SOLAPUR UNIVERSITY,

SOLAPUR

Faculty of Science

M. Sc. Part: I - ZOOLOGY

(Choice Based Credit System)

Syllabus

w.e.f. June 2015-2016

SOLAPUR UNIVERSITY, SOLAPUR

M. Sc. Part: I - ZOOLOGY

(Choice Based Credit System Syllabus)

w.e.f. June 2015-16

SEMESTER - I

Paper/Practical	Title of paper/Practical	Credits	Total marks
Theory			
ZOO 101	Biosystematics	4	100
ZOO 102	Tools and techniques in Biology	4	100
ZOO 103	Cell and Molecular Biology	4	100
ZOO 104	Population Genetics and Evolution	4	100
Practical			
ZOO 105	Practical based on Zoo 101 & 102	4	100
ZOO 106	Practical based on Zoo 103 & 104	4	100
	Seminar / Study Tour		25
		Total	625

SEMESTER - II

Paper/Practical	Title of paper/Practical	Credits	Total marks
Theory			
ZOO 201	Computational Biology	4	100
ZOO 202	General and Comparative Endocrinology	4	100
ZOO 203	Development Biology	4	100
ZOO 204	Environmental Physiology	4	100
Practical			
ZOO 205	Practical based on Zoo 201 & 202	4	100
ZOO 206	Practical based on Zoo 203 & 204	4	100
	Seminar / Study Tour		25
		Total	625

As per the credit system, the assessment of theory paper of 100 marks , weightage will be as follows : 70 marks theory assessment by University examination and 30 marks internal assessment by the college/institute. For internal assessment of candidate, periodical tests/seminars/viva/oral/quiz/study tour etc. may be suitably adopted as per the syllabus guidelines.

M. Sc. I, Semester: I

Paper ZOO 101

Title : Biosystematics

Maximum marks: 100 **Teaching Periods: 40= 4 credits**

1.0 Definition and basic concept of Biosystematics and Taxonomy (6)
- 1.1 Historical Resume of Systematic
- 1.2 Importance and Applications of Biosystematics in Biology.
- 1.3 International Code of Zoological Nomenclature.

2.0 Trends in Biosystematics: (6)
- 2.1 Chemotaxonomy
- 2.2 Cytotaxonomy
- 2.3 Molecular Taxonomy

3.0 Molecular Perspectives on the Conservation of Diversity (5)
- 3.1 Diversity and Ecosystem Process --Theory, Achievements and Future Directions

4.0 Dimensions of Speciation and Taxonomic Characters (7)
- 4.1 Mechanism of speciation in Panmictic and Apomictic species
- 4.2 Species concepts- category, different concepts, sub-species and other intra-specific categories
- 4.3 Theories of Biological Classification, Hierarchy of Categories
- 4.4 Taxonomic Characters- Different Kinds, Origin of Reproductive Isolation- Biological Mechanism Genetic Incompatibility

5.0 Procedure and keys in taxonomy (7)
- 5.1 Taxonomic Collection, Preservation and Curetting Process of Identification
- 5.2 Taxonomic Keys: Different Kinds of Taxonomic Keys, their merits and demerits
- 5.3 Systematic publications: Different Kinds of Publications
- 5.4 Process of Typification of different Zoological Types

6.0 Molecular Phylogenetics (6)
- 6.1 How to Construct Phylogenetic Trees?
- 6.2 Phylogenetic Inference: Distance Methods, Parsimony Methods, Maximum Likelihood Methods
- 6.3 Immunological Techniques.
- 6.4 Amino Acid Sequences and Phylogeny.
- 6.5 Nucleic Acid Phylogeny

7.0 Study of Biodiversity Indices : (3)
- 7.1 Shannon diversity index, Simpson diversity index

Suggested Reading Material:

1. M.Kato- The Biology of Diversity.
2. J.C. Avise – Molecular Markers. Natural History and Evolution, Champman & Hall, New York.
3. E.O. Wilson- Biodiversity, Academic Press, Washington.
4. G.G. Simpson –Principle of Animal Taxonomy, Oxford IBH Publishing Company.
5. E. Mayer- Elements of Taxonomy.
6. E.O. Wilson- The Diversity of Life. W.W. Northern and Company.
7. B.K. Tikedar- Threatened Animals of India, ZSI Publication, Calcutta.
8. E. Mayer- Principles of Systematic Zoology, M. Hill Publication.

