic Studies; Pedigree analysis ; Inheritance of Autosomal and sex chromosomal traits ; Multi-factorial and polygenic Inheritance ; Population genetics-Hardy Weinberg law; Factors changing allelic frequencies – Mutation, Selection, Genetic drift, Migration. Meiotic drive.

### **UNIT - V**

Population and sample- Sampling techniques ; Organization of biological data – Tabular and Graphical Methods ; Analysis of data – Measures of central tendency( Mean, Median, Mode) Standard deviation ; Probability & Frequency distribution –Normal, Binomial and Poisson distributions ; Correlation and regression ; Chi-Square test; Test of significance , t –test, Analysis of Variance(ANOVA).

## REFERENCES:

1. Weaver R. F (1995) Basic Genetics, 2<sup>nd</sup> edition, Wm.C. Brown Publishers, CI.
2. Jain H. K (1999) Genetics, Principles, Concepts & Implications, Oxford and IBH Publishers, New Delhi
3. Jha A. P (1997) Genes and evolution, McMillan Publishers, New Delhi.
4. Brown T. A (1998) Genetics a molecular approach, III edition, Chapman & Hall Publishers, London.
5. Hartl D. L (2001) Genetics: Analysis of genes and genomes, IV edition, Jones & Bartlett publishers, Boston.
6. Martens T. R (2001) Genetics- laboratory investigations, 12<sup>th</sup> edition, Prentice Hall, New Jersey.
7. Russel P (1998) Genetics, V edition, Addison – Wasley, California.
8. Strickberger M. W (1997) Genetics, III edition, McMillen press, New York
9. Zubay, Geoffrey (1987) Genetics, Benjamin Publishers, California.
10. Redai G. P (1998) Genetics manual: current theory, concepts and terms, World Scientific Publishers, Singapore.
11. Fraser C. F and Nora J. J (1986) Genetics of man, II edition, Lea and Febiger publishers, Philadelphia.
12. Burns G. W (1983) The science of genetics, V edition, McMillan Pub. Co., Inc., New York.
13. Connor J. M and Smith M. A F (1987) Essential Medical Genetics, II edition, Black well scientific publications.
14. Gardner E. J, Simmins M. J and Snusstad D. P (1991) Principles of Genetics, VIII edition, John Wiley and Sons Inc.,
15. Lewin B (1996), Genes, VII edition, John Wiley & Sons, New York.
16. Strickberger M. W (1995) Genetics, III edition, Prentice Hall of India Pvt. Ltd.,
17. Tamarin R. H (1994) Principles of genetics, III edition, PWS Publishers, Boston.
18. Mange E. J and Mange A. P (1994) Basic Human Genetics, Rastogi Publications, Meerut, India,
19. Hutt F. B and Rasmusen B. A (1982) Animal genetics, II edition, John Wiley & sons, New York.
20. Jones R. N and Karp A (1986) Introducing Genetics, John Murray publishers Ltd.,
21. Schlieff R (1986) Genetics and molecular biology, Addison Wesley Pub. Co., Massachusetts
22. P. A. Lawrence (1992) The making of a fly: The genetics of animal design, Blackwell scientific publishers, London, Boston.
23. Norman T. J. Bailey (1994) Statistical methods in biology, 3<sup>rd</sup> edition, Cambridge University Press.
24. T.H. Hassard (1991) Understanding Biostatistics, Mosby year Book St. Louis.

## **AZ 503: BIOLOGY OF IMMUNE SYSTEM**

**Teaching hrs - 12 hrs/Unit**

### **UNIT -I**

Overview of the immune system -  
Historical perspective  
Innate and adaptive immunity  
Cells and organs of immune system  
The complement system

### **UNIT - II**

Immunogens and immunogenicity  
Epitopes and their characteristic properties.  
Major histocompatibility complex  
Processing and presentation of antigens

### **UNIT -III**

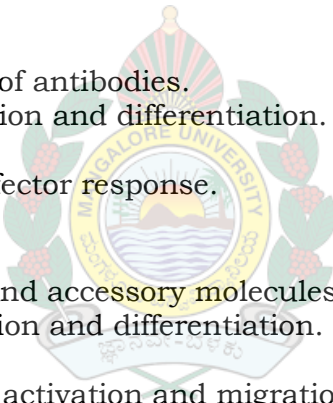
Structure and functions of antibodies.  
B-cell generation, activation and differentiation.  
The humoral response  
Regulation of immune effector response.

