

# SHIVAJI UNIVERSITY, KOLHAPUR

## SYLLABUS

For  
M.Sc. Zoology  
(Semester Pattern)

M. Sc. Sem. I to IV



Academic Non flexibility & without credit  
system

For College P.G.Centers  
Implemented  
From  
June, 2008 onwards

**M.Sc. Zoology Academic Non flexibility and without credit  
system**

**M.Sc. Part – I & II**

Sem	Paper/Practical	Title of the paper/practical	Hours/ wk	Total Marks
I	<b>Paper - I</b>	Biosystematics and Biodiversity	4	100
	<b>Paper - II</b>	Ecology and Environmental pollution	4	100
	<b>Paper - III</b>	Cell & Molecular Biology	4	100
	<b>Paper – IV</b>	Applied Entomology	4	100
	<b>Practical I</b>	Practical based on paper I and II	6	100
	<b>Practical II</b>	Practical based on paper III and IV	6	100
II	<b>Paper - V</b>	Physiological Chemistry	4	100
	<b>Paper - VI</b>	Quantitative Biology & Tools and Techniques in Biology	4	100
	<b>Paper - VII</b>	Elements of Physiology	4	100
	<b>Paper – VIII</b>	Biology of Parasites	4	100
	<b>Practical III</b>	Practical based on V and VI	6	100
	<b>Practical IV</b>	Practical based on VII and VIII	6	100
III	<b>Core course</b>			
	<b>Paper – IX</b>	Animals in Biotechnology	4	100
	<b>Paper- X</b>	Enzymology	4	100
	<b>Elective Course</b>			
	<u>Special Course</u>	<u>Any one of the following (Optional)</u>		
	<b>Paper - XI</b>			
	Cell Biology			
	Comparative	Computational Molecular Biology	4	100
	Animal	Invertebrate Endocrinology	4	100
	Physiology			
	Entomology			
	Sericulture	Basic Entomology	4	100
	Aquaculture &	General Sericulture and Moriculture	4	100
	Fisheries	Fisheries Resources – Inland and Marine fisheries	4	100
	Food Science,			
	Food	Food Chemistry	4	100

	Technology & Nutrition			
III	<b>Core course Paper – XII</b>			
	Cell Biology	Molecular Biology of Gene	4	100
	Comparative Animal Physiology	Vertebrate Endocrinology	4	100
	Entomology	Agricultural Entomology	4	100
	Sericulture	Silkworm Biology and Rearing Technology	4	100
	Aquaculture & Fisheries	Fish Pathology and Reproductive Endocrinology	4	100
	Food Science, Food Technology & Nutrition	Food Processing and Packing	4	100
	Practical V	Practical based on IX and X	6	80
	Practical VI	Practical based on XI and XII or each Elective Subject.	6	80
IV	<b>Core course Paper – XIII</b>	Animal Cell in Biotechnology	4	100
	<b>Paper- XIV</b>	Toxicology and Immunology	4	100
	<b>Paper - XV</b>	<b><u>Elective Course</u></b>		
	Cell Biology	<u>Any one of the following (optional)</u> Cell in , Differentiation , Development Specialization	4	100
	Comparative animal Physiology	Animal Physiology	4	100
	Entomology	Insect Anatomy and Physiology	4	100
	Sericulture	Cytology, Genetics of Silkworm and Their Host Plants	4	100
	Aquaculture & Fisheries	Aquaculture Practices	4	100

	Food Science, Food Technology & Nutrition	Food Biotechnology	4	100
IV	<b>Elective course Paper – XVI</b>	<u>Special Course</u> <u>Any one of the following (Optional)</u>		
	Cell Biology	Cell Pathology	4	100
	Comparative Animal Physiology	Applied Physiology	4	100
	Entomology	Pest Management Concepts	4	100
	Sericulture	Seed and Silk Technology and Economics of Sericulture	4	100
	Aquaculture & Fisheries	Fishery Technology	4	100
	Food Science, Food Technology & Nutrition	Food Nutrition	4	100
	Practical VII	Practical based on XIII and XIV	6	80
	Practical VIII	Practical based on XV and XVI for each elective subject.	6	80
		<b>Project Seminar, field visit &amp; tour report Submission. (Individual or in group of 2 – 5 Students: Based on special papers)</b> <b>Out of 80 marks 60 marks for Project, (10 marks for Seminar one on any elective paper &amp; 10 marks for field visit / students tour report/ submission.)</b> <ul style="list-style-type: none"> <li>• Project – 60 marks (Individual / group of 2-5 students: Based on elective papers)</li> <li>• Seminar – 10 marks (one on any elective paper.</li> </ul>		

		<ul style="list-style-type: none"> <li>• Submission of students tour report,/ Submission or field visit / 10 marks.</li> </ul>		
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**THEORY EXAMINATION**  
**Nature of Question Paper**  
**(For Academic Flexibility Only)**

(Not for P G centres in colleges)

(fill in the blanks, match the pair, multiple choice)

Question paper Format- 80 Marks

Note- Q. 1 to Q. 5 are compulsory. 16

Q.1 On unit no. 1 long answer 16

Or

On unit no. 1 long answer / two short answers

Q.2 On unit no. 2 long answer 16

Or

On unit no. 2 long answer / two short answers

Q.3 On unit no. 3 long answer 16

Or

On unit no. 3 long answer / two short answers

Q.4 On unit no. 4 long answer 16

Or

On unit no. 4 long answer / two short answers

Q.5 Short notes any two (out of four one short note from each unit)16

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**Practical Examinations**

Sem I

Sem II

Sem III

Sem IV.

Practical Examination of Sem. I and III together at the end of respective semesters

Practical Examination of Sem. II and IV together at the end of respective semesters  
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The Department of Zoology is adapting the scheme of credit system as a part of Academic Flexibility from the academic year 2008-2009.

Under this,

1. The weightage for the semester and internal exam, will be 80:20.
2. The nature of question paper for Internal Exams. Will be as follows.  
Q.1: Objective type (Multiple choice and / or fill in the blanks) 10 items – 10 marks.  
Q.2: Descriptive type – 10 marks.  
OR  
Q.2: Short note type (To attempt two out of three)  
Internal Total ----- 20 marks.
3. The Semester exams (for 80 marks) will be of 3-hr. duration for each paper. The nature of questions will be as follows.  
Q.1 to Q.4 will have internal options with descriptive or short note type. Student has to attempt any five questions. For Q. 5 student has to attempt 2 short notes out of 4. All questions carry equal marks (5 X 16) =80.  
This scheme will be adapted after approval from the University bodies.
4. The Semester grade points will be decided based on the total performance in the Internal (20 marks) + the Semester Exam (80 marks) (Total 100 marks) on the basis of the following Table.

**M. Sc. (Part: -----) (Semester: -----) Examination, -----**

**Zoology (Paper : -----)**

**Title of Paper -----**

**(For College P.G. Centres)**

**Day & Date : -----**

**Time : Three Hours**

**Total Marks: 100**

**Instructions:**

- 1. All Sections are compulsory*
- 2. All questions carry equal marks.*
- 3. Section I should be written in the questions paper itself, to be attempted within first 30 minutes. Each item carries one mark.*

**Section: I**

**Q. 1 Objective type 20 items** (Fill in the blanks/ Match the following / Multiple choice questions / Define / Explain the term or combination of these) - (20) Marks.

**i.**

**ii.**

**iii.**

**iv**

**v**

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**XX**



**M. Sc. (Part: -----) (Semester: -----) Examination, -----**

**Zoology (Paper : -----)**

**Title of Paper -----**

**(For College P.G. Centres)**

**(Section II and III)**

**Day & Date: -----**

**Time: Three Hours**

**Total Marks: 80**

**Instructions:**

1. *Write both sections – II & III in the same answer book.*
2. *Attempt any three questions from section – II*
3. *All questions carry equal marks.*
4. *Draw neat and labelled diagrams wherever necessary.*

**Section: II (Attempt Any Three of the Following) - (60) Marks.**

- Q. 2            Long answer question
- Q. 3            Long answer question
- Q. 4            Long answer question
- Q. 5            Long answer question
- Q. 6            Long answer question

**Section: III            (20) Marks.**

Q. 7    Write Short notes on **any four** of the following.

- i.
- ii.
- iii.
- iv.
- v.
- vi.

**(While setting the questions for Section II and III entire syllabus of the paper be covered.)**

**Practical Examinations**  
**Academic Flexibility/College P.G. Centres**  
**Semester I - IV**

Sem I Practical I and II	100 marks each
Sem II Practical III and IV	100 marks each
Sem III Practical V and VI	80 marks each
Sem IV Practical VII and VIII	80 marks each
Course IX	80 marks

**Course IX**

**Project Seminar, field visit & tour report Submission.**

**Project** – (Individual / group of 2-5 students: (Based on Special / elective papers) -  
**60 Marks.**

**Seminar** – (one on any special /elective paper). **10 Marks.**

**Submission** of student's tour report/ Submission of field visit - **10 marks**

**Skeleton of practical question paper: Semester I – II      Total Marks: 100**

Q. 1

Q. 2

Q. 3

Q. 4

**20 marks each**

Any question from 1-4 can have sub questions A and B & marks can be divided according to weightage of sub question (practical)

Q. 5 Record Book      **10 marks**

Q. 6 Viva voce      **10 marks**

**Skeleton of Practical question paper Semester III and IV    Total marks: 80**

Q. 1

Q. 2

Q. 3

Q. 4

**15 marks each**

Any question from 1 - 4 can have sub questions A and B & marks can be divided according to weightage of sub question (practical)

Q. 5 Record Book      **10 marks**

Q. 6 Viva voce      **10 marks**

# **M.Sc. Zoology**

**Academic Flexibility / College P.G. Centres  
M.Sc.-I Sem.-I**

## **Paper – I Biosystematics & Biodiversity**

### **I. BIOSYSTEMATICS**

- Unit –I: Introduction to taxonomy & biosystematics, definition of biosystematics & taxonomy & Task of taxonomists.  
Modern trends in taxonomy (Taxonomic kinds of characters).  
Morphological, Physiological, ecological ethological, Geographical, biochemical, genetical & numerical characters.  
Theories of biological classification & their history.
- Unit –II: **Concept of species:**  
Typological, communalistic biological, evolutionary & recognition species concept. Kinds of species, polytypic, subspecies, intraspecific groups, taxonomic collection identification, description, taxonomic key types taxonomic publication.  
Rules of zoological nomenclature, international code, code of zoological nomenclature, preamble & important articles on zoological nomenclature.

### **II – BIODIVERSITY**

- Unit –III: Concept of Biodiversity introduction, evolution, factors promoting biodiversity, Brief account on the diversity of unicellular & multicellular animal.  
High biodiversity, global biodiversity, biodiversity value, use and importance of biodiversity.
- Cellular and molecular aspects of biodiversity. Rise of biological diversity – photosynthetic prokaryotes, Microbial diversity in soil marine prokaryotic diversity genetic species & ecosystem diversity. Terrestrial & aquatic biodiversity.
- Unit –IV: **Biodiversity conservation.**  
Threats to biological diversity, loss of biodiversity & its courses, listing of threatened biodiversity including vulnerable, rare, threatened, endangered & extinct plant & animal species.

Concept of conservation, conservation values & ethics, inventorisation of biological resources, Action plan of conservation, conservation of rare & endangered species, conservation through network of protected areas, Role of NGO's in conservation activities & conservation & sustainable development.

**Recommended Books:**

- Alston, R.E. and B.L. Turner (1963): Biochemical systematics Prentices Hall Inc. Englewood Cliffs, N.J. 404 pp.
- Avisé, J.C. (1974): Systematic value of Electrophoretic data. *Syst. Zool.* 23 (4): 465 – 481.
- Benazzi, M. (1973): Cytotaxonomy and evolution, General remarks vertebrate evolution. Ed. A.B. Chiarelli and Campus Academic Press, London and N.Y. pp. 1-3.
- Blomback, B and M. Blomback (1968): Primary structure of animal proteins as a guide in taxonomic studies. In *chemitaxonomy and serotaxonomy* (ed.) Hawkers pp. 3 – 20.
- Camp, W.H. (1951): *Biosystematics Britania* 7: 113 – 127.
- CHamberlin, W.J. (1952): *Entomological Nomenclature and Literature* 3<sup>rd</sup> edition Dubuvue Iowa William C. Brown Co.
- Cole, A.J. (1969): Numerical taxonomy proceedings of the colloqui in numerical taxonomy held in the University of St. Andrews Sept. 1968. Academic Press, N.Y 324 pp.
- Hennig, W. (1966): *Phylogenetic systematics Univ. Illinois Press III*, 263 pp.
- Heywood, V.H. (1973): *Taxonomy and Ecology Systematics Association special Vol. 5 Academic Press, London, and New York* 370 pp.
- Huxley, J.S. (ed.) *The New Systematics Oxford Uiv. Press London* 538 pp.
- Jeffrey, C. (1977): *Biological nomenclature Indian Ed. Oxford and IBH Pub. Co. New Delhi* 72 pp.
- Mayr, E. (1969): *Proinciples of systematics Zoology Mc. Graw Hill N.Y.* 428 pp.
- Mayr, E. and E.G. Linsley and R.L. Usinger (1953): *Methods and Principles of systematic Zoology, Mc Graw Hill N.Y.* 328 pp.
- Oman, P.W. and A.D. Cushmann (1948): *Collection and Preservation of insects U.S. Dept. of Agric. Misc. Pub. 601: 1 – 42.*
- Pankhurst, R.J. (1978): *Biological identification Edwards Arnold Ltd. London*, 104 pp.
- Pankhurst, R.J. (1984): *Online identification programme version 4. British museum (Natural History) London.*

Strickland, H.E. (1842): Rules of Zoological nomenclature Report of the 12<sup>th</sup> meeting of British Association held at Manchester in 1842 Brit. Assoc. Adv. Sci. Rept. 1842: 7 – 18.

Ernst Mayr (1969): Principles of Systematics Zoology TMH Ed. Tata McGraw Hill Publishing company Ltd. Bombay New Delhi.

Primack, R.B. (1950): A primer of conservation biology 3<sup>rd</sup> edition Sinuer Associates Inc. Publishers Sunderland Massachutts USA.

Ray Samit an Ray A.K. (2006): Biodiversity and Biotechnology New Central Book Agency (P) Ltd.

Kapoor, V.C. (2001): Theory and practice of Animal Taxonomy 5<sup>th</sup> edition Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Wilson, E.O.: Biodiversity.

Knudsen, J.W.: Biological techniques collecting preserving and illustrating plant and animals.

Black Welder, R.E. and Blair W.F. Guide to the Taxonomic literature of vertebrates.

Alexander, R.M. The Chrodate.

Waterman, A.J. Chordate

Saxena and Saxena: Plant taxonomy

Vyas,Purohit, Grag: A text book of Angiosperms.

Chan and Noel Krieg: Microbiology

Sharma, K.: Text Book of Micorbiology

Sharma K Manual of microbiology

Prescott: Microbiology

Wilson, E.O. Biodiversity National Academy Press 1988.

Tandon, Biodiversity status and prospects

Ray: Biodiversity and Biotechnology

Y.A. Abrol: Biodiversity and its significance

Prithipalsingh: An Introduction to Biotechnology

Chanchan Modern Pattern of Biodiversity conservation.

K.V. Krishnamurthy: An advanced textbook on biodiversity, principles and practice.

Allen, J.M. The nature of biological diversity

S.K. Jain: Conservaiton Biology

Bowles, M.L. and Whelman, C.J. Restoration of endangered species

Norton, B.G. The Preservation of speices The value of Biological Diversity.

**M.Sc. Zoology**  
**Academic Flexibility / College P.G. Centres**  
**M.Sc.-I Sem.-I**  
**Paper – II - Ecology and Environmental Pollution**

**Unit 1: Habitat and Community Concept:**

**Concept of habitat:** Types of habitat, Ecological niches, Types of biotic interactions in communities, Biotic community concept, Structure of biotic community, Dominance, Fluctuations and cyclic oscillations,

**Succession:** Basic patterns of succession, Types of succession, Factors affecting succession

**Kinds of aquatic habitats:** (Freshwater and Marine), Impact of environmental factors on biota, Productivity and mineral cycles in aquatic habitat, Biology and ecology of reservoirs

**Unit 2: Ecosystem Management & Conservation:**

**Ecosystem Dynamics and Management of Ecosystem:** Stability and complexity of ecosystems, Speciation and extinctions,

**Environmental Impact Assessment (EIA):** Environmental impact on human actions, responses of society, Administrative procedures, What should an EIA do?, Methods for EIA assessment, Socio-economic effects and impacts.