Paper ZOO 102
Title : Tools and Techniques in Biology

Maximum marks: **100** **Teaching periods: 40= 4 credits**

1.0 **Principles and uses of analytical Instruments** **(6)**
- 1.1 Spectroscopy (Spectrophotometer, NMR, FTIR)
- 1.2 Lasers in Biology
- 1.3 X- rays in Biology
- 1.4 Electron Microscope (TEM, SEM)
- 1.5 Proteomics – Mass spectrrophotometry

2.0 **Cell Culture Techniques** **(6)**
- 2.1 Design and functioning of Tissue Culture Laboratory
- 2.2 Culture media preparation
- 2.3 Types of culture: Monolayer, Suspension, Macrocarrier Culture, Capillary Culture Units, Feeder Layers, Cell Secretions and Metabolic Harvesting
- 2.4 Cell Viability Testing
- 2.5 Cell Characterization
- 2.6 Cell Transformation

3.0 **Cell-based techniques** **(6)**
- a) Fusogens Somatic Cell: Fusion and its Application.
- b) Fusion in different cell-cycle phases and its applications
- c) Cell hybrids and its applications

4.0 **Cryotechnique** **(5)**
- 4.1 Cryopreservation of Cells, Tissues, Organs and Organisms
- 4.2 Cryotomy
- 4.3 Freeze - drying and freeze fracturing techniques

5.0 **Separation techniques.** **(5)**
- 5.1 Chromatography-TLC& Paper Chromatography, Electrophoresis and its types, Column Fractionation
- 5.2 Ultracentrifugation and sub-cellular fractionation
- 5.3 Cell separation by: Flow-cytometry,

6.0 **Radioisotopes and uses.** **(6)**
- 6.1 Radiolabel Techniques in Biology
- 6.2 Radioactivity Counter Geigometry and Scintillation
- 6.3 Autoradiography
- 6.4 Metabolic labeling
- 6.5 Biotelemetry

7.0 Immunological techniques based on antigen antibody interactions **(6)**

Antibody labels, Hybrid antibody, Immunoassay, Immunocytochemistry and its applications, Vectors, DNA Cloning, DNA library.

Suggested Reading Material:

1. John R.W. Masters. Animal Cell Culture. IRL Press.
2. Robert Braun. Introduction of Instrumental Analysis. McGrow Hill International Editions.
3. K. Wilson and K.H. Goulding.A Biologist Guide to Principles and Techniques of Practical Biochemistry. ELBS Ed.
4. Pattabhi, V. Biophysics. Narosa Publishing House.
5. Bisen, P.S. & Mathur. Tools and Techniques in Life Sciences. CBS Publishers and Distributors.
6. Keith Wilson & John Walker. Practical Biochemistry. Cambridge University Press.
7. Cell Cooper , A molecular approach Second Edition
8. Cell : Alberts, 2002
9. Annenberg E. Rediscovering Biology: Edition
10. Geise: Cell Physiology

PAPER ZOO 103

Title : Cell and Molecular Biology

Maximum marks : 100 **Teaching periods: 40= 04 Credits**

1.0 Biomembranes: (6)

1.1 Molecular Composition, Arrangement and Functional Consequences
1.2 Transport across the cell membrane: Passive and active transport, pumps, uniports, symports and antiports.
1.3 Transport across epithelia
1.4 Membrane potential

2.0 **Structural organization and function of intracellular organelles: (6)**

Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum

3.0 Cytoskeleton: (6)

3.1 Microfilaments and Microtubules: Structure and Dynamics
3.2 Cilia, Flagella: Structure and Dynamics
3.3 Microtubules in Mitosis
3.4 Microtubular organizing centers: Centriole, Kinetochore, Basal Bodies
3.5 Intermediate filaments: structure and functions
3.6 Actin-binding proteins
3.7 Cell movement and cytoskeleton

4.0 Cell-cell adhesion (5)

4.1 Cell junctions (tight adhesion belts, focal contacts, septate, desmosomes, hemidesmosomes, gap, chemical synapses, plasmodesmata) Cell matrix and cell matrix adhesion
4.2 Integrins
4.3 Collagens