### **UNIT - IV**

T-cell receptor complex and accessory molecules.  
T-cell maturation activation and differentiation.  
T-cell effector response.  
Cytokines and leukocyte activation and migration.

### **UNIT -V**

The immune system in health and disease-  
Tolerance and autoimmunity  
Transplantation immunology  
Vaccines  
Immunodeficiency



## REFERENCES :

- 1) Abbas A. K. and Lichtman A. H. (2009) Basic Immunology-Functions and Disorders of the Immune System, Third edn. Reed Elsevier, India Pvt. Ltd., Noida.
- 2) Lesley-Jane E (2001) Immunology for life scientists. John Wiley and Sons. Surrey.
- 3) Elgert K. D. (1996) Understanding the Immune System, Wiley Liss, New York.
- 4) Kindt T. J., Goldsby R. A. and Osborne B. A. (2007) Kuby Immunology, Sixth edn. W. H. Freeman and Company, New York.
- 5) Lydyard P. M., Whelan A. and Fanger M. W. (2000) Instant Notes in Immunology, Viva Books Pvt. Ltd., New Delhi.
- 6) Roitt I. M. Brostoff J. And Male D. K. (1998) Immunology, Fifth edn., Mosby- year Book Europe Ltd., London.
- 7) Stites D. P., Stobo J. D., Fudenberg H. H. and Wells J.V. (1984) Basic and Clinical Immunology Fifth edn. Lange Medical Publications, California.



## **AZ 504: FISHERY BIOLOGY AND ANIMAL BREEDING**

**Teaching hrs - 12 hrs/Unit**

### **UNIT -I**

Fish Biology – Introduction, Classification of fishes with special reference to evolutionary trends and adaptations.

Distribution of freshwater and marine fishes of India.

Fish Growth and Reproduction- Determination of age and growth, Growth curves, Length-weight relationship and Length frequency analysis, Food and feeding habits of fishes (general account)

Reproduction- Reproductive diversity, Reproductive cycles, Reproduction and spawning; fish eggs and larvae, Reproductive behavior and parental care. Hybridization, selective breeding, cryopreservation

### **UNIT - II**

Fish Culture - Freshwater and Lacustrine fish culture practices in India.

Culture of ornamental fishes.

Brackish water aquaculture.

Mariculture – finfish and shellfish culture

Fish and shellfish diseases, fish immunization, prophylaxis and therapy.

Setting-up and maintenance of an aquarium

Fishery Technology - Fishing gears and crafts.

Fish industries in India, Fishery economics.

Fishery Research Institutes in India.

### **UNIT-III**

Selection of animals for breeding-

Methods of selection – selection criteria – Artificial selection, Long term artificial selection. Gametic selection, Zygotic selection, heterozygous advantage.

Heritability and genetic improvements. – Broad and Narrow- sense heritability

Selection differential, Generation interval, Genetic gain

Evaluation of breeding animals - desirable traits, Identification system, Performance record, Reproductive efficiency, production traits, Selection indices.

Selection of superior breeding stock – Breeding value, aids to selection

### **UNIT-IV**

Breeds of animals –Cattle breeds – Beef cattle, Dairy cattle, Dairy goats

Sheep, Swine, Poultry and Horse breeds.

Practical breeding plans – Dairy cattle breeding – Beef cattle breeding –

Sheep breeding – Pig breeding – Poultry breeding

Feeding and managing of Dairy animals, Feeding and managing of swine, sheep, poultry and horse breeds.

Issues in animal Husbandary – Assessing risk, animal welfare, environment issues, consumer issues, marketing issues.

## UNIT-V

Breeding methods – Inbreeding, Systematic inbreeding, measurement of inbreeding, panmictic index, Advantages and disadvantages of inbreeding.

Cross breeding and line breeding – Hybrid vigor, advantages and disadvantages.

Methods of breeding of farm animals – Cattle, swine, poultry, horse.