**Principles of Ecosystem Conservation:** Conservation strategies, Sustainable development

**Unit 3: Concept of Pollution: Aquatic Pollution:**

Important characteristics of pollutants, Population increase, Production and natural resource consumption, Effect of pollutants (Local and Global)

**Aquatic Pollution:** Water pollutants and sources of water pollution

**Types of domestic and Industrial pollutants and their composition and treatment of domestic waste:**

**Domestic pollutants:** Classification/Types, Composition and impacts, Treatments and disposals

**Industrial pollutants:** Classification/Types, Composition and impacts, Treatments and disposals.

#### **Unit 4: Agricultural Air and Heavy metal Pollution:**

**Agricultural Waste:** Types, composition, impact, treatment and disposal

**Air Pollution: Air Pollutants:** Sources, Types, composition, impact, treatment and disposal

**Heavy Metal Pollution:** Hg, Pb, Cd, Cr as sources, Impact on biota, Disposal

#### **Suggested Reading Material:**

Begon, M.J.L. Harper and C.R. Townsend. Ecology. Individuals, Populations and Communities. Blackwell Science. Oxford, UK.

Cherrett, J.M. Ecological concepts. Blackwell Sci. Pub. Oxford. U.K.

Elseth, B.D. and K.M. Baumgartner. Population biology. Van Nostrand co., New York.

Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.

Krebs, C.J. Ecology. Harper & Row, New York.

Krebs, C.J. Ecological methodology. Harper & Row, New York.

Ludwig, J.A. and J.F. Reynolds, (1988) statistical ecology. John Wiley & Sons, New York.

Pianka, E.R. Evolutionary ecology. Harper & Row, New York.

Ricklefs, R.E. and G. Miller. Ecology, W.H. Freeman & co., New York.

Roughgarden, J., Ecological methods.

Southwood, T.R.E.

Swartzman, G.L. and S.P. Kaluzny. Ecological simulation primer, Macmillan, New York.

Roof. D.A. The evolution of life histories. Theory and Analysis. Chapman & Hall, London, UK.

Odum E.P. Fundamentals of Ecology. W.B. Saunders publication, Philadelphia.

Odum E.P. Basic Ecology, Saunders publication, Philadelphia (1983).

Laurent Hodges. Environmental Pollution Halt, Rinehart & Winston,  
New York (1977)



**M.Sc. Zoology**  
**Academic Flexibility / College P.G. Centres**  
**Sem.- I**

**M.Sc.-I**

**Paper - III**  
**Cell and Molecular Biology**

- Unit –I: Nuclear Components:
1. Nucleus – EM. Structure.
  2. Nuclear envelope – structure & function.
  3. Chromosomes – Packaging of genome, chromosome structure, genetic maps, nucleolus.
  4. Information net works – Internet, HTTP, HTML URLs, E M B net, NCBI, Japan net. Protein information – databases. Genovne information – databases also).
- Unit –II: Secretary Pathway:
1. ER-structure (SER, RER), transport.
  2. Ribosomes, polysomes, free ribosomes, membrane associated ribosomes & secretary pathway.
  3. Vesicles involved in intracellular transport.
  4. Assembly of cell organelles.
- Unit –III: Cellular respiration & degradation:
1. Mitochondria structure, assembly components.
  2. Peroxisomes – structure and functions.
  3. Endosomes – late and early – structure, formation, assembly & components.
  4. Lysosomes – structure & polymorphism.
  5. Proteosomes – types structures, assembly & functions.
- Unit –IV: Cell cycle division and signal transduction:
1. Cell cycle – cyclines & cyclin dependent kinases & check points.
  2. Cytoskeleton & intracellular movement – microtubule, MTO C.
  3. Micro filaments & intermediate filaments.
  4. Meiosis.
  5. Mitosis – role of mitotic apparatus in cell division.
  6. Signal transduction. Receptor mediated.
  7. G proteins (adenyl cyclase & ion channels phospholipase).
  8. Non-receptor mediated.

Reference Book:

1. Molecular biology of the Cell –Bruce Albert Pub. By Garland Pub. Inc. New York & London.
2. Molecular Cell biology – Lodish Berk, Matsudaira, Kaiser, Krleger (2004) pub. By W.,H. Freeman & Company, New York.
3. Molecular cell biology – Gerald carp (2005) pu. By John Wiley & Sons.
4. Avers C.J. (1986)/ latest edition) Molecular Cell Biology, Addison- Westey, Reading in Massachusettes.
5. Baserga, R (1985)/ latest edition) The Biology of Cell Reproduction. Harward University Press Cambridge, Massachuselts.
6. Beck, F. and J.B. Lloyd (eds) (1974) The Cell in Medical Science, Academic Press, London.

**Additional Reading:**

7. Callan, H.G (1986)/ latest edition) Lampbrush Chromosomes Springer – verlag New York.
8. Chambliss, G(ed)(1980)/latest edition) Ribosanes – Structure, Function & Genetics University of Park Press, Baltimore.
9. Edmunds, L.N. 1984 / latest edition- Cell Cycle Clock, Marcel Dekker, New York.
10. Edmunds, L.N. 1987/ latest edition. Cellular & Molecular Basis of Biological Clocks Springer – Verlag Berlin.
11. Gomperts, B.D.(latest edition) Plusma Membrane Academic press, New York.
12. Henning, W (ed) 1987/ latest edition Structure & Function of Eukaryotic Chromosanes Springer – Verlag, Berlin.
13. Moens, P.B. (ed) 1987/ latest edition Meiosis Academic Press, Orlands, Florida, USA.
14. Nomura, M.A./Tissiers & P. Lengyel (eds). 1974 Latest edition – Ribosomes Cold Spring Harber Laboratory Press, New York.
15. Tzagtoloff. A 1982/ latest edition Mitochondria Plenum Press, New York.
16. E. Munn 1982/ latest edition, Mitochondria: Structure, assembly & function.
17. Whaley – The Golgi apparatus 1976/ latest edition. The Frontiers in Cell Biology series Academic Press.
18. HoltzmanE The frontiers in Cell Biology series Academic Press.
19. Petty H.R 1993. Molecular Biology of Membrane Plenum.
20. Yeagle P.L. 1993. The Membranes of Cells 2<sup>nd</sup> ed.Academic Press.
21. Berger E.G. et.al. 1998. Reviews of Golgi Complex Trends Cell Biology Vol. 8 No.1.

22. Rapoport, T.A. et al. 1996. Protein Transport across the eukaryotic ER & Bacteria inner membrane *Annu. Rev. Biochem.* 65:271-303.
23. Robinron M.S. 1997. Coats & vesicle budding *Tred Cell Biol.* 799-102.
24. W.Baumeister et al. 1998- The Proteosome: Paradigm of a self compartmentalizing protease *Cell* 92:367-380.
25. Robison, M.S. et al 1996 Membrane dynamics in endocytosis *Cell* 84: 13-26.
26. Amos, L.A & Amos W.B. 1991 *Molecules of Cytoskeleton* Guilfor Press.
27. Bay,D. 1992 *Cell Movement* Garkud.
28. Drubin, D & Hirokawa N. Eds 1998. *Cytoskeleton Curr. O pin. Cell. Biol.* Vol.10,1.
29. Hyams, J.S. & Lloyd, C.,W. 1994 *Microtubules* Wiley-liss.
30. Stearns, T. & Winey, M. 1997. The Cell Center at 100 *Cell* 91:303-309.
31. Shaw, P.J. & Jordan, E.G. *The nucleotus*, 1995 *Ann. Rev.Cell. Dev. Bio.* 11: 93-121.
32. Green, R. & Noller, H.F. 1997.
33. *Ribosomes & translation.* *Ann.Rev. Biochem.* 66: 679-716.
34. Hill W.E. et al 1990 *The Riboson: Structure function & Evolution – American Society Microbiology.*
35. Davis L.I. 1995. The nucleus pore complex *Ann.Rev. Biochem.* 64: 865-896.
36. Lamond, A.I. & Earnshaw, W.C. 1998. Structure & function in the nucleus *science* 280:547-553.
37. Ohino, M. et al. 1998. Nucleocytoplasmic transport The last 200 nanometers *Cell* 92: 327-336.
38. Spector, D.L. 1993. Macromolecular domains within the nucleus. *Annu. Rev. Cell Biol.* 9:265-313.

**M.Sc. Zoology**  
**Academic Flexibility / College P. G. Centres**  
**M.Sc.-I Sem.-I**  
**Paper -IV– Applied Entomology**

Unit –I:

Identification, Characteristics, Biology, Damage and Control of pests. Study of generalized insect: Grass hopper & Butterfly – Morphology and Anatomy.

**House hold pests:** Cockroaches, Ants, Crickets, Clothes Moths, Carpet beetles, Furniture beetles, Cigarette beetles, House hold hairy caterpillar, Silverfish, Book louse, Wasps.

**Stored grain pests:** Rice weevil, Rice moth, Termites, Khapra beetle, Pulse beetle, Rust red floor beetle.

**Medicinal Pests:** Mosquitoes, Housefly, Bedbug, Sand fly, Human lice, Tse Tse fly, Rat flea, Hippobosca.

Unit –II:

5. **Veterinary pests** – mosquitoes, sandfly, Horsefly, Blowflies, stable fly, warble fly, crew worm fly, fleas.

6. **Forest Pests** – Termites, leaf miners, *Pteroma plagoepheps*, *Hypsa ficus*, *Eumeta crameri*, *Spodoptera litura*, *Eutectona machearalis*, *Hyblea puera*, *Acherontia sty*, *Inderbella sp.*, *Sahyadrassus malabaricus*, Bamboo leaf roller, *Spruce bud worm*, *Lyctus beetle*, *Achea janata*, *Sal borer*, *Spilosoma oblique*, gall midge, *Batocera rufumacualata*, lace wing bug, *Anomala bengalensis*.

Unit –III:

7. **Sericulture:** Types of silk worms (Mulberry & Nonmulberry), Moriculture, Rearing of Mulberry Silkworm, Diseases and pests of silk worm. Diseases and pests of mulberry.

Unit –IV:

8. **Forensic insect:**

9. **Insects on human food.**

10. **Lac culture:** cultivation practices of host plants, extraction and uses of lac, pest and diseases of lac insect.

11. **Apiculture.**

**M.Sc. Zoology**  
**Academic Flexibility / College P. G. Centres**  
**M.Sc.-I Sem.-I**  
**Practical – I**  
**Practical based on paper – I & II**

1. Study of museum specimens and slides invertebrates phyla (one representative from each class) for biosystematics & biodiversity.
2. Study of museum specimens of chordates phylum (one representative from each class) for biosystematics and biodiversity.
3. Study of plant groups with respect to biodiversity.
4. Identification of insects/ molluscs with the help of keys up to orders.
5. Identification of insects/ molluscs with the help of keys up to families.
6. Identification of animals with the help of keys up to families (fish/ amphibian with the help of preserved specimens / models / pictures).
7. Methods of collection, preservation and curation of animals.
8. Visit to ZSI.
9. Study of inter relationships parasitism, symbiosis, commensalisms (2-3 examples from each).
10. Study of endangered species. (Models, pictures, charts.).
11. Study of adaptations in animals from pieces, amphibian, reptilian, birds & mammals (2-3 examples from each).
12. Visits to sanctuaries and National parks to study wild life management.
13. Study of community character by Quadrant & transect method.
14. Study of ecosystem (Soil, water, forest).
15. Use of software for identification of plants & animals.
16. Assessing existing data base on www.
17. Harnessing information through Internet regarding Biodiversity.
18. Preparation of culture media isolation of DNA from plants & animals.
19. Study of microbes isolation, culture and staining from soil & water.
20. Determination of DO, CO<sub>2</sub> Hardness, Chloride, Alkalinity of freshwater and sewage water.
21. Determination of COD of sewage water.
22. Determination of BOD of sewage water.
23. Estimation of inorganic phosphate and nitrate from water sample.
24. Qualitative and quantitative estimation of Zooplanktons.
  1. Detection of heavy metal from the water sample.
  2. Practices set on the network – internet, protein information, Genome & Chromosome database set by teacher.
27. Any other experiment set by the concerned teacher.

**M.Sc. Zoology**  
**Academic Flexibility/College P.G. Centres**  
**M.Sc.-I Sem.-I**  
**Practical – II**

**Practical based on paper – III & IV**

1. Demonstration of extracellular material
  - a. Collagen
  - b. Elastin
2. Demonstration of Glycosaminoglycans in the extracellular material using
  - a. AB-1
  - b. AB-2.5
  - c. PAS
  - d. AF +AB 2.5 (Sialic Acid)
  - e.  $\text{MgCl}_2$  influence on alcinopilia.
3. Study of cell Organelles.
  - a. Nucleus demonstration by
    - i) Basic Dyes : TB, HE, Methylene blue.
    - ii) Feulgen reaction Effect of temperature
4. Lysosome demonstration (Acid phosphatase and any other method)
5. Golgi bodies demonstration (Cajal Method)
6. Effect of tonicity of solutions on plasma membrane – Isotonic, Hypotonic, Hypertonic
  - b) Fragility test of RBC & Osmotic Resistance.
7. Study of generalized insect. Identification economic importance of following insect pests (6-8 pests from each category)
8. Pests of stored gains.
9. Household pests.
10. Pests of medical importance.
11. Pests of veterinary importance.
12. Forest pests.
13. Types of silk moths.
14. Rearing appliances of mulberry silk worm and demonstration.
15. Study of forensic insects
16. Study of nutritional insects.
17. Life cycle and types of honey bees.
18. Lac insect economic importance.
19. Field visit for demonstration of pest damage.

**M.Sc.-I Sem.-II**  
**Paper- V : Physiological chemistry**

**Unit I**

**1.0 Biomolecules of cells**

Water as a solvent  
Proteins – structure, classification and function  
carbohydrates - structure, classification and function  
Lipids- structure, classification and function  
Nucleic acids- DNA structural elements, RNA structural elements-  
tRNA, rRNA

**Unit 2**

**2.0 Carbohydrate metabolism**

Glycolysis  
TCA cycle  
Electron transfer and ATP generation  
Bioenergetics of ATP cycle  
Gluconeogenesis and Pentose phosphate shunt and glycogenesis

**Unit 3**

**3.0 Lipid metabolism**

catabolism of fatty acid – Beta oxidation, significance of beta oxidation, alpha and omega oxidation.  
Biosynthesis of lipids – biosynthesis of saturated fatty acids, biosynthesis of triglyceride, biosynthesis of membrane phospholipids, biosynthesis of cholesterol, biosynthesis of prostaglandins and leukotrienes  
Lipoprotein metabolism

**Unit 4**

**4.0 Vitamins and coenzymes, steroids and nucleotides and amino acids metabolism**

Fat soluble vitamins and water soluble vitamins.  
Steroidal hormones  
Biosynthesis of nucleotides.  
Biosynthesis of essential and non essential amino acids.  
Oxidation of amino acids.