5.0 Cell cycle (6)

5.1 Cell cycle control (cyclins and cyclin dependent protein kinases (cdk), MPF-role, re-replication block and its removal, feed back control)

6.0 Cell organelles and cell traffic (6)

6.1 Protein synthesis on free and bound polysomes
6.2 Uptake into ER
6.3 Membrane proteins and other proteins in ER
6.4 Post transcriptional modification and protein sorting in Golgi apparatus
6.5 Lysosomal assembly and functions
6.6 Biogenesis of mitochondria

7.0 Biology of cancer- causes of cancer, cancer cell morphology and properties (5)

Suggested Reading Material

1. B. Alberts *et al*. The Molecular Biology of Cell Garland Publishing Inc. New York and London.
2. De. Robertis *et al*. Cell and Molecular Biology. Saunders College Publishing, Philadelphia.
3. W. H. Elliot and D.C. Elliot. Biochemistry and Molecular Biology. Oxford University Press. Oxford, New York.
4. Giese A.C. Cell Physiology. Saunders College Publishing, Philadelphia.
5. P.S. Verma & V.K. Agrawal . Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Company, New Delhi-55
6. Sandhya Mitra. Genetic Engineering, Macmillan.
7. R.C. Dubey .A text Book of Biotechnology. S. Chand and Company, New Delhi-55.
8. Mohan Arora. Genetic Engineering. Himalaya Publishing House.
9. Becker Kleins Smith. The World of the Cell. Pearson Education.
10. Geoffrey M. Cooper. Cell. A Molecular Approach. ASM Press, Washington.
11. Gerald Karp. Cell and Molecular Biology. Willey International Edition.
12. Watson *et al.* Molecular Biology of the Gene. Pearson Education.

PAPER ZOO 104

Title : Population Genetics and Evolution

Maximum marks: **100** **Teaching periods 40 = 4 Credits**

1.0 Concepts of evolution and theories of organic evolution (8)

Emergence of evolutionary thoughts: Lamarck, Darwin–concepts of variation, adaptation, struggle, fitness and natural selection, Mendelism, spontaneity of mutations, the evolutionary synthesis

2.0 Neo Darwinism (6)

2.1 Hardy-Weinberg Law of genetic equilibrium

2.2 A Detailed account of destabilizing forces a) Natural selection b) Mutation c) Genetic drift d) Migration e) Meiotic drive

3. 0 Molecular population genetics (6)

4.1 Patterns of change in nucleotide and amino acid sequences

4.2 Ecological significance of molecular variations

4.3 Emergence of Neo-Darwinism-neutral hypothesis

4.0 Genetics of speciation (4)

6.1 Phylogenetic and biological concept of speciation

6.2 Patterns and mechanisms of reproductive isolation

6.3 Models of speciation (Allopatric, Sympatric and Parapatric)

5.0 Molecular evolution (6)

7.1 Gene evolution

7.2 Evolution of gene families, Molecular drive in evolution

7.3 Assessment of molecular variation

7.4 Evolutionary links based on gene and protein families and eukaryotic evolution based on different gene families

6.0 Origin of higher categories (4)

8.1 Phylogenetic gradualism and punctuated equilibrium

8.2 Major trends in the origin of higher categories

8.3 Micro and macro evolution

7.0 Population genetics and ecology (6)

9.1 Metapopulations

9.2 Monitoring natural populations

9.3 Why small populations become extinct?

9.4 Loss of genetic variation

9.5 Conservation of genetic resources in diverse taxa

9.6 Genomic studies in biodiversity

Suggested Reading Material

1. Hart, D.L. A primer of Population Genetics. Suinuaer associates, Inc. Massachusetts.
2. King. M. Species Evolution. The Cambridge University Press, Cambridge.
3. Smith J.M. Evolutionary Genetics. Oxford University Press. Oxford, New York.
4. Merrel D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc.
5. Jha A.P. Genes and Evolution. John Publication, New Delhi.
6. Boylan. Genetic Engineering: Science and Ethics on the New Frontier.Pearson Education. Delhi
7. G.A. Harrison , G.M. Tanner, D.R. Pilbeam , P.T. Baker ; Human Biology. Oxford Science Publication. 1988.
8. Carl Zimmer Harper: Evolution The triumph of an Idea Collins Publishers 2001