Requirements and methods of breeding small lab. animals. ( Rats and Mice)

Institutional animal ethics committee. Diseases of domestic animals and

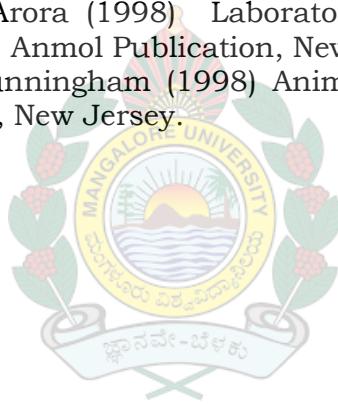
preventive measures. Modern trends in animal breeding – artificial

insemination – Super ovulation - embryo transfer techniques. Animal cloning

## REFERENCES:

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### III SEMESTER

#### PRACTICALS

#### AZ 505: PARASITIC DISEASES- LAB

4 Hours/Week

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*, *Fasciola*  
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

## **AZ 506 – GENETICS AND QUANTITATIVE BIOLOGY –LAB**

**4 Hours/Week**

1. Preparation of culture media and maintenance of Drosophila – To Study the life cycle .
2. Morphological features of Drosophila
3. Drosophila mutants
4. Mounting of Genital plate and Sex comb
5. Study of Polytene chromosome of Drosophila .
6. Chromosome banding techniques and karyotyping.
7. Study the dermatoglyphics pattern and its significance.
8. Chromatographic separation of eye pigments in Drosophila
9. Study of Human blood group genetics and estimation of allelic frequencies
10. Experiments to demonstrate the pattern of inheritance of characters in Drosophila –
  - a. Expt. 1: To demonstrate Mendel's law of segregation
  - b. Expt. 2: To demonstrate Mendel's law of independent assortment
  - c. Expt. 3: To demonstrate Pattern of inheritance of X- linked genes
11. Genetic problems
12. Biostatistics problems

## **AZ 507: BIOLOGY OF IMMUNE SYSTEM – LAB**

**4 Hours/Week**

1. Study of Cells of immune system
2. Organs of immune system.
3. Agglutination reaction
4. Precipitation reaction
5. Quantitative precipitation assay.
6. Immuno-electrophoresis
7. Rocket immuno-electrophoresis
8. Countercurrent immuno-electrophoresis
9. Preparation of antisera
10. Precipitation of immunoglobulins by ammonium sulphate method.
11. Isolation and purification of Immunoglobulin G
12. Enzyme Linked ImmunoSorbent Assay (ELISA)
13. Dot ELISA
14. Hapten conjugation method
15. Scale grafting in fish.

## **AZ 508: FISHERY BIOLOGY AND ANIMAL BREEDING - LAB**

**4 hours/week**

1. Use of Limnology equipments: Secchi disc, Ekman's grab, Water sampling bottle, Plankton net, Sedgwickrafter counting cell.
2. Study of distinguishing features, identification and classification of fishes available in the museum.
  1. Collection of local fishes and their identification using taxonomic keys.
  4. Determination of length-weight and length frequency in fish.
  5. Determination of absolute and relative fecundity in fish.
  6. Fish gears and fish byproducts.
  7. Identification of fish food organisms (Phyto and Zooplankton, benthic invertebrates)
  8. Intestinal parasites of fish.
  9. Field visit: Fish ponds, Fish landing centre and/Fish processing unit.
  10. Mouse breeding experiments
  11. Demonstrations of fish breeding techniques
  12. Visit to Dairy farm and preparation of report
  13. Visit to Piggery and Poultry farm and preparation of report
  14. Vermitechnology



## **IV SEMESTER THEORY**

### **AZ 551: ANIMAL CELL BIOTECHNOLOGY**

**Teaching hrs - 12 hrs/Unit**

#### **UNIT –I**

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

Equipments – 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

Culture of tumor cells, application in cancer research, Lymphocyte culture technique and its applications

Organ culture - Methods, Raft and grid methods, Watch glass technique, Maximow single slide technique, agar gel technique, histotypic culture ; Gel and sponge technique, hollow fibres, spheroids

Large scale cultures – Fermentor design, scaleup in suspension and monolayer. Downstream processing.

### **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

Cell cultures in the production of medicinally important compounds – pharmaceuticals, enzymes, hormones etc.,

### **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.

Application of recombinant DNA technique in Medicine and industry. Use of genetically engineered microorganisms in the environment, genetic engineering approach to detoxification.

### **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.

Regulation of genetic engineering – Biosafety regulations, risk versus benefits, ethics involved in animal cloning and stem cell research. Ethics of xenotransplantation.

Intellectual property rights, Patenting of living organisms, Ethical issues.

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## **AZ 552: NUTRITION AND METABOLISM**

**Teaching hrs - 12 hrs/Unit**

### **UNIT -I**

Concepts of nutrition

The feed nutrients their classification and general functions.

Methods of analysis of nutrients and feedstuffs.

Measurement of feed and nutrient utilization and requirements in animals.