**Reference**

1. A K Anderson- Essentials of physiological chemistry.
2. H. Harper- Review of physiological chemistry.
3. P. Karlson- Introduction to modern biochemistry
4. West E and Todd W- Text book of biochemistry
5. Mahler H and Cordes E – Biochemical chemistry
6. Lehninger's- Biochemistry – COX & Nelson.
7. Reithel F J- Concepts in Biochemistry
8. G H Bell , Je N Davidson and D E Smith- Text book of physiology and biochemistry
9. Mitton and Toporely- Essentials of biochemistry

10. Outline of Biochemistry by Conn & Stump.

**M.Sc. Zoology**  
**Academic Flexibility /College P. G. Centres**  
**M.Sc.-I Sem.-II**

**Paper- VI: Quantitative Biology and Tools and Techniques in Biology**

**Unit I:**

**Introduction, Application in Biology:**

**Hypothesis Testing:**

Significance test, student – t – test, chi-square test, level of significance, confidence limits

**Probability:**

Theory of probability, Probability rules, Probability distribution, Normal and binomial distribution

**Unit II:**

**Correlation:** Types of Correlation

Regression analysis, Analysis of Variance (ANOVA)

**Basic Mathematics for Biologist:** Matrices and vectors, Exponential functions, periodic functions.

**Unit III:**

**(A) Analytical instruments and their applications in Biology.**

1. Spectroscopy (Spectrophotometry, Spectroflurometry, NMR, IR, ESR).
2. X-rays & lasers in Biology.

**(B) Separation techniques.**

1. Centrifugation techniques. Basic principles of sedimentation and centrifuges & their uses, differential centrifugation, density gradient centrifugation.
2. Chromatographic techniques – Chromatography theory & practices, column chromatography, HPLC, affinity chromatography, ion exchange chromatography, GLC, Thin layer chromatography.



3. Electrophoretic techniques – General principles, support media electrophoresis of proteins, and nucleic acids, Isoelectric focusing.

#### **Unit IV:**

##### **Microscopy, Radiometry & Immunochemical techniques.**

1. Light microscope, phase contrast microscope, fluorescent microscope, Electron Microscope (SEM & TEM).
2. Autoradiography & Radiolable techniques in biology.
3. Production of antibodies, immunoprecipitation, Labelling antibodies, immunoblotting, immunoassay & immunohisto / cytochemistry.

#### **Reference Books:**

1. Practical biochemistry – principles & techniques – Keith Wilson and John Walker.
2. Separation techniques in Biochemistry – Morison.
3. Methods in Enzymology – volumes telling with immutoological techniques.
4. Biostatistics and computer Science by Shah Y.I., Paradkar A.r. and Dhayagude M.G.
5. Statistics by R.C. Gupta.

**M.Sc. Zoology**  
**Academic Flexibility / College P.G. Centres**  
**M.Sc.-I Sem.-II**

**Paper – VII: Elements of physiology**

**Unit I:**

- A) Gastrointestinal tract and associated organs ( liver, pancreas, salivary gland- nervous control, blood flow, digestion, absorption, physiology and assimilation of carbo, Froth X lipids disorders of carbo, Froth X lipid metabolism.
- B) Dietary balance, regulation of feeding, obesity and vitamins and their role in nutrition.
- C) Physiology of Respiration: pulmonary ventilation, circulation exchange of gases regulation of respiration.

**Unit II:**

- i) Heart- cordial muscles, as a pump, working, cardiogram-  
- Systemic circulation, and local circulation
- ii) Body fluids- blood, lymph, blood clotting, homeostasis
- iii) Kidney- Structure of formation of urine, control of body fluids and their constituents and acid base balance
- iv) Cerebrospinal fluids and brain metabolism

**Unit III:**

- 1. Central nervous system  
sensory nervous system  
motor nervous system  
Processing of information and conduction of nerve impulse, muscle and smooth muscle physiology.  
storage of information
- 2) Autonomic nervous system- sympathetic and parasympathetic 3) 3)
- 3) Special senses- vision , hearing , chemical sense (taste and smell), somatic senses

**Unit IV:**

- i) Pituitary and its hypothalamic control
- ii) Structure and functions of thyroid and parathyroid.
- iii) Pancreatic and adrenacortical hormones and their functions
- iv) Gonads and reproduction.

**Reference:**

- Human Physiology – by A.C. Guyton. Saunders Company London, Toronto.
- Shepherd G.M. Neuro Biology, New York Oxford University Press 1987.
- Hurst J.W et al (eds) The Heart 7th ed. New York McGraw- Hill Book Co. 1990.
- Hand Book of Physiology Vols. Circulation. Renkin, E.M. & Michel, C.C. (eds) Americal Physiological Society, 1984.
- Gayton A.C. et al. Circulation Overall regulation Annu Re. Physiol. 34: 13 1972.
- Guyton A.C. 1980 Arterial pressure & Hypertension Philadelphia, W.B. Saunders Co- Cartiar output & its regulation 1973.
- Kaplan N.M. et al 1989- The Kidney in Hypertension (Perspectives in hypertension vol.2) New York. Raven Press.
- Guyton A.C. et al 1975 Dy namics & Control of the Body flerids Philadelphia, W.B. Saunders, Co., 1975.
- Brenner B.M. & Rector, F.C. (Jr) 1986. The kidney 3<sup>rd</sup> ed. Philadelphia, W.B. Saunders Co., 1986.
- Brooks V.B. 1986. The neural Basis of motor control New York, Oxford University Press.
- Johnson L.R. et al Physiology of the gastrointestind tract 1987 New York Raven press.
- Thompson J.C. et al (eds) Gastrointestinal Endocrinology. New York McGraw Hill book co., 1987.
- Setchell K.D.R. et al eds 1988. The Bile Acids New York Plenum Pub. Corp.
- Guthrie H.A. 1988. Introductory Hutrition 7<sup>th</sup> ed. St.Lonis C.V. Mosby Co.,
- Felig P et al (eds) 1987. Endocrinology & Metabolism New Your MacGraw- Hill Book Co.,
- DeGroot L.J. et al 1989. Endocrinology 2<sup>nd</sup> ed. Philadelphia, W.B. saunders Co. 1989.
- Kannan, C.R. 1988. The adrenal gland New York Plenum Pub. Corp.
- Wozney J.M. et al 1988. Novel regulators of bone formation: Molecular clones & cultivates science 242: 1528.
- Martin R.B. & Burr D.B. 1989. Structure, function & adaptation of compact Bone New York, Raven Press 1989.
- Knobil E. et al (eds) The physiology of Reproduction New York, Raven Press 1988.
- Leung P.C.K. et al (eds) Endocrinology & Physiology of reproduction New York Plenum Pub. Corp. 1987.

**Academic Flexibility / College P. G. Centres**  
**M.Sc.-I Sem.-II**  
**Paper- VIII: Biology of Parasites**

- Unit –I: Animal association: Intra and inter specific type of parasites, Types of hosts. Host parasite interrelationship. Specificity of hosts and adaptations of parasites Q hosts.
- Unit –II: Vectors: flies: order diptera. Bugs: order Hemiptera, Ticks class: Arachnida. Epidemiology: Biochemistry, Physiology & Immunology immunity to parasites and control measures.
- Unit –III: Study of parasite. protozoan & castoda
1. Trypanosomes and leishmonia of humans.
  2. Intestinal flagellates Giardia, Q Trichomonus, Coccides, Theileria and Babesia Gregarina.
  3. General life cycle of cestoda: Tacnia, Diphilabothrium, Diphylidium, Echinococcus & Davainia.
- Unit –IV: Study of parasite. Trematodes & Nematodes Hetelophyses, Schistosomo, Faciola, paragonimus, Opisthorchis Dicidecolium. Nematocles: Wuchreia, Ancylostoma, Trichinella Strongyloides, Entrobilus, Ascardea galtae, plant nematods & Soil nematodes: Cyst nematode, citrus nematode.

**Books:**

1. Parasitology – By Ramnik sood, C.B.S. Publisher, New Delhi – 1993.
  2. Parasitology – By K.D. Chaterjee, Medical Pulisher Calcutta, 1987.
  3. Physiology of parasites – By L.S. Chapell, John, Willey & Sions N.Y. (1980).
  4. Parasitology – By Hobler, E.R. and Noble, G.A. (1982) 2<sup>nd</sup> Ed. Lea & Febieger U.S.A.
  5. Parasitism & Symbiology – By C.P. Read (1970) Ronald Press New York.
  6. Foundation of Parasitology – By Schmidt, G.D. & Robert, L.S. (1981) 2<sup>nd</sup> Ed. C.V. Mosby Co. St. Lohis ISSR.
  7. Introduction Animal Parasitology – By Smit. D.G. (19977) 2<sup>nd</sup> Ed. Johns Willey Sons New York.
- The Biology of parasitism and introduction to the study of associate organism- by White field, P.J. (1977) University Parks Press Baltimore.
- Animal Parasitism – by Read C.P. Prenters Hall of India Pvt. Ltd., New Delhi.
- Helminths, Arthropods & Protozoo of domesticated Animals. By E.J.L. soulsby, ELBS publication London Ed. 1969 ed.
- Parasitology – by Chandler and Chands,

A Text book of Parasitology by S.S. Kelkar and Rohini S. Kelkar,  
Bombay popular prakashan.

**M.Sc. Zoology**  
**Academic Flexibility / College P.G. Centres**  
**M.Sc.-I Sem.-II**  
**Practical – III**  
**Practical based on paper – V & VI**

1. Estimation of glycogen.
2. Estimation of lipids & phospholipids.
3. Estimation of Vitamin C.
4. Estimation of Cholesterol.
5. Estimation of alpha-amino nitrogen by formol titration..
6. To find saponification value for a given fat.
7. To prepare phosphate buffer of known pH and molarity- pH measurement, measurement of pH of lemon juice, urine and serum.
8. To find absorption spectrum of hemoglobin, bovine serum albumin, tyrosine and (uv-visible).
9. To estimate free amino acids by Ninhydrin method.
10. To estimate protein content by Biuret method/ Lowry et.al./ Bradford method.
11. To estimate the sugar by Nelson-Somogyi method and glucose.
12. Separation of sugars by TLC.
13. Spot test of amino acids.
14. Examples based on different population genetical principles (Based on theory).
15. To isolate proteins by salting out or by adjusting isoelectric point.
16. To estimate tyrosine content by Folin-phenol method.
17. To estimate the purity of ATP.
18. Examples based on Chi-square test & student t-test.
19. Examples based on regression.
20. Examples based on Correlation coefficient.
21. Examples based on Coefficient of variance.
22. Examples based on ANOVA.
23. Examples based on Probability.
24. Any other practical set by the department.

**M.Sc. Zoology**  
**Academic Flexibility / College P. G. Centres**  
**M.Sc.-I Sem.-II**  
**Practical – IV**  
**Practical based on paper – VII & VIII**

1. Detection of Amylase from saliva / Salivary glands of insects / sheep gastro intestinal tract pepsin trypsin detection.
2. Glucose tolerance test.
3. Blood clotting time.
4. Blood – analysis (glucose, proteins, albumin RBC count WBC count. Differential WBC count.
5. Urine analysis.
6. Brain parts – histological analysis.(Rat/mouse)
7. Pituitary cell types.
8. Thyroid – histology & PAS +ve secretion.
9. Hypotrophy & hypertrophy (hormone induced) in gonads atomized rats/ mice.
10. Study on some imp. Specimens belonging to protozoa, platy helminthes & Nematohelminthes. (Including soil & plant -nematodes)
11. Important arthropod vectors of human and animal diseases.
12. Collection, preservation and identification techniques to study parasitic protozoans.
13. Collection, preservation, identification and staining techniques for platy helminthes & Nematohelminthes.
14. Collection, preservation & identification of arthropod vectors of parasites.
15. Study of larval/ asexual developmental stages of parasites.
16. Any practical / experiments set by the Department.

**M.Sc. Zoology**  
**Academic Flexibility / College P.G. Centres**  
**M.Sc.-II Sem.-III**

**Paper – IX: Animals in Biotechnology**

**Unit –I**

**1. Animal care and use.**

- i) Animal protection act.
- ii) Animal ethics and associated laws and issues for use of laboratory animals.
- iii) Animal Care and Management of Laboratory Animals-  
Animal House – Necessities Design and maintenance:  
Infrastructure, Cages, Conditions and other requirements for Maintenance, Biology of four laboratory animals- Rat, Mouse, Rabbit & Guinea pig.  
Breeding and maintenance of Rat, Mouse, Rabbit, Guinea pig.  
Nutritional requirements for normal breeding and maintenance  
- Modifications for nutritional experimental work (at least two examples viz. protein deficient diet and supplementation)
- iv) Reproductive event studies – Estrus cycle, decidual reaction etc.
- v) In vivo immunological studies- Paw edema, Granulomata, Hypersensitivity models.
- vi) Normally aged animals for senescence studies.

**Unit II**

**2. Laboratory Animal models and application.**

- 1. Surgical models for Endocrinological and Reproductive Biological studies  
*In vivo* studies of estrous cycle, implantation, pregnancy  
Gonadectomised, Adrenalectomised, Hypophysectomised, Sham operated, Thymectomised and splenectomised rats, mice etc.  
Foster mother  
Hormonal supplementation studies  
In vivo models of hepatitis diabetes , Hypercholesterolemia, atherosclerosis, senescence and their use & its use in drug testing.  
Cloned animals  
Preparation, maintenance and uses  
Genetically engineered animals -Development and maintenance  
Transgenic animals  
Knock out and knock in animals.

**Unit III**

## **Invertebrate animal models**

- i) Differentiation and developmental models-

### **Organogenesis in invertebrate model system:**

*C. elegans*- Developmental control genes & rules of cell behavior.

*D. melanogaster* -Molecular aspect of pattern formation, )

*Arbacia punctata*, and *Aplysia* (for neurophysiological studies)

- ii) Models used for studies of genetics *C. elegans*, *D. melanogaster*, silkworm
- iii) Pollution indicators and environment assessment indicators- Zooplanktons, water insect and larvae's, soil nematodes, annelids and mollusk
- iv) Invertebrates in population dynamics studies.
- v) Aquatic invertebrates – as metal bioaccumulation models.

## **Unit IV**

### **1. Vertebrate animal models**

- i) for development and genetics studies.
  - Heart development.
  - Kidney development/

*Danio rerio* (Zebra fish)- development mutants studies.

*Xenopus* species-development (thyroid hormone studies) and genome studies(Mesoderm induction and patterning, Hox genes).

Chick *Gallus domesticus* development for teratogenic effects studies, angiogenesis studies..
- ii) For biomedical and immunotoxicity studies
  - *Danio rerio* human disease model (e.g. eye diseases).
  - Carp (Type I diabetes).
  - Rainbow Trout (carcinoma studies).
  - Snakes (for encephalitis virus infection Salmonella etc ).
  - Aquatic invertebrates metal bioaccumulation models .
- iii) for physiological studies.
  - *Gnathonemus petersii* (electric fish) for neurophysiological studies.
  - *Danio rerio* (Zebra fish) immunotoxicological models.

Snake- venom studies.

Genetics Gardner  
Brace Albert  
Strickberger.



**M.Sc. Zoology**  
**Academic Flexibility / College P. G. Centres**  
**M.Sc.-II Sem.-III**

**Paper-X: Enzymology**

**Unit- I:**

- 1.0 Classification and Nomenclature of Enzymes, Isoenzymes, Multienzyme Complexes.
- 2.0 Cofactors.
  - 2.1 Inorganic.
  - 2.2 Organic.
    - a. Pyridoxyl Phosphate.
    - b. Biotin.
    - c. Lipoic acid.
    - d. Thiamine diphosphate.
    - e. Flavin nucleotides.
    - f. Nicotinamide.
- 3.0 Purification of Enzymes.
  - 3.1. Objectives and strategies.
  - 3.2 Methods of separation.
    - a. Centrifugation.
    - b. Dialysis.
    - c. Gel-filtration.
    - d. Ion Exchange chromatography.
    - e. Electrophoresis.
    - f. Isoelectric focusing.
    - g. Affinity chromatography.
- 4.0 Structure of Enzymes.
  - 4.1 Primary, Secondary, tertiary and quaternary.
  - 4.2 Active sites and Allosteric sites.
  - 4.3 Structure of chymotrypsin.
- 5.0 Enzyme Kinetics.
  - 5.1 Relationship between initial velocity and substrate concentration.
  - 5.2 Michaelis Menten equation.
  - 5.3 Briggs Haldane Hypothesis.
  - 5.4 The Line Weaver Burk Plot.
  - 5.5 The Halden relationship for reversible reaction.
  - 5.6 Effect of Modifiers on enzyme Kinetics.
  - 5.7 Effect of temperate.
  - 5.8 Thermal denaturation.
  - 5.9 Effect of pH.
- 6.0 Enzyme Actions of-

- 6.1 Chymotrypsin.
- 6.2 Fructose biphosphate aldolase.
- 7.0 The control of Enzyme Activities by Non Genetic Mechanism.
- 8.0 Enzymes in Organised System.
  - 8.1 RNA nucleotidyl transferase.
  - 8.2 The Pyruvate dehydrogenase.
- 9.0 Enzyme Technology.
  - 9.1 Use of isolated enzymes in industrial processes.
  - 9.2 Immobilized enzymes.