9. PBS Org. Website for Evolution concept

M.Sc. I, SEMESTER – I

PRACTICAL PAPER ZOO 105
(Based on Theory Papers ZOO 101 & ZOO 102)

Biosystematics: **Marks 100= 4 Credits**

1. Calculation of diversity indices of Zooplankton communities from freshwater resources.
2. Classification of Invertebrates specimens available in laboratory (approximately 40) preserved/CD/Models/chart.
3. Study of types of invertebrate larvae –Peculiarities and evolutionary significance/CD/Models/chart
4. Classification of Vertebrates specimens available in laboratory (approximately 40) preserved/ CD/Models/chart
5. Identification of poisonous and non poisonous snakes (preserved/CD/Models/chart)
6. Study of temporal vacuities in skulls of reptiles.

Tools & Techniques:

1. Study of different laboratory equipments (Calorimeter, Spectrophotometer, pH meter, Electrophorosis, Ultra Centrifuge machine etc.)
2. Study of different microscopes (compound, phase contrast).
3. Cell separation by density gradient centrifugation
4. Separation of amino acids by paper chromatography.
5. Separation of sugars by paper chromatography.
6. Isolation of active ingredients from natural resources by using column chromatography.
7. Sub cellular fractionation by using ultra centrifugation.
8. DNA Extraction and Isolation.
9. Analysis of DNA samples by Gel Electrophoresis.
10. Excursion: Visit to ZSI/Seashore/ National Institutes /Wildlife Sanctuary/ National Parks/ Water reservoirs

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PRACTICAL PAPER ZOO 106
(Based on Theory Papers ZOO 103 & ZOO 104)

Cell and Molecular Biology: **Marks 100= 4 Credits**

1. Sub cellular fractionation of suitable material to show Nucleus and Mitochondia.
2. Estimation of marker enzyme – Succinate dehydrogenase in mitochondrial fraction. (use suitable material).
3. Demonstration of collagen using suitable material/virtual demo/CD.
4. Metaphasic chromosome preparation of mitosis using suitable material
5. *Demonstration of meiosis in onion bud.*
6. Preparation of *Drosophila* Culture (Virtual/CD/Model)
7. Polytene chromosomes from permanent slide/photos of salivary glands of *Chironomous/ Drosophila* larva (CD/Model/Chart).

Population genetics and evolution:

1. Migration influenced examples identification with pictures/Chart/Model/CD
2. Isolation influenced examples identification with pictures/Chart/Model/CD
3. Evolution influenced examples identification with pictures/Chart/Model/CD
4. Estimation of genes & genotypic frequencies by Hardy - Weinberg law .
5. Construction of Phylogenetic trees based on DNA, RNA and RFLP
6. Study of prezygotic isolation in some species of Drosophila.
7. Case studies related with population genetics and evolution.

M. Sc. I SEMESTER – II

PAPER ZOO 201
Title : Computational Biology

Maximum marks : 100 **Teaching periods: 40=4 Credits**

1.0 Measures of Central Tendency and Measures of Dispersion: (8)

1.1 Arithmetic mean, median and mode

1.2 Absolute and relative measures of dispersion:

Range and its coefficient, Mean deviation and its coefficient, Quartile deviation and its coefficient, Standard deviation and its coefficient, Coefficient of variation

2.0 Correlation and regression (ungrouped data): (7)

Concept of correlation and regression, Methods of studying correlation

a) Scatter diagram

b) Karl Pearson's coefficient of correlation and

c) Rank correlation

3.0 Probability (5)

3.1 Elements of Probability, classical definition of probability

4.0 Probability distributions (5)

4.1 Introduction to probability distribution

4.2 Definition and properties of binomial distribution and normal distribution.

5.0 Tests of simple hypothesis (7)

5.1 Based on normal distribution (population mean, population proportion)

5.2 Student's 'T' test (paired, unpaired)

5.3 Chi-square tests for goodness of fit and for independence of attributes.

6.0 One way Analysis of variance (4)

7.0 Sequencing software (4)

7.1 Sequencing analytical techniques for DNA, amino acids & proteins synthesis.

Suggested Reading Material

1. Sokal R.R. and F.J. Rohit. Biometry, Freeman, San Fransisco.
2. Gupta- Fundamentals of Statistics.
3. Snedecor, G.W. and W.G. Cochran, Statistical Methods, East-West Press, New Delhi.
4. Green, R.H. Sampling Design and Statistical Methods for Environmental Biologist. John Wiley & sons, New York.
5. Pranab Kumar Banerjee. Introduction to Biostatistics. S. Chand and Company, New Delhi-55.
6. Zar. Biostatistician Analysis. Pearson Education. Delhi.
7. Deshpande A.V.Introduction to Probablity and Statistics. Vipul Prakashan.
8. Arora P.N. and Malhan P.K. Biostatistics. Himalaya Publishing House.