Effect of environment on nutritional efficiency

### **UNIT- II**

Applied animal nutrition-

Factors affecting feed consumption

Principles of animal nutrition

Feed preparation, processing and diet formulation

Nutrition of dairy and wild animals

Recycling of animal wastes.

### **UNIT- III**

Human nutrition-

Balanced nutrition and nutritional basis of health

Protein energy malnutrition and other deficiency disorders.

Starvation and obesity

Importance of fibre in diet

Food toxicants and dietary antioxidants.

### **UNIT- IV**

Energy metabolism-

Design and regulation of metabolic pathways.

Laws of thermodynamics,

High energy phosphate compounds.

Glycolysis and Citric acid cycle

Electron transport and oxidative phosphorylation.

### **UNIT - V**

Carbohydrate, mineral and vitamin metabolism -

Metabolism of glycogen.

Gluconeogenesis and pentose phosphate pathway

Metabolism of macro and micro elements.

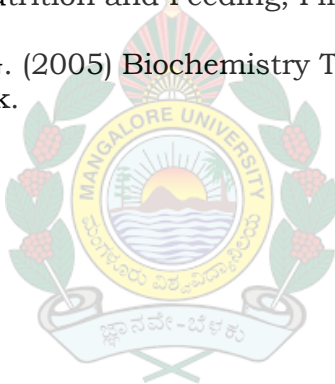
Metabolism of fat- and water soluble vitamins.

Role of vitamins and minerals in intermediary metabolism



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2. Gillespie J. R. (1987) Animal nutrition and feeding Delmar Publishers Inc., New York.
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9. Voet D. and Voet J. G. (2005) Biochemistry Third edn, John Wiley and Sons, New York.



## **AZ 553- NEUROBIOLOGY AND BEHAVIOUR**

**Teaching hrs - 12 hrs/Unit**

### **UNIT-I**

Cellular neurophysiology-  
Organization of nervous systems  
Ionic basis of resting membrane potential  
Generation and conduction of action potential  
Neural transmission and integration  
Sensory transduction

### **UNIT-II**

Motor systems –  
Excitation-Contraction coupling  
Molecular basis of muscle contraction  
Skeletal muscle mechanics and fibre types  
Smooth muscle and cardiac muscle  
Neuro-Muscular disorders

### **UNIT-III**

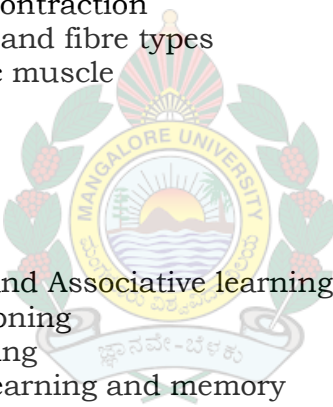
Learning and memory-  
Instincts and Imprinting  
Habituation, sensitization and Associative learning  
Cognitive abilities and reasoning  
Types of memory and learning  
Molecular mechanisms of learning and memory

### **UNIT-IV**

Communication-  
Olfactory communication – Pheromones in insects and mammals  
Vomeronasal organ  
Sound production and auditory communication in insects  
'Dance language' in honeybees  
Speech production and features of language

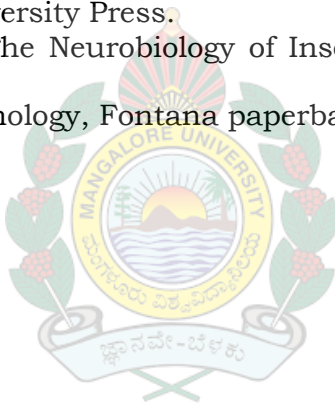
### **UNIT-V**

Reproductive strategies-  
Features of sexual reproduction  
Parental investment of the sexes  
Sexual selection  
Mate choice, competition and aggression  
Mating systems – polygamy, monogamy, polygyny.



## REFERENCES:

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**AZ 554-BIODIVERSITY AND CONSERVATION**  
**Teaching hrs - 12 hrs/Unit**

**UNIT -I**

Biodiversity concepts- Ecosystem diversity, Genetic diversity, Species diversity, Biodiversity from ecological, taxonomical and evolutionary prospective (Alpha, Beta and Gamma diversity); Biodiversity assessment- Inventorying and Monitoring biodiversity- Sources of information, Data collection and management- Taxon data sheet, Biodiversity indices.