#### Suggested Reading Material:

Fundamentals of Enzymology : Price N.C. and L. Stevens e.. Oxford New York.

Dixon, M., Webb, E.C; et al. (3<sup>rd</sup> Ed.) Longman, London.

Methods in Enzymology all volumes.

Scopes, R.K. Protein Purification, Principles and Practice.

Ferdinand, W. (1976) fundamentals of enzyme kinetics, Butterworths, London.

Enzyme by Palmer.

Niggins, I.J. Best D.J. and Jones, J. Biotechnology – Principles and applications, Black well, scientific oxford (1985).

Bulock, J. and Kristiansen, B- (1987) Basic biotechnology.

**M.Sc. Zoology**  
**Academic Flexibility/ College P.G. Centres (Y.C.I.S.Satara)**  
**M.Sc.-II Sem.-III**  
**Cell biology – Elective Paper- I**

**Paper-XI: Computational Molecular Biology**

- Unit –I: Basis of computational molecular biology.
1. DNA Physical, Chemical & Biological characters.  
DNA sequencing, PCR, Nucleic acid hybridization technology, DNA libraries, genomic, CDNA & gene libraries.
  2. RNA sequencing & protein sequencing, protein structure and protein families.
  3. Genetic code, its features, co don preference.
  4. Gene structure, prediction of open reading frame, predict of RNA sequences protein sequences (6 frame translation) gene search.
  5. Genomic marker – RAPD, RFLP, SNP, EST etc.
- Unit –II: Sequence comparison methods & search algorithms:
1. Searching sequence databases by sequence similarity. (Nucleic acid and proteins).
  2. Pairwise alignment techniques – local and global similarities, global alignment (Need emann & which algorithm), dot plot method.
  3. Multiple sequence alignment, consensus sequences.
  4. Different algo rithems – FASTA, different types) BLASTA (different types), CLUSTAL-W & recent algorithms, analysis packages.
- Unit –III: Phylogenetics, gene analysis & protein structure prediction:
1. Cladistics ontology, softwares for building phylogenic trees, finalizing tree.
  2. Evolution of macromolecular sequences & sequence annotation.
  3. Microarray and genomic & proteomic data analysis, gene searching, chromosomal mapping.

- Unit –IV: Building a sequence search protocol & structural bioinformatics.
1. Problems & difficulties.
  2. Structural & functional interpretation.
  3. Protein families & pattern database multiple sequence alignment.
  4. Models of protein structure, function & their evolution.
  5. Structural alignment (classification of proteins by CATH & SCOP).
  6. Protein structure prediction & modeling.
  7. Higher order systems.

Reference Books:

1. Introduction to Bioinformatics (2002) – AM Lesk Pub. By oxford University Press.
2. Bioinformatics – A practical guide to the analysis of genes & proteins (2001) = Ed by A.D. Baxevanis & B.F, Francis Ouelletele pub. By A Jahn Wiley & sons publication, New York.
3. Introduction to Bioinformatics (2003) T.K. Atwood & D.J. Parry smith.
4. Instants notes – Bioinformatics (2003) West head D.R. Parish J.H. & Twyman R.M.
5. Pearson Education (Cell & Molecular biology in action series).

**M.Sc. Zoology**  
**Academic Flexibility/College P. G. Centre (S .G.M. Karad)**  
**M.Sc.-II Sem.-III**  
**Comparative Animal Physiology**  
**Elective Paper- I**  
**Paper- XI: Invertebrate endocrinology**

**Unit - I:**

**1.0 Endocrinology, Comparative endocrinology**

- 1.1 Concept of homeostasis.
- 1.2 Homeostasis and neuroendocrine integration.
- 1.3 Classes of hormones – Synthesis, secretion, circulation, metabolism and physiological roles

**Unit -II:**

**2.0 Structure & chemistry of Invertebrate hormones.**

**Unit –III:**

**3.0 Endocrine regulation of reproduction in Invertebrates.**

- 3.1 Hormones and control of female reproduction.

**Unit -IV:**

**4.0 Endocrine control of growth and development.**

- 4.1 Regeneration.
- 4.2 Metamorphosis in –Arthropods.
- 4.3 Reproduction.

**5.0 Neuroendocrinology of gut and other organs in invertebrate.**

- 5.1 Gut endocrine system (Mid gut and associated).
- 5.2 Pheromones hormonal control of Metabolism and Osmoregulation, Dipause.
- 5.3 Hormones in insect pest control.

**References:**

1. Modern entomology- Dr. D B Tembore Dpt. Of Zoolgy Nagpur University, Nagpur. Himalaya publishing house
2. Resent advances in insect endocrine research Editors- D Murlidharan and Mariamma Jacob.
3. General and comparative physiology William S. Hoar, Latest edition Prientice- Hall of India pvt ltd , New Delhi.
4. Endocrinology – Mac E Hadley, latest edition.
5. Comparative K.G. Hignam and Hill L. invertebrate endocrinology.
6. Biochemistry by Metzler.

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-III**  
**Paper- XI: Basic Entomology**  
**(Entomology Elective Paper-I)**  
**(Evolution, Diversity, Morphology & Classification of Insects)**

**Section –I : Evolution and Morphology:**

- Unit –I:     Arthropod Evolution:  
                  Introduction.  
                  Arthropod diversity.  
                  Theories of arthropod evolution.  
                  Evolution of diversity of insects.  
                  Insect and Man:  
                  Introduction  
                  Beneficial insects.
- i)     Insects whose products are commercially  
                              valuable.
  - ii)    Insects as pollinator.
  - iii)   Insects as agents of biological control.
  - iv)   Insects as food.
- Generalized insect body structure:  
                  Introduction.  
                  The Head.  
                  The Thorax.  
                  The Abdomen.
- Unit –II:     The head –  
                  The mouth parts.  
                  Antennae.  
                  The Thorax –  
                  Thoracic segmentation.  
                  Loco motion.  
                  The wings.  
                  Insect flight.  
                  The Abdomen –  
                  Segmentation.  
                  Skeletal composition.  
                  Pregenital, genital & post genital segments.

Abdominal appendages.

## **Section –II : Diversity & Classification:**

Unit –III: Classification of insects.  
Modern scheme of insect.  
Extinct insect orders.  
Apterygote orders.  
Thysanura.  
Diplura  
Proturo.  
Collembola.

Pterygote orders.  
Ephemeroptera.  
Plecoptera.  
Odonata  
Embioptera  
Orthoptera  
Phasmoda.  
Dermaptera.  
Blattaria.  
Mantodea  
Isoptera.  
Psocoptera.  
Mallophaga  
Anoplura  
Thysanoptera  
Heteroptera  
Homoptera.

Unit –IV: Endopterygote orders –  
Coleoptera  
Hymenoptera  
Megaloptera  
Neuroptera  
Lepidoptera  
Diptera.

Note: -

1. While describing insect orders, details of the habitats, External morphology internal anatomy & classification at least up to families with suitable example are considered.

2. Those orders which are very common & represented in this region and not describe in syllabus will be covered in practical.



**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem. – III**  
**(Sericulture Elective Paper-I)**  
**Paper – XI: General Sericulture & Moriculture**

**Unit –I : General Sericulture.**

**History and scope of Sericulture.**

- General account of global production of mulberry and non-mulberry silk
- Silk route.
- Geographical distribution of mulberry & non-mulberry sericulture.
- Scope of sericulture in India.
- A comparative studies of sericulture v/s other agricultural crop.

Systematic position & salient features of mulberry and non-mulberry silkworms. (Salient features of class, order, super family, family etc.)

**Unit –II : Soil management.**

**Concept of mulberry cultivation.**

Agro climatic zones and agro climatic conditions for mulberry cultivation.

Site suitability for mulberry garden establishment.

Soil Management.

Classification of different types of soil.

Physical and chemical properties of soils.

Selection & preparation of land for mulberry cultivation.

**Unit –III : Moriculture.**

Mulberry varieties characteristic features of popular mulberry varieties of tropical & temperate regions.

**Mulberry propagation –**

1. Scope and significance of sexual and asexual propagation.
2. Different methods of propagation.

**Mulberry crop production –**

1. Planning for establishment of mulberry garden.
2. Concept and establishment of mulberry garden for chawki & late age worms.

**Water management –**

1. Concept of irrigation.
2. Methods of irrigation.

3. Frequency of irrigation.

**Unit –IV : Pest and Diseases Mulberry.**

**Pests:**

1. Lepidopteron pests.
2. Coleopteron pests.
3. Orthopteron pests.
4. Dipteron pests.
5. Hemipteron pests. (Sap feeders)

**Diseases:**

1. Fungal diseases – Root rots, Powdery mildew disease. Leaf spot, Leaf rust etc.
2. Bacterial diseases - Leaf blight diseases, Bacterial not root rot.
3. Viral diseases – Mulberry leaf mosaic disease.
4. Nematode diseases.

**References:**

Reference books at the end of Sericulture elective paper-IV.

**M. Sc. Zoology**  
**Academic Flexibility**  
**M. Sc. II, Semester – III**  
**(Aquaculture and Fisheries Elective Paper – I)**

**Paper- XI: Fisheries Resources – Inland and Marine Fisheries**

**Unit 1:**

**A. Marine Capture Fisheries:**

**Coastal fisheries** – Sardine, Mackerel, Bombay duck; **Off-shore fishery** – Sole, Tuna, Pomphret; **Crustacean fishery** – Lobsters, Crabs, Shrimps; **Molluscan fishery** – Mussels, Oysters, Clams; **Ornamental fishery** – Fishes, Corals, Sponges

**B. Marine Fisheries of the World:**

Review of marine living resources; Major fishing nations of the world; Major fishing regions of the world; Their catch and nations harvesting; Present and future status of world fisheries; Estimation of potential harvest and problems of development

**Unit 2:**

**A. Freshwater (Inland) Fisheries of India:**

Riverine fisheries, Reservoir fisheries, Sewage fed fisheries, Lake and pond fisheries

**B. Carp Seed Resources of India:**

Pre-monsoon survey and selection of sites for spawn collection, Techniques of spawn collection, Spawn collection by nets, Identification, Segregation and transport, Present status of carp seed production in India.

**Unit 3:**

**A. Management of Inland Fishery Resources:**

Fishery management in rivers, reservoirs, lakes and tanks, Productivity of various water bodies in relation to fish stocks, Competition, predation and stocking, Techniques in fishery management, Fertilization of water bodies.

**B. Management of Marine Fishery Resources:**

Biological basis of marine fishery management, Objectives of management – biological and non-biological, Concept of maximum sustainable yield, Techniques of management, Fishery regulation and control of catch composition, Allocation of shares and limited entry, International fishery management – i) Law of the sea, ii) Planning of future exploitation, iii) Fishery regulatory bodies; Monitoring control and surveillance .

#### **Unit 4:**

##### **Economics of Fisheries and Extension Programme:**

Marketing and economics of fish production, Co-operative fisheries societies,

Role of government agencies in extension programme, Fisheries education,

Training and extension Problems of fisheries.

#### **BOOKS:-**

##### **FISHERIES RESOURCES – INLAND AND MARINE FISHERIES.**

Management of Marine Fisheries: J.A. Gullad.

Fishery Science: W.C. Royce.

Ecology, Utilization and Management of marine fisheries; G.A. Rounsefell.

Fisheries development of India: U.K. Shrivastava and M. Dharma Reddy.

Aquaculture research needs for 2000 AD: Jaw. Kai. Wang and P. V. Dehadari.

Fish farming hand book: E.E. Brown and J.B. Gratzek.

Fresh water biology: K.F. Lagler.

Fish and Fisheries of India: V.G. Jhingran.

Advances in aquaculture: T.V.R. pillay.

Fishes an introduction to ichthyology: P.B. Moyle and J.J. Cech.

Fishery management: S.C. Agarwal.

Applied fishery science (Vol. I & II): S.M. Shafi.

M. Sc. Zoology  
Academic Flexibility  
M. Sc. II, Semester – III  
Paper- XI  
Food Science, Food Technology and Nutrition

**Food Chemistry**

**Unit- 1:**

- 1. Development of food chemistry.**
  - . Moisture in food.
  - a. Hydrogen bonding.
  - b. Bound water.
- 2. Fats and lipids.**
  - . Properties.
  - a. Flavor.
  - b. Rendering and Pressing.
  - c. Solvent extraction.
  - d. Hydrogenation.
  - e. Products of the fats and oils.
  - f. Shortening. Value of different fats.

**Unit-2:**

- 3. Carbohydrates.**
  - . Different types of sugars.
  - a. Technology of starch – i. Enzymes and starch, ii) FRCTANS, iii) CHITIN, iv) Hyaluronic Acid, v) Pectic substances, vi) Gel formation with pectin.
  - b. Identification of carbohydrates.
  - c. Changes of carbohydrates on cooking.
- 4. Proteins in food.**
  - . Proteins in mans diet.
  - a. Chemical and physical properties of proteins.
  - b. Determination of protein. i. Effect of heat on the proteins.
  - c. Pure Proteins. i. Plant protein, ii. Egg white protein, iii. Milk proteins.
- 5. Flavor and Aroma of the food.**

Sensation of the flavors. Taste and odour, feeling and bland.

Control of flavor and aroma.  
Recent development.

**Unit- 3:**

**6. Meat and Meat products.**

- . Animal structure.
- a. Postmortem changes.
- b. Color of the meat.
- c. Cured smoked meat.
- d. Changes in meat on cooking.
- e. Tenderness.

**7. Vegetables and fruits.**

- . Classification, Composition, Selection, Fungus as a food, Algae as a food.
- a. Fruits – Classification, Composition, post harvest changes and storage Ripening of fruits, Enzymatic Browning and Non enzymatic browning.

**Unit-4:**

**8. Sugar and Related products.**

- . Properties, sugar related products, Sugar cookery, Artificial sweeteners.

**9. Spices and Herbs, Beverages and Appetiser revaluation, revaluation of food quality, food adulteration, food preservatives and food additives.**

**10. Organic food – organic farming, conventional farming, Biopesticides, organic manures, limitations of organic formic and certification of organic farming.**

**Reference:**

Reference books will be provided in due course or by concerned teacher.

**M.Sc. Zoology**  
**Academic Flexibility/college P.G. Centre (Y.C.I.S. Satara)**  
**M.Sc.-II Sem.-III**  
**Cell Biology – Elective Paper - II**

**Paper – XII : MOLECULAR BIOLOGY OF GENE**

**Unit I**

**1.0 Genes concept and structural basis**

- 1.1 Chromosomes- The carriers of the genes (features of chromosome)
- 1.2 Chromosomes as a carrier of genes
- 1.3 Genes as a unit of inheritance
- 1.4 Linkage groups, genetic maps, Crossing over and genetic recombinations.
- 1.5 Genetic recombinations analysis in Drosophila
- 1.6 Polytene chromosome as a gene expression model

**Unit II**

**2.0 Genome stability and complexity**

- 2.1 Viral, prokaryotic, eukaryotic & cell organelle genome.
- 2.2 Gene numbers, repeatation and redundancy, c-value paradox.
- 2.3 Whole genome duplication (Polyploidy).
- 2.4 Gene duplication (globin genes)
- 2.5 Jumping genes & the dynamic nature of the gene & mobile. Role of mobile genetic elements in evolution genetic elements.
- 2.6 Eukaryotic complexity of genome (cot index, Rot index).

- 2.7 Satellite DNAs.
- 2.8 Minisatellite DNAs (Polymorphic) NTR.
- 2.9 Microsatellite DNAs.
- 2.10 Repeated DNA sequences with coding functions.
- 2.11 Repeated DNA sequences that lack coding functions (SINES & LINES).
- 2.12 The markers used in DNA fingerprinting RFLP, RAPD, SNPs etc.,

### **Unit III**

#### **3.0 Gene & its expression:**

- 3.1 Concept of gene
- 3.2 Transcriptional control of gene expression in prokaryote (Lac, trp operon).