PAPER ZOO 202

Title : General and Comparative Endocrinology

Maximum marks: 100 **Teaching periods: 40= 4 Credits**

1.0 Endocrinology: General consideration (6)
- 1.1 Discovery of hormones
- 1.2 Classification and chemical nature of hormones
- 1.3 Experimental methods of hormone study

2.0 Neuro-endocrine system of vertebrates and neuro secretion in invertebrates (5)

3.0 Biosynthesis and mechanism of hormone secretion (6)
- 3.1 Biosynthesis of amino acid derivative peptides and steroid hormones
- 3.2 Hormones: Secretion, transport and degradation

4.0 Physiology and mechanism of hormone action (6)
- 4.1 Hormones and homeostasis
- 4.2 Hormone receptors and mechanism of hormone action
- 4.3 Hormonal regulation in metabolism

5.0 Hormone action in different facets of life (6)
- 5.1 Growth
- 5.2 Migration and colour change
- 5.3 Behavior

6.0 Hormones and reproduction in Vertebrates (6)

7.0 Hormones of gastro -intestinal tract (5)

Suggested Reading Material

1. E.J.W. Barrington. General and Comparative Endocrinology. Oxford , Clarendon Press.
2. Turner. C.D. General Endocrinology,
3. A. Gorbman *et al*. Comparative Endocrinology. John Wiley & Sons.
4. R.H. Williams. Text Book of Endocrinology. Press. Oxford, New York.
5. Turner C.D. and Bangara J.T. General Endocrinology
7 Mac E. Hadley. Endocrinology, Pearson Education.
8 Burch, Warner M, Burch, Endocrinology, Lippincott Williams & Wilkins.
9 Felig: Endocrinology and Metabolism. McGraw-Hill ISE.
10 Prosser & Brown. Comparative Animal Physiology. Saunders Publication.
11. S.S. Nussey and S.A. Whitehead: Endocrinology: An integrated approach (NCBI) 1999

PAPER ZOO 203

Title : Developmental Biology

Maximum marks: 100 **Teaching periods: 40= 4 Credits**

1. Evolution of sexual reproduction in Eukaryotes (6)
2. Study of egg, blastula, gastrula and three germ layers in Amphioxus, Frog, Chick and Mammals , Fertilization and Capacitation (6)
3. Introduction to Organogenesis (6)
   Development of limbs in Fishes, Amphibians, Birds and Mammals. Regulation of limb development in Chordates (6)
4. Development of anteriority to posteriority in *Drosophila* and Chordates. Regulation of development in *Drosophila* (5)
5. Programmed Cell Death: Cell Apoptosis & its role in development of human limbs (4)
6. Cloning experiments in Mammals , Embryonic stem cells and their applications (4)
7. Regeneration (3)

Suggested Reading Material

1. Turner, C.D. and Bangara J.T. General Endocrinology
2. R.G. Edwards. Human Reproduction.
3. Austen C.R. and Short R.V. Reproduction in Animals.
4. F.T. Longo. Fertilization, Chapman & Hall.
5. Mathur Ramesh: Embryology, Anmol Publications .
6. Morgan T. H.: Embryology & Genetics. Agrobios India
7. Balanski, Introduction to Embryology.
8. Scott F Gilbert: Developmental Biology, Sixth Edition. Sinaur Publications

PAPER ZOO 204

Title : Environmental Physiology

Maximum Marks: 100 **Teaching periods: 40= 4 Credits**

1.0 Homeostasis and physiological regulations (6)

1.1 Concept of homeostasis

1.2 Acclimatization- acclimatization and adaptation

2.0 Physiology of stress (6)

2.1 Fundamental concept of stress

2.2 Causes and effects of stress

2.3 Stress, strain and fatigue

2.4 Environmental stresses (temperature, light, humidity, vibration, noise and toxins

2.5 Physiological responses to stresses

2.6 Stress management

2.7 Man under stress

3.0 Environment and Health (6)

3.1 Environmental health hazards

3.2 Industrial health hazards

3.3 Occupational diseases

3.4 Man – machine and environment system

4.0 Space physiology (6)

5.0 Blood and circulation (6)

Blood corpuscles, haemopoiesis and formed elements, myogenic heart and specialized tissues, ECG - Its principle and significance, cardiac cycle, blood pressure, neural and chemical regulation of cardiac cycle.