**UNIT -II**

Zoo geographical regions of the world and Ecological subdivisions of India; Biodiversity Hotspots; Biome essays- Tropical and Temperate forests, Tundra, Boreal forests, Cave and Mountains, Coastal ecosystems, Mangroves and Estuaries, Coral reefs, Lakes and Rivers.

**UNIT-III**

Unique Indian animals- Diversity and distribution; Endemic species, Species interaction- Concept of niche, territory and home range, Keystone species; Capturing and marking techniques- entrapment, darting, tagging and banding; Population analysis- territory mapping, line transect, capture-recapture, pellet count, pug mark, call track count; Radio telemetry; Still and Video photography.

**UNIT- IV**

Threats to Biodiversity- Habitat destruction, Climate change, Exotic species introduction, Over exploitation; Diseases and their control; Species extinction; IUCN Red list criteria and categories; Biodiversity conservation- insitu methods- National parks and Sanctuaries; exsitu methods- Captive breeding program- role of Zoos and Botanical gardens.

## UNIT- V

Legal aspects- National and International conventions- CITES, TRAFFIC;  
Wildlife laws- Wildlife (protection) Act-1972; Indian biodiversity laws; Special projects- Project Tiger, Gir Lion project, Project Elephant, Crocodile breeding project. Biodiversity acts, Earth summits, Ramsar conventions.

## REFERENCES:

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9. Daniel J.C and Gerrao J.S. (1990) Vegetation types of India in relation to environmental conditions In: conservation in developing countries, problems and prospects eds., Bombay Natural History Society, Bombay
10. Nair, S.M. (1992) Endangered animals of India and their Conservation, National Book Trust, India.
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## IV - SEMESTER

## **PRACTICALS**

### **AZ 555: ANIMAL CELL BIOTECHNOLOGY- LAB**

**4 Hours/week**

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/hemopoietic cell cultures
12. Contamination of cultures
13. Study of restriction sites in  $\lambda$  DNA – Demonstration
14. Western blot technique -Demonstration.

### **AZ 556: NUTRITION AND METABOLISM -LAB**

**4 Hours/week**

1. Assay of transaminases
2. Assay of phosphatases
3. Assay of dehydrogenases
4. Study of enzyme kinetics
  - a) Effect of substrate concentration
  - b) Effect of pH on enzyme activity
  - c) Effect of temperature on enzyme activity
  - d) Effect of metal ions on enzyme activity
5. Estimation of phosphorous
6. Estimation of ascorbic acid.
7. Proximate analysis of feed:
  - a) Estimation of moisture content.
  - b) Estimation of nitrogen content
  - c) Estimation of lipid content
  - d) Estimation of crude fibre content
  - e) Estimation of ash content
  - f) Determination of N2 free content
  - g) Calculation of energy content of feed.

## **AZ 557: NEUROBIOLOGY AND BEHAVIOUR - LAB**

**4Hours/week**

1. Methylene blue visualization of sensory neurons in *Drosophila*.
2. Differentiation of mechanoreceptors and chemoreceptors in Insects.
3. Golgi-staining technique.
4. Stimulus - contraction parameters in muscles – Kymographic studies.
5. Effect of Neurotransmitters/mimics on pacemaker neurons – cardiac pacemakers.
6. Habituation in earthworms/crab.
7. Olfactory discrimination in insects
8. Social insects – study of insect colonies.
9. Recording and analysis of insect (cricket) calls, bird calls.
10. T-Maze labyrinth, learning in mice.
11. Filial imprinting in chicks.
12. Sensitization in crabs.

## **AZ 558 – BIODIVERSITY AND CONSERVATION**

**Practical /Field work/ Small project work      4Hours /Week**

1. Habitat analysis: Aquatic habitat- water quality analysis- salinity, pH, Temp etc    Terrestrial habitat- Soil analysis- Nutrient test
2. Species diversity analysis: collection, preservation and identification of local species of animals- vertebrates and invertebrates (aquatic and terrestrial)
3. Food habit analysis of insectivorous animals- Lizards, Bats etc
4. Identification of bird species by audio- visual methods
5. Live transect analysis, Quadrant analysis and Biomass analysis
6. Biodiversity indices- calculation and interpretation,
  - i) Simpson's index
  - ii) Evenness
  - iii) Morishita Horn
8. Construction of Rank abundance curve, Comparison of Rank abundance curve,
9. Pitfall trap, Beat sheet, sweep nets for insects.
10. Pug mark and hoof mark castings.
11. Visit to observe and record types of ecosystem and associated flora and fauna. (Protected and unprotected areas, Biological parks etc)