#### **4.0 Transcriptional control of gene expression in eukaryotes:**

- 4.1 RNA polymerases and gene control.
- 4.2 Regulatory sequences in protein coding gene.
- 4.3 Activators & Repressors of Transcription.
- 4.4 Regulation of transcription factor activity.
- 4.5 Regulation of elongation and termination of transcription.
- 1.0 Other eukaryotic transcription systems.

#### **5.0 Post transcriptional gene control and nuclear transport:**

- 5.1 Processing of pre m-RNA.
- 5.2 Regulation of pre m-RNA processing.
- 5.3 Macromolecular transport across the nuclear envelope.
- 5.4 Cytoplasmic mechanisms of post transcriptional control.

### **Unit IV**

#### **6.0 Genetic engineering**

- 6.1 Gene manipulation
  - 6.2 Restriction maps
  - 6.3 Gene cloning- Gene cloning vectors PCR, cDNA, DNA, Gene, Genetic library.
  - 6.4 Molecular analysis of genes and gene products: Nucleic acid by hybridization (in situ) technique- R loop mapping.
- Engineering the gene/s and eliminating the genes e.g.  
Engineering genes for transgenic animals.

### **Reference:**

Genes Vol. I to VII by Benjamin Lewin.



**M.Sc. Zoology**  
**Academic Flexibility/ College P. G. Centre ( S.G.M. Karad)**  
**M.Sc.-II Sem.-III**  
**Comparative Animal Physiology**  
**Elective Paper- II**  
**Paper- XII: Vertebrate endocrinology**

**Unit I:**

**1.0 Types of vertebrate hormones.**

- 1.1 Pituitary hormones.
- 1.2 Hypothalamic hormones.
- 1/3 Neurohypophysial hormones.
- 1.0 Mechanism of hormone action.
- 1.5 Hormonal control of Calcium homeostasis.
- 1.6 Adrenal steroid hormones

**Unit II:**

**2.0 Endocrinology of sex differentiation and development in male.**

- 2.1 Hormones and control of male reproduction( Fish , amphibians, reptiles, birds and mammals )

**Unit III:**

**3.0 Endocrinology of sex differentiation and development in female.**

- 3.1 Hormones and control of female reproduction ( Fish , amphibians, reptiles, birds and mammals )
- 3.2 Endocrinology of pregnancy , parturition, and lactation ( Oviparity, ovoviviparity and viviparity)

**Unit IV:**

**4.0 Endocrine control of growth and development.**

- 4.1 Endocrine glands and pathophysiology.
- 4.2 Vertebrate metamorphosis.
- 4.3 Thyroid hormones, Growth hormones, Pancreatic hormones, Gastrointestinal hormones, Melanotrophic hormones and catecholamines.

**Reference:**

1. Biochemistry : Strayer.
2. Lehninger's Biochemistry: Nelson & Cox.
3. Biochemistry by Metzhther.
4. Vertebrate Ovary – Jones Academic Press.
5. Endocrinology – Mac Hadley.
6. Endocrinology – Turner & Bugner.

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II, Sem.-III**

**Entomology Elective– Paper –II**

**Paper- XII: AGRICULTURAL ENTOMOLOGY**

Identification, characteristics, biology, damage and control of important agricultural pests.

- |            |     |   |
|------------|-----|---|
| Unit –I:   | 1.0 | Pests of Cereals:<br>Jowar stem borers, midgefly, aphid, Rice grasshopper, Leaf hoopers, Striped borer,   |
|            | 2.0 | Pest of pulses:<br>Gram pod borer, cutworms, Turplume moth, turpod bug, turpod fly, Lentilbod borer, and beanfly.   |
| Unit –II:  | 3.0 | Pest of fruits and fruit trees (Temperate):<br>Sanjase scale, apple wooly aphis, white fly, cherry stem borer, codling moth, apple stem borer, peach fruit fly and Almond weevil.   |
|            | 4.0 | Pest of fruits and fruit trees:<br>Citrus psylla, citrus white fly, citrus caterpillar, citrus fruit moth (Ophideres spp), Mango stem borer. Mango jassid, Mango mealy bug, Mango stone weevil, Breadfruit fly, Beer beetles. Grapevines leaf hopper, grapevine thrips, grapevine beetle & girdler, Pomegranate anarbutterfly, Banana weevil, Guava fruitly, papaya AK grasshopper. |
| Unit –III: | 5.0 | Pest of sugar cane:<br>Borers, purilla, Sugarcane woolly aphid, whitefly, mealy bug, termites.  |
|            | 6.0 | Pest of fiber crops:<br>Cotton pink boll worm, spotted boll worms, Red cotton bug, dusky cotton bug, cotton aphid, leaf roller, jute stem girdler, jute stem weevil and sunhemp capsid.   |
|            | 7.0 | Pest of Oilseed Crops:<br>Mustard aphid, Mustard Sawfly, groundnut aphid, groundnut stembooser, the white grub, aphid.  |
| Unit –IV:  | 8.0 | Pests of vegetable crops:<br>Cabbage caterpillar, Diamond back moth, potato tuber moth, Onion thrips, Brinjal fruit borer, Red pumpkin beetle and Hadda beetle.   |
|            | 1.0 | Pest of plantation crops: Coffee stem borer   |

Tea mosquito bug coconut weevil, Rhinoceros beetle and coffee shoot-hole borer.

10.0 Pest of spices and Narcotic:

Chillithrips, castor capsule borer, white grub, Bihar hairy caterpillar, Tobacco caterpillar and Tobacco aphid.

Books Recommended:

1. Agricultural pest of India and South East Asia, By A.S. Atwal, Kalayni publ. New Delhi.
2. Hand Book of Economic Entomology for South India by T.U. Ramkrishna Ayyar.
3. A textbook of Agricultural Entomology. ICAR New Delhi by Druthi S.H.
4. A text book of Applied Entomology, By K.P. Shrivastava Kalyani Publ. New Delhi.
5. Agrochemicals and pest management DPH New Delhi by T.V. Sathe.

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-III**  
**(Sericulture Elective paper – II)**  
**Paper- XII: Silkworm Biology & Rearing Technology**

- Unit – I:      Silkworm Biology.  
                 Silkworm races.  
                 Genealogy  
                 Classification  
                 Geographical distribution.  
                 Life history of mulberry & non-mulberry silkworms.  
                 1.      Life cycle of mulberry silkworm.  
                 2.      Life cycle of non-mulberry silkworms.  
                 (Morphology of egg-Larva – pupa- moth)
- Unit –II:      Anatomy & Physiology of-  
                 Digestive system.  
                 Circulatory system.  
                 Excretory system.  
                 Nervous system.  
                 Respiratory system.  
                 Reproductive system.  
                 Endocrine system.  
                 Silk gland & Silk synthesis-  
                 Silk gland organization and development.  
                 Silk gland proteins – Fibrion, Merion & P-25.  
                 Biosynthesis of silk proteins.
- Unit –III:      Rearing technology.  
                 Principles of silkworm rearing.  
                 Varieties of silkworms & their rearing methods.  
                 Facilities of rearing.  
                 Types of rearing houses.  
                 Rearing equipments.  
                 Management of rearing house & disinfection.  
                 Environmental conditions for silkworm rearing.  
                 Chawki & late age rearing.
- Unit –IV:      Silkworm diseases-  
                 Protozoon diseases.  
                 Bacterial diseases.  
                 Viral diseases.  
                 Fungal diseases.  
                 Predators & Parasites of mulberry and non-mulberry silkworms.
- Reference:

Reference books at the end of Sericulture elective paper-IV.

**M. Sc. Zoology**  
**Academic Flexibility**  
**M. Sc. II, Semester – III**  
**Aquaculture and Fisheries Elective Paper – II**  
**Paper- XII: Fish Pathology and Reproductive Endocrinology**

**Unit 1:**

**Bacterial, Fungal and Viral Diseases of Fishes:**

Bacterial, fungal and viral fish pathogens, Characteristics of infections and conditions suitable for infection, Symptoms, diagnosis and pathology of known bacterial, fungal and viral diseases of marine and freshwater fishes.

**Unit 2:**

**A. Parasites and Diseases of Fish and Crustacean:**

Major protozoan and metazoan parasites of commercially important fish, crustacean and mollusca, their morphology and life history, Modes of infection and host –parasite relationship, Microbial diseases of crustaceans, Symptoms, diagnosis, pathology and treatment

**B. Control Measures of Diseases of Fish, Crustacean and Mollusca:**

Sanitary and prophylactic measures in the control of disease of cultured fishes, Crustaceans and Molluscs, Use of filters, Disinfection by irradiation, chemicals and Bio-organic manures, Experimental study on disease resistance.

**Unit 3:**

**A. Fish Health in Relation to Environment:**

Abiotic factors influencing disease outbreak in cultured and feral populations, Rural and urban developmental programmes like sewage disposal, Effect of industrial and agriculture waste on diseases and pathogens, Effect of pesticides and carcinogenic substances on fish in relation to water quality.

**B. Epizootic Ulcerative Syndrome (EUS):**

History and areas affected by EUS, Spread of disease and fish species affected, Present state of knowledge of EUS, Extension of range and human significance, Recommendations for treatment, Socio-economic impact of EUS.

#### **Unit 4:**

##### **Reproductive Endocrinology:**

Pituitary gonadotropins – biochemical nature, role of gonadotropins in pre-spawning and spawning behaviour, Gonadal steroids and reproductive behaviour – differentiation of secondary sexual characters.

#### **BOOKS:-**

##### **FISH PATHOLOGY AND REPRODUCTIVE ENDOCRINOLOGY**

1. Fish physiology (Vol.I to XII): W.S. Hoar and D.J. Randall.
2. Fish endocrinology : A.J. Matty.
3. Fishery science: W.F. Royce.
4. Introduction to fishes: S.S. Khanna.
5. Pond fisheries : F.G. Martyshev.
6. Fresh water fishery biology: K.F. Lagler.
7. Coastal Ecosystem management : John Clark.
8. Appliedn Fishery Science Vol. I & II : S.M. Shafi.

**M. Sc. Zoology**  
**Academic Flexibility**  
**M. Sc. II, Semester – III**  
Food Science, Food Technology & Nutrition Elective paper-II  
**Paper- XII**  
**Food Procession and Packing**

**Unit-1:**

**Inactivation of Micro-organisms from food.**

Detection of Micro-organism.

Microbial Inactivation of the food.

Control of Micro-organisms.

Cleaning and sanitization of equipments in food processing.

**Processing of Edible oil and fats.**

Source and distribution of oil and fats.

Preservation of oils.

Uses of edible oil.

**Unit-2:**

**Processing of fruits.**

Sources and distribution of fruits.

Processing of fruits.

Preservation of fruits.

Nutritive values of processed fruits.

Use of food in medicine.

**Food processing of cereals.**

Flouring of cereals.

Processing and preservation of cereals.

Nutritional values of processed cereals.

**Unit-3:**

**Food processing in Bakery and Dairy.**

Food processing and preservation in bakery and Dairy.

Nutritional value of Bakery products.

Economic value of Bakery product.

**Processing and preservation of Meat, Fish and other sea food.**

**Food fermentation** – nutritive value of fermented food.

**Food Packing.**

History of packaging and labeling.

Material used in packing.

Appropriate form of packaging used for varieties of food & its uses.

Role of packaging in food Industries.

Packaging and labeling.

**Unit-4:**

**Technological development in food packaging.**

Recycling of packaging material.

Resource recovery in food industry.

Legal responsibility of manufacturer.

**Food marketing.**

Role of packaging at the point of sale and self service retailing.

Commutative function of packaging.

Cost of packaging relative to product cost.

Effect of packaging of food waste.

Right and responsibilities of advertisers, retailers and consumers, setting of business, food safety and hygienic.

**Reference:**

Reference books will be provided in due course or by concerned teacher.



**M.Sc. Zoology**  
**Academic Flexibility/College P.G. Centres-(Y.C.I.S. & S.G.M.)**  
**M.Sc.-II Sem.-III**  
**Practical – V**  
**Practical based on paper – IX & X**

1. Handling and feeding of the animals
2. To study estrous cycle (rat and mouse) and breeding
3. Surgery- adrenalectomy, thymectomy, splenectomy, Gonadectomy and Steroidal hormone supplementation study
4. CCl<sub>4</sub> toxicity *in vivo*.
5. Paracetamol toxicity *in vivo*.
6. Studies of drug induced and natural ageing
7. Study of Diabetes Models- Alloxan induced & streptozotacin induced.
8. Study of induced hypercholesterolemia (cholesterol) in rat
9. Study of life cycle of *Drosophila*
  - Puff studies in polytene chromosomes.
  - Metamorphosis studies.
10. Eye colour mutants in *Drosophila* silkworm for endocrinological studies, larval mutants of silkworm.

11. Study of Angiogenesis in chick embryo – To study effect of inhibitors & activators of angiogenesis.
12. Study of brain development in chick
13. Carp fingerlings & other stages of common carp for toxicological studies.
14. Estimation of proteins.
15. Estimation of Amylase / any other suitable enzyme.
16. Effect of pH on Amylase activity / any other suitable enzyme.
17. Effect of temperature on Amylase activity / any other suitable enzyme.
18. Michaelis – Menten constant determination for Amylase / any other suitable enzyme.
19. Effect of modifiers on enzyme activity / Thermolability of enzyme.
20. Isolation of Amylase or any other enzyme.
21. Any other practical set by the Department.

(From 1 to 14 at least five to six practicals expected to be completed)

(From 14 to 21 at least five to six practicals expected to be completed)

**M.Sc. Zoology**  
**Academic Flexibility/College P. G. Centres Y.C.I.S. Satara**  
**M.Sc.-II Sem.-III**  
**Practical – VI**  
**Cell Biology Practical-I**  
**Practical based on paper – XI & XII**  
**(Cell Biology Elective paper – I & II)**

1. Example based on DNA sequencing.
2. Example based on RNA sequencing.
3. Example based on Protein sequencing & SS bond prediction, transmembrane & signal peptide sequence prediction.
4. Examples based on Genetic code
  - 6 frame translation at frames.
  - Codon preference base translation frames.
  - Open reading frame search.

5. Examples based on restriction maps Computer & Internet based practicals.
6. Problems based on evolution of gene families (glaringness, polyploidy SINES & LINES role in evolution)
7. Entrez, SRS & gene bank sites & their use in Bioinformatics.
8. BLAST & FASTA clausal w algorithms use and analysis.
9. Use of Phylogenic algorithms & their studies.
10. Building of sequence search protocol.
11. Metaphasic chromosome preparation from bone marrow cells.
12. C-band of metaphasic chromosomes.
13. Preparations of polytene chromosomes from Drossophila / chironemus.
14. Isolation and estimation of DNA & RNA.
15. Estimation of proteins (Loury's).
16. Demonstration of DNA by futguen in rat/ mouse liver & demonstration of polyploid cells.
17. Demonstration of RNA (by RNase digestion & TB pH 3.5) & estimation.
18. Estimation of Histones.
19. Demonstration of Histones.
20. Estimation of phosphate from isolated nucleic acids.
21. Any other experiments / practicals set by the Department.

(At least 11 praticalcs expected to be completed.)

(At least 5 to 6 Practicals from 1 to 10 practicalcs expected to be completed)

**Academic Flexibility/College P. G. Centre-S.G.M.**  
**M.Sc.-II Sem.-III**  
**Practical – VI**  
**Comparative Animal Physiology Practical-I**  
**Endocrinology**

Invertebrate Animals: (Four practicals)

Dissection so as to expose the endocrines system of representative from following group of animals.

Pila.

Leech.

Earthworm.

Bivalve

Prawn

Crab

Scorpion

Cockroach / Grasshopper

Bugs

Dragon flies / Naiads

Butterfly /Moth-larvae (Caterpillar)

Honey bee / wasps

Beetles

Houseflies

Snail & slugs

Histological preparations from selected above mentioned animals (four practicals).

Histochemical analysis of neurosecretary material from selected above mentioned animals. (Three practicals)

Anatomy of male & female reproductive system of the selected above mentioned animals. (Four practicals)

Demonstration of role of brain hormone in metamorphosis (ligature or Quatrisation Experiment) in silkworm. (One practical).