6.0 Physiology of respiration and nervous system (6)

Comparison of respiratory system in vertebtates, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture

7 Thermoregulation (4)

Comfort zone, body temperature – physical, chemical and neural regulation, acclimatization

Suggested Reading Material

1. Echert R. Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
2. Hoar W.S. General and Comparative Animal Physiology, Prentice Hall of India.
3. Pummer L. Practical Biochemistry , Tata McGrow –Hill.
4. Wilson K. and Walker J. Practical Biochemistry.
5. Strand F.L. Physiology : A Regulatory System Approach. Macmillan Publishing Co. New York.
6. Wilma P.G. *et al*. Environmental Physiology, Blackwell Sci. Oxford, UK.
7. Frederic Martini. Fundamentals of Anatomy and Physiology. Prentice Hall.
8. Tortora. Principles of Anatomy and Physiology. Wiley Publications.
9. Ezeilo, Gabriel C. Textbook of Physiology. Oxford University Press.

M.Sc. SEMESTER – II

PRACTICAL PAPER ZOO 205

(Based on Theory papers ZOO 201 & ZOO 202)

Marks: 100 = 4 Credits

Computational Biology:

1. Example based on Measures of central tendency.
2. Example based on Measures of dispersion.
3. Example based on Coefficient of variation.
4. Example based on Correlation coefficient and regression coefficient (ungrouped data).
5. Problems based on classical definition of probability
6. Example based on Chi-square test
7. Example based on Student's 'T' test
8. Example based on one way ANOVA
9. Sequence search using BLAST search engine.
10. Reading of sequence of DNA and protein based on photograph of polyacryl amide gel.
11. Any other practical set by the Department in connection with the computational Biology.

General and Comparative Endocrinology :

1. Study of testicular cells Sertoli cells, Interstitial cells and sperm cells in the sections of testis (Permanent slides/CD/Model/Chart).
2. Demonstration of cell types in pituitary (Permanent slides/CD/Model/Chart).
3. Demonstration of neurosecretory cells (Permanent slides/CD/Model/Chart).
4. Bioassay of estrogen by vaginal smear technique by photos / pictures/permanent slides/CD/Model/Chart.
5. Effect of Adrenalin and Atropine Sulphates (Permanent slides/CD/Model/Chart/virtual).
6. Study of different endocrine glands of vertebrates and invertebrates (Permanent slides/CD/Model/Chart).

PRACTICAL PAPER ZOO 206

(Based on Theory papers ZOO 203 & ZOO 204)

Marks: 100 = 4 Credits

Developmental Biology

1. Sperm motility test and analysis (Suitable Material)
2. Demonstrate of different phases of oestrus cycle in Rat.
3. To demonstrate acrosomal development in Rat testis by PAS method. (Procedure with permanent slides/CD/Chart/Virtual).
4. Procedure to understand embryological stages of chick up to 72 hrs' by non - invasive method- using CD/Model/Chart
5. Study of mammalian development (Rat) up to three germ layers using CD/Virtual method.

Environmental Physiology

1. Heart perfusion and recording of cardiogram of frog by CD/Model/Virtual demonstration
2. Estimation of rate of O_2 consumption by the freshwater fish
3. Study of effect of Temperature on the heart rate of frog (CD/Virtual).
4. Study of effect of temperature on chick heart rate. (CD/Virtual).
5. Study of spiracle and trachea (CD/ permanent slide/Model)
5. Study of effect of aphlatoxins or CCl_4 induction (CD/Chart/Conventional Method)
6. Estimation of Blood lactic acid (use suitable material with standard method).
7. To study digestive enzyme (Amylase, Protease and Lipase) by standard biochemical methods.

8 To study effects of various physical and chemical factors on enzyme activity and to demonstrate the protein nature of enzyme (by standard method).