**Vertebrate Animals: Endocrinology**

Anatomy & histology of endocrine organs of selected vertebrate from following.

Fish – Labeo

Bird (fowl / pigeon / Quail )

Rat / Mouse / Rabbit.

(Pituitary gland, Adrenal gland, Thyroid gland, Pancrease, Gonadal endocrine gland).

Effect of adrenalin and acetyl choline/ epinephrine on fish chromatophore.

Induction of Alloxan diabetes in the mouse / Rat. Gonadetomy, Pancreotomy, Thyradactomy in the Rat / Mouse.

Study of sperm count.

Study of morphological abnormalities of sperms.

Capacitation and motility of sperms.

Demonstration of artificial insemination.

Study of oestrous cycle by vaginal smear method in Rat.

Any other experiment set by the concerned teacher.

(At least 10 practicals expected to be completed).

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-III**  
**Practical – VI**  
**Special Practical –I**  
**Aquaculture and Fisheries (I & II)**

Identification of important food fishes, prawns and molluscs upto the species level (Freshwater and Marine)

Estimation of the rate of oxygen consumption in fish

Dissection of fish to expose – a) Pituitary gland b) Urinogenital system

Fecundity assessment in fish

Preparation of permanent slides of different types of scale

Demonstration of induced breeding technique by ovaprim / ovatide.

Estimation of DO, CO<sub>2</sub>, Alkalinity, Inorganic nitrate and Phosphate from water sample

Qualitative analysis of digestive enzymes

Identification of diseased fish – Bacterial, fungal and viral infections (Slides)

Examination of fish for protozoan parasite

Examination of fish for helminth parasite

Blood glucose estimation in fish

Sexual dimorphism and secondary sexual characters in fishes

Short term bioassay of LC50 determination (Demonstration)

Study of permanent histo-pathological slides of important tissues in fishes exposed to toxicants.

Any other experiment set by the teacher/ Department.

Field trips and study tours to fish farms, fisheries institute, or national laboratory etc. is compulsory.

Any practical set by the concerned teacher / Department.

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-III**  
**Practical – VI**  
**Special Practical –II**  
**Based on Paper – XI & XII**  
**Sericulture Special Practical**

1. Morphology of egg. Larva (Caterpillar), pupa and adult (moth) of different Silkworm types (Mulberry & non-mulberry)
2. Dissection of organ systems.
  1. Digestive system.
  2. Nervous system.
  3. Reproductive system (Adult).
  4. Circulatory system.
3. Study of haemocyte types & their count (total & differential) in the silkworm.
4. Study of digestive enzymes -  
Amylase, Invertase, Trehalase & Protease.
5. Study of isture loss during respiration of Larvae.
6. Study of following families.  
i) Mora ceae ii) Rhamnaceae iii) Verbena ceae iv) Laura ceae  
v) Ephorbiaceae.
7. Preparation of herbarium of plant the locally available non-mulberry host plants.
8. Study of anatomy of parts – Leaf, stem & petiole.
9. Collection & preservation of mulberry pests.
10. Field visit for demonstration of pest habitats & damage.
11. Study of mulberry diseases.
12. Study of rearing appliances.
13. Rearing of 1 or 2 life cycle of mulberry silkworm.
14. Any other experiment set by the concerned teacher./Department.

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-III**  
**Practical – VI**  
**Practical based on Paper – XI & XII**  
**Entomology Special Practical**

1. Collection and preservation of Insects. (Dry and wet preservation)
  - Preparation of permanent slides of small insects.
2. Study of insect head and its appendages:
  - Types of mouth parts & Antennae.
  - Preparation of permanent slides.
  - Mounting of tentorium.
3. Study of Thorax and its appendages -
  - Types of wings & legs.
  - Mounting of appendages including halteres.
4. Study of Abdomen and its appendages.
  - Types of genitalia, Cerci, tympanum, pseudo leg, & sting etc.
5. Type study of insect orders of locally available with sufficient examples of each order.

**Agriculture Entomology**

6. Collection and preservation of insect pests.
7. Preparation of slides of insect pests.
8. Identification and economic importance of 6-8 pests of following crops.
9. Pests of cereals.
10. Pests of pulses.
11. Pests of fiber crops.
12. Pests of fruit and fruit trees.
13. Pests of Oil seed crops.
14. Pests of Vegetable crops.
15. Pests of spices & Narcotic crops.
16. Field visit for demonstration of pest damage.
17. Any practical set by the concerned teacher.



**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-III**  
**Practical – I**  
**Food Science, Food Technology & Nutrition**  
**(Practical based on paper- XI & XII)**

Studies on alkali treatment of make.  
Determination of moisture in food.  
Extraction of red color from red Beets.  
Isolation of proteins from eggs milk.  
Isolation of muscle proteins – action, myosin.  
Isolation of phospholipids from oil and seeds.  
Estimation of vitamins A and C green leafy vegetables.  
Isolation of micro-organism from food cereals cereal flours and Bread.  
Determination of thermal death point (TDP) and thermal death time.  
Effect of food additives on the production and growth.  
Isolation of flavonoids from medicinally important plant.  
Any practical set by the concerned teacher.

**M.Sc. Zoology**  
**Academic Flexibility/College P.G. Centres (Y.C.I.S. & S.G.M.)**  
**M.Sc.-II Sem.-IV**  
**Paper- XIII: Animal Cells in Biotechnology**

**Unit I:**

**1. Laboratory design and introduction of cells:**

Equipments and Materials for animal Cell Culture Technology

Design of Tissue Culture Laboratory

Equipments : Laminar Flow Hoods, CO<sub>2</sub> incubator, Open and closed cultures, Microscopes, centrifuge, Refrigerators and Freezers, pipetting aids, Miscellaneous small items of Equipments, Materials, filters, Miscellaneous Items.

Basic Aseptic Techniques

Storage shipping and safety

**2. Characters of cells and behavior:**

Cells and tissue types

Behavior of cells in culture: Primary cell lines permanent/Established cell lines/Transformed cell lines

Tumor/cancer originated cells

**Unit II:**

**3. Growth media**

Physical requirements and Nutritional Requirements of Cells and growth media and cell culture growth kinetics

Natural media

Basal salt solution (BSS)-Various types

Minimum Essential Medium( MEM)

Antibiotics in media

Serum dependent defined media

Serum independent defined media – Cell specific media

pH, bulk ions, trace ions, CO<sub>2</sub>, O<sub>2</sub> tension , Ascorbic acid, sugars,  
Vitamins coenzymes.

#### **4. Basic Techniques of mammalian cell culture**

Open and closed cell-cultures

Primary Cell culture – Isolation and separation of cells, viable cell count, maintenance of cell culture, maintenance of stock culture, Antibiotic free stock cultures

Types of cell cultures – Monolayer, Suspension, Clonal culture, Mass culture-micro carrier culture (monolayer), Stem cell cultures (ESC)

### **Unit III:**

#### **5. Biology and Characterization of cultured cells**

Karyotyping

Contamination Testing of Culture

Viability measurement and cytotoxicity

Measurement of growth parameters

Cell cycle analysis and Synchronization of cultures

#### **6. Use of Animal Cells in Culture**

- Mutant cell preparation
- Evaluation of Chemical carcinogenicity, Cell malignancy Testing
- Toxicity Testing, Karyotyping and cytogenetic characterization
- Production of metabolic products
- ESC applications
- Pluripotent stem cell applications

### **Unit IV:**

#### **7. Cell surgery Methods**

Preparation of anucleated cells and polykaryon cells

Preparation of ghost RBCs.

Preparation of mini cells, micro cells

Surgical manipulation of *in vitro* fertilization

#### **8. Cell Fusion Methods**

- Cell fusion techniques
- Hybridoma cell preparations and their properties
- Use of Hybridoma technology: e.g. M AB and other related techniques
- Mini cells, micro cells and anucleated cells in fusion and their application.

## **9. Tissue Engineering :**

Capillary culture Units

Techniques for culturing differentiated cells : Reconstituted basement membrane rafts, feeder layers.

Other tissue engineering methods.

### **Reference:**

1. Morgan, S.I. Animal Cell culture 1993 Bio. Scientific Publishers Ltd Oxford.
2. Freshney, R.I. Culture of Animal Cells: A manual of Basic Technique, 1994, John Wiley & Sons Inc. Pub. USA.
3. Butler, M. Mammalian Cell Biotechnology.: A practical Approach 1991 IRL Press Oxford.
4. Jenni P. Mather & David Barnes Eds: Animal Cell culture Methods. Methods in Cell Biology Vol. 57 Academic press.
5. Cell Culture: Methods in Enzymology, vol. 58 1979/recent volume. Academic Press.
6. Kuchler, R.J. Biochemical Methods in Cell culture & vivology 1977. Dowden, Huchinson & Ross, Inc. Strausberg, USA.

**M.Sc. Zoology**  
**Academic Flexibility? College P.G. Centres (Y.C.I.S. & S.G.M.)**  
**M.Sc.-II Sem.-IV**  
**Paper – XIV: Toxicology & Immunology**  
**Toxicology**

Unit –I: Fundamentals and scope of toxicology, Bioassay methods: acute and chronic, Dose response relationships, factors affecting toxicity, Mechanisms of Bio-accumulation and Bio-transformation, Detoxification, excretion of pesticides (Xenobiotics) Classification, basic aspects of pesticide toxicity, metabolism (Chlorinated hydrocarbon & organophosphate) and their effects on animals.

Unit –II: Metals survey, effects and management, Arsenic, Cadmium, Lead and Mercury, Natural toxicants: Animal venoms and poisons, microbial (Algal and bacterial) and plant toxins, Microbial toxins, toxic food constituents, food toxicants, contaminants, food adulterants and health hazards.

**Immunology**

Unit –III: Antigen superantigens; Antibody structure, classification, diversity, organs and cells involved in immune response, MHC/HLA classes, T-Cells, B-cells receptors & cluster determinants (CDs)

Unit –IV: Innate and cognate immunity, Hypersensitivities – Types – I, II, III, IV & V (Anaphylaxis, cytolytic, immune complex, delayed, stimulatory) with examples.

**Reference Books:**

- Chris Kent (2001) : Basics of Toxicology  
Devid J.K. and Kit A.K. (2006): Toxicological testing handbook 2<sup>nd</sup> Ed.  
Gupta P.K. and Salunkhe D.K. (1985): Modern toxicology (Vol. I,II & III) Pandey, Shukla and Trevedi (2004): Fundamentals of Toxicology.  
Thomas J.H. and William O.B. (1987): Handbook of Toxicology.  
Kuby Immunology, WH Freeman, USA.  
W Paul Fundamentals of Immunology.  
I.M. Roitt, Essential Immunology, ELBS edition.  
Roiff, I Brosfott, J and Male D – Immunology.  
Sharma, J.M. : Avian Cellular Immunology.  
Karger and Basel: The year of Immunology 1988.  
Zapata A.G. and Cooper, E.L. The immune system.  
Smialowicz R.J. and Holsapple Michael. Experimental Immunology toxicology.  
Laurie Hoffman – Goetz : Exercise and immune function.

Cooper E.L and Brazier M.A.B : Developmental Immunology.  
Clark W.R.. Experimental functions of Modern Immunology.  
Immunobiology - Charles A. Janeway and others – 2001.

**M.Sc. Zoology**  
**Academic Flexibility?College P.G. Centre (Y.C.I.S.)**  
**M.Sc.-II Sem.-IV**  
**Cell Biology Elective Paper- III**

**Paper – XV: Cell in, Differentiation, Development & specialization**

**Unit I**

**1.0 Differentiated cells and maintenance of tissues:**

- 1.1 Differentiated state
- 1.2 Tissues with permanent cells (Eye lens, photoreceptor cells of retina)
- 1.3 Renewal of cells by mitosis (Liver cell, endothelial cells)
- 1.4 Renewal of cells by stem cells (Skin epithelium, intestinal epithelium)
- 1.5 Renewal of cells by pluripotent stem cells (Blood cell formation).

**Unit II**

**2.0 Principles of development**

- 2.1 Basic concepts in developmental biology
- 2.2 Cell fate and commitment
- 2.3 Mechanisms of development commitment
- 2.4 Mosaic and regulative development
- 2.5 Maintenance of differentiation
- 2.6 Pattern formation and compartments
- 2.7 Morphogenesis

**3.0 Experimental developmental biology**

- 3.1 Model organisms
- 3.2 Developmental mutants
- 3.3 Transgenic organisms in development
- 3.4 Cellular and microsurgical techniques

**4.0 Genes in development**

- 4.1 Gene expression and regulation
- 4.2 Chromatin and DNA methylation
- 4.3 Signal transduction in development
- 1.0 The cytoskeleton, cell adhesion and extra cellular matrix during development.

**Unit III**

**5.0 Muscle as a cell and contraction unit:**

- 5.1 Genesis, modulation and regeneration of skeletal muscle.
- 5.2 Fibroblasts and their transformations.  
The connective tissue cell family.

- 5.3 Bone remodeling.
- 6.0 Mammalian neurons:**
  - 6.1 Types, similarities, differences, and specialized regions of neurons.
  - 6.2 Propagation of action potentials in neurons (Myelinated) structure and function, signaling circuits & neuron computation.
  - 6.3 Synapse
  - 6.4 Long term potentiation in hippocampus.

#### **Unit IV**

- 7.0 Pancreatic Cells**
  - 7.1 Acinar Cells
  - 7.2 Islets of Langerhans
  - 7.3 Ductal Cells
- 8.0 Pituitary Cell Types**
- 9.0 Neurosecretary Cells**
- 10.0 Corneal Endothelial cells**
- 11.0 Cardiomyocytes from chick heart**
- 12.0 Hepatoparenchymal cells**

#### **Reference:**

Cell & Molecular Biology by Gerald Karp (2005) published by John Wiley & sons.

Molecular cell biology by Lodish, Berk, Matsudaira, Kaiser, Krieger (2004) published by W. H. Freeman & company, New York.

The Cell by Bruce Alberts, published by Garland publishing Inc. New York & London



**M.Sc. Zoology**  
**Academic flexibility? College P.G. Centre (S.G.M.)**  
**M.Sc. II Sem.-IV**  
**Comparative Animal Physiology Elective Paper-III**  
**Paper -XV: Animal Physiology**

**Unit I :**

**Respiration and circulation**

**1.0        Respiration:**

- 1.1    Integumentary, bronchial- External and internal gills, aquatic to aerial breathing. Trachea in insects book lungs in arachnids and eternizing in mollusks.
- 1.2    Lungs – Birds and mammalian, chemical regulation of respiration

**2.0        Circulation**

- 2.1    Teleost, Lung fish, amphibian, mammals (Tracheoles)
- 2.2    Regulatory mechanisms, Pace markers of ventilation, carotid and aortic bodies.

**Unit II :**

**3.0        Internal fluids and it circulation –**

- 3.1    Vascular channels.
- 3.2    Vascular fluids.
- 3.3    Hemodynamics.
- 3.4    Peristalsis.
- 3.5    Vascular pumps (arthopods)-Hearts, lymphatic circulation , cardiac output , valves and stop cocks, elasticity of vessels, homeostasis and circulation of body fluids.
- 3.6    Cardiac rhythms- Myogenic hearts, hemogenic hearts, chemical control, mechanical effects, nervous regulation, blood pressure and control.
- 3.7    Fluid skeleton, Laws of circulation, transport of CO<sub>2</sub> and vascular fluids

**Unit III :**

**4.0        Respiratory pigments:**

- 4.1    Haemoglobin, Chlorocruorin ( annelids), Hemocynins, nemerythrin.
- 4.2    Phylogeny of efficient O<sub>2</sub> transport, O<sub>2</sub> equilibrium curves, CO<sub>2</sub> transport acid base balance and temperature.
- 4.3    Plasma proteins and regulation of fluid volume, Hemostasia and coagulation of blood , plasma protein regulation and regulation of fluid volume.

#### **Unit IV:**

##### **5.0 Organs of excretion and formation of urine**

- 5.1 Without special excretion tubules.
- 5.2 Contractile vacuoles, storage excretion.
- 5.3 Excretory tubules- nephridia, Malpighian tubules, vertebrate nephron- Pronephridia( Acoelomate and pseudocoelomate), Metanephridia (Coelomates – Annelids, Mollusk),
- 5.4 Urine formation in mammals , Regulation, hormones and kidney function.
- 5.5 Invertebrate water balance and hormones.

#### **Reference:**

Reference books will be provided in due course or by concerned teacher.

**M.Sc. Zoology  
Academic Flexibility  
M.Sc.-II Sem.-IV  
Paper – XV Entomology Elective paper – III  
Insect Anatomy and Physiology**

#### **Unit-I:**

##### **1. Integument:**

- 1.1 Structure and functions of cuticle.
- 1.2 Physiology of integument.

##### **2. Physiology of muscle contraction in insect.**

##### **3. Nutrition:**

- 3.1 Digestive system & associated glands.
- 3.2 food and feeding including special diet.
- 3.3 Physiology digestion.

#### **Unit-II:**

##### **4. Respiration:**

- 4.1 Respiratory structures.
- 4.2 Mechanism of respiration in terrestrial, aquatic and parasitic insects.

##### **5. Circulation:**

- 5.1 Structure of circulatory organs.
- 5.2 Accessory pulsatory organs.
- 5.3 Chemical composition and functions of haemolymph.
- 5.4 Haemocyte types structure and functions.
- 5.5 Mechanism of circulation.

##### **6. Excretion:**

- 6.1 Structure of excretory organs.
- 6.2 Physiology of excretion & osmoregulation.

### **Unit-III:**

#### **7. Neuroendocrine system:**

##### **A) Nervous system –**

7.1 Structure and function.

7.2 Physiology of neural integration.

##### **B) Endocrine system –**

7.3 Structure and functions of endocrine organs.

##### **C) Sense organs –**

7.4 Photoreceptors.

7.5 Mechanoreceptors sensory hairs.

7.6 Proprioceptors.

7.7 Phonoreceptors.

7.8 Chemoreceptors.

### **Unit-IV:**

#### **8. Reproduction:**

8.1 Male & Female reproductive organs.

8.2 Physiology of reproduction.

8.3 Embryonic development upto gastrulating.

8.4 Post embryonic development – Nymphal, Larval & pupal.

### **Suggested Reading material.**

Imms Textbook of Entomology- O.W. Richards and R. C. Devis, volume I and II

Principles of insect morphology- R.E. Snodgrass.

Insect Structure and function – R F Chapman

General and applied Entomology - K K Nayar, T. N. Anantkrishnan and M. B. Devid

Introduction to Comparative Entomology – R M Fox and J W Fox

Embryology of Insects -A O John and F H Butt

Development systems in Insects – S J Counce and C H Waddington

Frost S E : Insect life and Insect natural History

Elzinga R J : Fundamentals of Entomology

Roass H textbook of Entomology

Mani M. S. – Modern Classification of Insects

Pant N S and Ghai S L – Insect Physiology and Anatomy

Little V A – General and applied Entomology

Mani M S – General Entomology

Lowrence P A – Insect Development

Wigglesworth – Insects and the life of Man

Du Port – Manual of Insect Morphology

Mutsuda R – Morphology of Evolution of Insect Head

Jaierne B D – Collection and Preserving Insects

Jerrer D J Jeleng J N and Triplenhern C A- Embryology of insects and Myriapodes  
 Romser W S – The Science of Entomology  
 Daily H V, Dayen J .T; Enrich P.R; Introduction to Insects  
 Clarks, L.R., P. W. Geir, R.D. Hughes and R.F. Morris (1968) Ecology of Insects population (Methen London)  
 Atkins M D – Introduction to Insect behavior McMilan publication company NY 1980  
 Bursell E – An Introduction to Insect Physiology  
 Candy D J and Kilba – The Insects – biochemistry and Functions  
 Daveis R G – Outline of Entomology  
 Downers, R. G. H and Lauffer, H- Endocrinology of Insects  
 Elzinga R J – fundamentals of Entomology  
 Essig E O – College Entomology  
 Fox R. M. and Fox J W- Introduction to comparative Entomology  
 Fried Lander C P – The Biology of Insects  
 Gilmor D – The biochemistry of Insects  
 Gillot S C – Entomology  
 Hishnam K C and Hill L The Comparative Endocrinology of Invertebrates  
 Johnson K C and Butt F H – Embryology of Insects and Myriopods  
 Kerkut G H , and Comprehensive Insect Physiology, Biochemistry and Pharmacology  
 Lefroy H M – Indian Insect Life  
 Pruthi, H S – A Text book of Agricultural Entomology ICAR New Delhi  
 Roeder , K D (Ed) – Insect Physiology  
 romser , W S The Science of entomology  
 Rockstein, M (Ed) – The Physiology of Insects vol. –I –VI  
 Roy, D. N. and Brown, A.W.A. Entomology- Medical and Veterinary  
 Saxena, S.C. – Biology of Insects  
 Thorndyke, M & Goldsworthy, G I (Eds) – Neurohormones in Invertebrates  
 Tiegs, O W and Manton, S M – The Evolution of The Arthropoda Biol. Rev 33: 255-377 (1958)  
 Waddington C H – Principles of Embryology  
 Wadhwani A M and Chhabra N N – Bee Keeping in India  
 Counce S J and Waddington C R – Development of Systematic in Insects Vol- I and II  
 Bamont J K, Treherene and wigglsworth – Advances in Insect Physiology  
 Beamont S. W. L and Treherene J E – Insect and Physiology  
 Novak V J A – Insect Hormones  
 Richerds O W Devis R C Imms Textbook of Entomology vol I and II  
 Snodgrass R E - Principles of Insect Morphology  
 Mani M S general Entomology  
 Reader K B – Insect Physiology

Wilkinson C. f. Insecticides Biochemistry and Physiology

Patton R. L Introductory Insect Physiology

Engelmann F The Physiology of Insect Reproduction.

Tembhare D.B. Modern entomology, Himalaya publishing house, New  
Delhi.

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-IV**  
**Sericulture Elective Paper – III**

**Paper – XV: Cytology, Genetics & breeding of silkworm & their host plants.**

- Unit –I: Genetics – Principle :  
Silkworm as laboratory tool for genetic studies.  
Heredity and environment.  
Genotype and phenotype, heredity and variation, distinguishing heredity and environmental variation Pure line & inbred line. Heredity traits and effect of environment of them. (egg, larva, cocoon, pupa and adult characters)  
Mendel's principles –  
Dominances, Segregation, Mendelian ratio & back cross ratio, dihybrid cross, Independent assortment, three way cross and double cross hybrid Genetic of Cocoon colours.
- Unit –II: Linkage maps and inheritance of cocoon colour, environment influence and hormonal Control.  
Inheritance of vortinism, moulting, environment influence hormonal control.  
Sex determination, sex linked, sex limited traits and their special significance in Sericulture.  
Chromosome number and nature of chromosome, parthenogenesis, Gynogenesis, Androgenesis, Polyploidy.  
Population genetics.
- Unit –III: Silkworm Breeding:
1. Origin, distribution and differentiation silkworm races.
  2. Present status of silk worm breeding in India.
  3. Breeding of silkworm---  
Pre-requisites, aims and objectives. Variability inbreeds.
  4. Choice of parents of initiation of breeding programmes.  
Hybridization of chosen strains to create base population for breeding. Methods of breeding – Line breeding, Cross breeding, Mutation breeding.
  5. Selection methods – Individual and family selection.  
Advantages and disadvantages. Effect of inbreeding.  
Consequence Homozygosity.
  6. Heterosis and combining ability in silkworm.  
Hybrid vigor for different characters.  
Hybrid vigor in different crossing systems.  
Hybrid vigor and environment.

- Theoretical basis of heterosis.
- Combining ability tests.
- Utilization of heterosis in sericulture.
- 7. Maintenance of races / strains.
- 8. Management of genetic resources –  
Collection, Conservation, Characterization and evaluation  
of silkworm varieties and their maintenance.

Unit –IV: Cytogenetics and Breeding of Silkworm host plants.

- 2. Cytological aspects of mulberry with an emphasis of their  
chromosomes.
- 3. A brief account of the Mendelian principles of Genetics.
- 4. Linkage and Crossing over- Linkage groups and linkage  
maps.
- 5. Maternal inheritance – Parthenogenesis and polyploidy.
- 6. Objectives of plant breeding.
- 7. Genetic Viability and its role in plant breeding.
- 8. Methods of reproduction and breeding methods in self  
pollinated and cross pollinated plants.
- 9. Breeding for drought and disease resistant plants.
- 10. Mutations and polyploidy and its role in host plant  
breeding.

**M. Sc. Zoology**  
**Academic Flexibility**  
**M. Sc. II, Semester – IV**  
**Paper XV**  
**Aquaculture and Fisheries Elective Paper – III**  
**Aquaculture Practices**

**Unit 1:**

**A. Introduction:**

Scope and principles of aquaculture, History of aquaculture, Importance of aquaculture.

**B. Classification of Aquaculture:**

Mariculture (Salmon, Eel, Sturgeon, Milkfish), Carp culture (Indian major carps, common carps, other carps), Brackish water culture, Potential of aquaculture in India

**Unit 2:**

**A. Fish Culture Practices: Aquaculture Management:**

Monoculture and composite culture, Hatchery management – development of fish hatcheries, types of hatcheries, production of spawn, fry and fingerlings, Pond management and fertilization - pre and post stocking management, induced breeding with special reference to Indian major carps.

**B. Fertilization and Artificial Feeding in Aquaculture:**

Need for fertilizing fish pond, Fertilizers (organic, inorganic and bio-fertilizers), Artificial fish feeds and their formulation, Balanced fish feeds and their preparation.

**C. Aquatic Weeds and Their Control:**

Problem of weed infestation in fishery waters, Common aquatic weeds and their distribution, Methods of weed control – manual, mechanical, chemical and biological, Types of weedicides, Techniques of treatment.

**Unit 3:**

**A. Culture of Edible Aquatic Crustaceans:**

Cultivable species of prawns, growth, maturity and spawning, rearing of prawns under controlled conditions, Farm layout for rearing crustaceans, harvesting and marketing

**B. Culture of Fish Food Organisms:**

General methods of collection, Maintenance and rearing of marine and freshwater fish food organisms, Culture of phytoplanktons, Culture of protozoan and rotifers.

**Unit 4:**



**A. Sea Weeds and Their Culture:**

Commercially important seaweeds and their occurrence and distribution, Methods of culture of seaweeds, Prospectus of seaweed culture in India, Uses of seaweeds and their products as human food, as animal fodder, Manure and other uses, Algae as medicine.

**B. Culture of Marine Molluscs (Mariculture):**

Production of marine molluscs through aquaculture, Species of edible molluscs, Culture of oyster, clams and mussels, Techniques of natural seed collection and breeding under controlled conditions, Different methods of culture – bottom culture, raft culture, long line culture etc., Pearl oysters – Species involved, methods of seed collection, techniques of pearl culture, Prospectus in India.

**Reference:**

Reference books will be provided in due course or by concerned teacher.

**M. Sc. Zoology**  
**Academic Flexibility**  
**M. Sc. II, Semester – IV**  
**Paper XV**  
**Food Science, Food Technology & Nutrition Elective paper-III**  
**Food Biotechnology**

**Unit-I:**

1. **Historical back ground:- History of micro-organisms in food, Historical development.**
2. **Sources, Types, Incidence and behavior of micro-organisms in foods. – Role of significance of Micro-organisms, Primary sources of micro-organisms found in food, common food born bacteria, genera of molds common to foods, genera of yeast common to food.**

**Unit-II:**

**Intrinsic and Extrinsic parameters of foods that affect microbial, intrinsic parameters, extrinsic parameters.**  
**Incidence and Types of Micro-organism in foods.**  
**Bioassays and related Methods – Advanced technique in food sciences.**  
**Theological testing nucleic acid and protein analysis and immunological technique.**

**Unit-III:**

**Determining Micro-organisms and their product in food – Culture, Microscopic and sampling method, membrane tillers, Microscopic colony counts, Agar droplets, Dry films, Dye reduction, Roll tubes, Microbiological Examination of surtaxes. Air sampling.**  
**Genetically modified foods – soybean, maize canola and oil seeds.**  
**Detoxification of food toxin.**  
**Advanced food toxicology.**  
**Food toxicants metabolism of toxicants, mutagenesis, chemical carcinogenesis, Risk assessments.**

**Unit-IV:**

- 10. Biofortification-** 1. Variety of mineral and iron rich plant – nutritional approach, 2. Golden rice.
- 11.Nutraceuticals** – Terpenes, carotenoids, limonoids, polyphenols and phytosterols – vitamin and carotenoid rich plant products.

**Reference:**

Reference books will be provided in due course or by concerned teacher.

**M. Sc. Zoology**  
**Academic Flexibility? College P.G. Centre (Y.C.I.S.)**  
**M. Sc. II, Semester – IV**  
**Paper – XVI: Cell Pathology**

**Unit I**

**1.0 Cell in stress and death**

- 1.1 Hypertrophy, Hyperplasty, Atrophy, polyploidy, modulation, metaplasia and displasia.
- 1.2 Biotransformation of Xenobiotics and cell stress
- 1.3 Cell death- a) Apoptosis-I b) Apoptosis-II
- 1.4 Cell organelles during cell degeneration/necrosis.

**Unit II**

**2.0 Cancer:**

- 2.1 Tumor cells & the onset of cancer (Benign & Metastatic tumors)
- 2.2 Culture cells can be transformed into tumor cells,
- 2.3 Successive oncogenic mutations can be traced in colon cancer.

**3.0 The genetic basis of cancer:**

- 3.1 Gain of function mutations convert proto-oncogenes into oncogenes.

- 3.2 Inherited mutations in tumor suppressor gene & cancer,
- 3.3 Loss of heterozygosity / non- disjunction,
- 3.4 Abbreviations in signaling pathways that control development & cancer.

#### **4.0 Oncogenic mutations in growth promoting proteins:**

- 4.1 Oncogenic receptors
- 4.2 Viral activators,
- 4.3 Active signal – Transduction proteins,
- 4.4 Transcription factors,
- 4.5 Loss of growth inhibiting cell cycle controls.
- 4.6 Carcinogens & DNA repair

### **Unit III**

#### **5.0 Ageing and cell**

- 5.1 Definitions of aging
- 5.2 Aging and average life
- 5.3 Mechanism of aging (Theories of aging)
- 5.4 Genetically programmed aging-Gerontology
- 5.5 Cellular changes during aging
- 5.6 Molecular changes during aging
- 5.7 Immunological changes during aging
- 5.8 Accumulation toxins and chemical garbage formation of lipofuscin granules
- 5.9 Aging and cell cycle
- 5.10 Cell defense system
- 5.11 Strategies against aging

### **Unit IV**

#### **6.0 Effects of inhibitors:**

- 6.1 DNA synthesis (Mitomycin)
- 6.2 RNA synthesis (Actinomycin & Rifampicin).
- 6.3 Protein synthesis (Diaminopurine, Cycloheximide, Tetracyclins, Chloramphenicol, streptomycins).
- 6.4 Mitochondrial metabolism (CN, CO, Actinomycin –A, Azide etc.)
- 6.5 Micro tubular inhibitors- Vinca alkaloids & other inhibitors.

#### **7.0 Animal viruses:**

- 7.1 RNA viruses – Polio (+ strand RNA), VSV (-RNA), influenza (segmented RNA), reovirus (ds segmented RNA genome),
- 7.2 DNA virus (SV40-ds DNA with circular genome), adenovirus (linear ds DNA genome), parvo virus (ss DNA virus), retroviruses (RNA genome that replicate through intermediate).

#### References:

- Cell & Molecular Biology by Gerald Karp (2005) published by John Wiley & sons.
- Molecular cell biology by Lodish, Berk, Matsudaira, Kaiser, Krieger (2004) published by W. H. Freeman & company, New York.
- The Cell by Bruce Alberts, published by Garland publishing Inc. New York & London.
- Laboratory Investigation –Vol.14, 1965,.
- Inhibitors of nucleic acid synthesis by Kersen & Kersen.
- Inhibitors of Protein Synthesis FBII publication.
- Metabolic Inhibitors Vol. I –IV.
- Molecular Biology of gene (Edn.-1987).

M. Sc. Zoology  
Academic Flexibility/College P.G.Centre (S.G.M.)  
M. Sc. II, Semester – IV  
Comparative Animal Physiology  
Elective Paper- IV

**Paper- XVI: Applied Physiology**

#### Unit I

- 1.0 Physiological compensation for environmental variation**
  - 1.0 Tolerance and resistance, acclimation and acclimatization, resistance to extreme conditions
  - 1.1 Temperature effects : Rates of biological activities, physiological compensation for rate limiting temperature effects in poikilotherms,
  - 1.2 Mechanism of compensation, Neuroendocrine mechanisms, behavioral regulation, temperature compensation in homeotherms, phylogeny and ontogeny , phylogeny and homeothermy,
  - 1.3 Regulation of body temperature
  - 1.4 Role of brown fat in temperature regulation, homeotherms in extreme condition,
  - 1.5 Hibernation/cold narcosis
  - 1.6 Behavioral regulation and migration.

## Unit II

### 2.0 Gases exchange:

- 2.1 O<sub>2</sub> in environment: Composition of environment, species differences in O<sub>2</sub> requirements.
- 2.2 Acclimation and acclimatization.
- 2.3 Living at high altitude.
- 2.4 Birds in flight.
- 2.5 Air breathing animals under water.
- 2.6 O<sub>2</sub> toxicity, effect of the environment on O<sub>2</sub> demand.
- 2.7 Temperature, salinity and photoperiod.
- 2.8 CO<sub>2</sub>

### 3.0 Pressure and buoyancy.

- 3.1 Deep sea diving problems.
- 3.2 Buoyancy adaptation-Exclusion of heavier elements, inclusion of light material, accumulation of gas, ammonium salts
- 3.3 High altitude Adaptations.

## Unit III

### 3.0 Light and photobiological processes

Harmful effects, photodynamic action, sustan and sunhum,  
Pigmentation and significance, Photoreceptor pigments-Caritenoids,  
visual pigments and visual cycles, phototactic responses,  
Biological clocks, circulation rhythms innar periodicity  
Photoperiodism: Dermal light sense, Localized photoreceptors- eyes  
and their cells and phylogeny (photopic and scotopic eyes )  
Color vision polarized light- sensitivity, arrhythmic eye, papillary  
response, adaptations.  
Electrical discharge, light production and colour change – electric  
organs control, electroreception, transduction, luminescent organ ,  
Bioluminance (extra and intracellular) , Chromatophores,  
pigments (Melanin, ommochromes, carotenoids, pteridins,  
pigment migration and regulation, nervous (cephalopod) ,  
Hormonal (Crustaceans) and neurohormonal ( vertebrates)  
regulation.  
Chemo receptors, mechanoreceptors,(Statocysts, tactile hairs,  
chordolonal sensilla )  
The Acoustico lateralis system, internal ears of vertebrates,  
vestibular organs, response to sand, thermo receptors.

## Unit IV

### 4.0 Physiology of men at work, ergonomics, stress and stress

**management, occupational physiology.**

**M.Sc. Zoology  
Academic Flexibility  
M.Sc.-II Sem.-IV  
(Entomology special paper-IV)**

**Paper – XVI: PEST MANAGEMENT CONCEPTS**

Unit –I:

1. Natural control of Insect Pests with respect to Biotic and Abiotic Factors.
2. Cultural, Mechanical, Physical and Legal control of Insect Pests.
3. The role of Antecedents, Attractants, Repellents and Chemosterllants in Pest Management.

Unit –II:

4. Biological Pest Control:

Definition, history, methods, biocontrol agents, aspects of biocontrol, organizations, Biocontrol programs in India.

5. Microbial Control:

Definition, Pathogens used in microbial control (Fungi, Bacteria, Viruses, Protozoans, Nematodes etc.) Toxins produced and mode of action and application.

Unit –III:

6. Genetic Control: Jacobson.

7. Insect in perspective – M.D. Atkins.

8. Destructive and useful insects – Meicalf & Flint

9. The crop protection – G.H. Rose

10. Insecticidal biochemistry and Physiology – C.F. Wilkinson.

11. Definition, methods and application.

12. The role of Hormonal and Radiational Control in Pest Management.

13. Behavioral Control:

Pheromones – mode of action and applications.

Unit –IV:

14. Chemical Control:

Plant and animal origin insecticides, chemistry, mode of action and applications.

15. Integrated Pest Management:

Definition, logic and necessity of IPM, Tools of IPM, Kinds of pests, integration of existing methods and recent advances.

Suggested Reading Material:

1. Agricultural Pests of India and South East Asia – A.S. Atwel, 1986.
2. A textbook of applied Entomology, Vol. II-K.P. Shrivastava.
3. Genetic control of insect pests- G.Davidson.
4. Biological Pest Suppression – Copell & Martins, 1977.
5. Agrochemicals and Pest Management – T.V. Sathe 2003.
6. Biological Pest Control – T.V. Sathe, P.M.Bhoje, 2000  
Insect sex pheromones – Martin.



**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-IV**  
**(Sericulture special paper-IV)**  
**Paper- XVI**  
**(Seed & Silk Technology & Economics of Sericulture)**

- Unit –I: Seed Technology:
- 1.1 Silkworm egg production.
  - 1.2 Grainage in detail.
  - 1.3 Embryonic development.
  - 1.4 Diapause & non-diapause eggs.
  - 1.5 Acid treatment.
  - 1.6 Incubation of eggs & related aspects.
- Unit –II: Silk Technology (general):
- 2.1 Textile fibers – Brief introduction to natural and man made fibers.
  - 2.2 Silk industry – General silk industry in various states of India.
  - 2.3 Cocoon's – Assessments cocoon properties.  
Silk reeling –
    - a) Cocoon stifling.
    - b) Storage & preservation of cocoons in silk reeling units.
    - c) Cocoon cooking.
    - d) Silk reeling & rereeling.
    - e) Raw silk testing.
    - f) Spun silk yarn.
    - g) Silk weaving.
- Unit –III: Sericultural organization & Economics:
- 3.1 Marketing of cocoon & silk.
  - 3.2 Organization of set up of sericulture.  
Economics –
    - b. Economics of mulberry (Cultivation).
    - c. Economics of cocoon production.
    - d. Economics of seed cocoon.
    - e. Economics of silk production.
- Unit –IV: Extension Education in Sericulture:
- Extension education.
- Classification of various extension teaching methods.

## Reference Books:

- Anonymous (1972): FAO Manuals on Sericulture Vol. I – IV
- Hanumappa (1978): Sericulture for Rural Development, Himalaya Publications, Delhi.
- Gubrajani, M.L. (1986): Silk Dyeing, printing and finishing, IIT, New Delhi.
- Ferguson, A. (1980): Biochemical Systematics and Evolution: Blankie Publications: Glasgo, London.
- Yokoyama, T. (1959): Silkworm Genetics illustrated: Japan Society for Promotion of Science, Tokyo.
- King, L.A. and Posse R.D. (1990): Baccuiovirus Expression System? Chapman and Hall, London.
- Byung, Jo. (1987): Silk Textile Engineering, Moon, Halk Publication Scol. Korea.
- Rayner Hollin (1903): Silk Throwing and Waste Silk Spinning Scott. Greewood and Sons, London.
- Koshy, T.D. (1990): Exports and Development, Ashish Publications, New Delhi.
- Singh, B.D.: Plant breeding, Kalyani Publishers, New Delhi.
- Tazima, Y. (1978): The silkworm. An important laboratory tool, Hodansha Publication, Tokyo.
- Anonymous (1972): Hand Book of silk rearing, Agriculture techniques Manual I., Fuji Publication, Tokyo.
- Jolly, M.S.: Appropriate Sericultural Techniques CSR and TI Mysore.
- Strunnikov, V.A. (1983): Control of silkworm reproduction, Development and sex MIR publications, Moscow.
- Jolly, M.S. Sen S.K. and Ahsan M.M. (1974): Tassar culture, CSTRI, Ranchi.
- Sarkar, D.C. (1988): Ericulture in India, CSB, Bangalore.
- Annual report of Central Sericultural Research and Training Institute, Mysore.
- Annual report of Central Sericultural Research and Training Institute, Bangalore.
- Annual report of Central Tasar Research Institute, Ranchi.
- Annual report of Central Muga Research Institute, Assam.
- Statistical Biannual , CSB Publication, Bangalore.
- Bibliography on Mulberry, CSIR and IIT, Mysore.
- A Treatise on acid treatment of silkworm eggs, CSR and TI, Mysore.
- Probe / Kematic soils of tropical mulberry garden and their management, CSR & TI, Mysore.
- Tips for successful silkworm cocoon crops, CSR and TI, Mysore.
- Tips for successful bivoltine silkworm cocoon crops, CSR and TI, Mysore.
- M.V. Samson, Chandrashekharaih, P. Gowde and Saheb B. (1995): Monograph on silkworm loose egg production, SSTC, CSB, Bangalore.
- CSTRI improved multiple reeling machines, CSRTI CSB Bangalore, 1995.
- CSTRI improved Charkha, 1995, SCTRI, CSB, Bangalore.
- Water Management in silk reeling machine, CSTRI CSB, Bangalore, 1995.
- Hand spinning on CSTRI spinning wheel, 1995, Mysore.
- Bivoltine grainage for tropics, M.S. Jolly.

Economics of sericulture under rain fed conditions, M.S. Jolly.  
Economics of sericulture under irrigated conditions, M.S. Jolly.

- Silkworm rearing and disease of silkworm (1956): Printed by the Director of printing, Stationary and publications at the Government Press.
- Gopalchar, A.R.S. (1978): Three decades of Sericultural progress, CSB, Bangalore.
- Narasimpanna, M.N. and Ullal, R.S. (1981): Hand book of practical Sericulture, CSB Publication.
- Tanaka, Y. (1964): Sericology, CSB Publication Bangalore.
- Ullal, S.R. (1968): Sericulture in USSR A study report, CSB, Bangalore.
- Berch (1979): Insect Pheromones.
- Boyer, H.W. and Nicosia S. (1979): Genetic Neginengineering, Elsetie/ North Holland, Biomedical Press, Amsterdam, New York.
- Davidson, G. (1974): Genetic control of Insect Pests, Academic Press, London.
- Gorbman, A and Bern, H. (1974): Text Book of Comparative endocrinology Wiley Eastern, New Delhi.
- Imms, A.D. (1961): General Text book of Entomology Edn. 9 Rev. by O.W. Rochards and R.G. Davis.
- Lavine, L. (1969): Biology of the gene, Saint Louis, Mosby.
- Odum, E.P. (1971): Fundamentals of Ecology, Philadelphhis, Saunders.
- Wigglesworth, V.B. (1956): Insect Physiology Edn. 5 Rev. Methuen, London.
- Novak, V.J.A. (1995): Insect hormones Chapman and Hall, London.
- Chapman, R.R. (1985): Insect Structure and Functions, ELBS Publ. New Delhi.
- Ganga, G and Chetty, S.J. (1997): An Introduction to Sericulture, 2<sup>nd</sup> Edition, Oxford and IBH Publishing Co. Ltd. New Delhi.
- Mohan Rao M.M. (1988): A text Book of Sericulture BSP Publications, Sultan Bazar, Hyderabad.
- Ahuja, H.L. Advanced Economic Theory, S. Chand and CO. Ltd. New Delhi.
- Stonier and Hauge: A Text book of Economic Theory.
- Crop production, Sericulture and Apiculture Part VI, Report of the National Commission on Agriculture, 1976.
- Hisao, Aruga: Principles of Sericulture. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- Sinha, H.: The Development of India Silk. Oxford and IBH Publishing Co. Ltd. New Delhi.
- Devaika Lecturers in Sericulture.
- Sarkar, D.D. Silkworm Biology, Genetics and Breeding. Vikas Publications, New Delhi.

**M. Sc. Zoology**  
**Academic Flexibility**  
**M. Sc. II, Semester – IV**  
**Paper XVI**  
**Aquaculture and Fisheries Special Paper – IV**  
**Fishery Technology**

**Unit 1:**

**Fishing Technology:**

Its application and significance: Conventional fishing methods – types of crafts and gears, Unconventional fishing methods, Modern methods of fishing, Rules and regulations for fishing operations and safety.

**Unit 2:**

**A. Techniques of Breeding Food Fishes:**

Breeding habits of food fishes, Environmental control of reproductive cycles, Induced breeding – breeding techniques of Indian major carps, Chinese carps, and Fecundity studies of these fishes.

**B. Genetics and Hybridization of Fishes:**

Principles of genetics, Interactions and environmental influences, Sex linkage, Mutations and variations, Population genetics, Practical application of genetics, Hybridization of fishes, Recent trends and techniques of hybridization, Selective breeding.

**Unit 3:**

**Biotechnology in Aquaculture:**

Prospects of aquaculture biotechnology, Biotechnological tools in diagnosis of diseases in aquaculture, Application of hybridism technology in

aquaculture, Cryopreservation technology in fishes, Application of biotechnology in health management in aquaculture, Genetics in aquaculture, Prospects of genetics and biotechnology in Indian aquaculture and fisheries, Molecular genetics in fisheries, Cytogenetics and molecular techniques in fisheries.

#### **Unit 4:**

##### **Post Harvest Technology:**

Fish in relation to public health, Nutritional importance of fish, Spoilage of fish, Principles of different fish preservation methods, Preservation of fish by traditional methods – sun drying, salting, smoking, marinating, fermenting etc., Different types of spoilage in traditionally preserved fish, Modern methods of fish processing – freezing and canning, Major fish products and by-products, HACCP for fish processing industry.

##### **Reference:**

Reference books will be provided in due course or by concerned teacher.

**M. Sc. Zoology**  
**Academic Flexibility**  
**M. Sc. II, Semester – IV**  
**Paper XVI**  
**Food Nutrition**

**Unit I:**

**1. Proportion of food.**

- i. The food nutrients, basic structure and food source.
- ii. The properties of specific nutrient in food.
- iii. Selection of food for balanced diet.
- iv. The energy value of nutrients.
- v. Nutritional foods and fallacies.
  - a. Presentation of food for aesthetic.
  - b. Social,
  - c. Economical and
  - d. Nutritional appeal.
- vi. The relationship between nutritional composition, taste and texture and appearance of food and food acceptability.

**Unit-II:**

**2. Food Nutrition and consumption.**

- i. Nutritional implications of eating semi processed food and fully processed food.
- ii. Nutritional status of people.
  - a. Pediatric nutrition.
  - b. Clinical nutrition.
  - c. Geriatric nutrition.
  - d. Nutrition and Dietetics.
  - e. Community nutrition.
  - f. Maternofoetal nutrition.

#### **Unit-III:**

### **3. Food Nutrition and consequences.**

- i. Physical and psychological consequences of over nutrition and under nutrition.
- ii. Physical and psychological consequences of mal nutrition.
- iii. Variation in food consumption pattern.
- iv. Fallacies related to food consumption and world hunger.

### **4. Nutritional diseases.**

- i. Food Allergy and intolerance.
- ii. Maternofoetal nutrition.
- iii. Nutritional diseases.

#### **Unit-IV:**

### **5. Nutraceuticals.**

- i. Polynutrients – Trepan, phytosterole phenols and theols.
- ii. Distribution of poly nutrients.
- iii. Isolation of poly phenols.
- iv. Protective properties of nutraceuticals.

### **6. Low cost nutrient supplements.**

#### **Reference:**

Reference books will be provided in due course or by concerned teacher.

**M.Sc. Zoology**  
**Academic Flexibility?CollegeP.G. Centre (Y.C.I.S. & S.G.M.)**  
**M.Sc.-II Sem.-IV**  
**Practical – VII**  
**Practical based on Paper – XIII & XIV**

1. Preparation of glassware for cell culture  
Preparation of cells that do not need enzyme digestion ( RBC, Spleen lymph nodes, B.M.)
2. Isolation of cells by enzyme digestion
3. Separation of cells by suitable methods
4. Viable cell count (Tyypan Blue)
5. Primary cell culture and its maintenance
6. Measurements of growth parameters- DNA
7. Cell cycle analysis – mitotic cells.
8. Karyotype studies- Bone marrow peritoneal macrophages.
9. Evaluation of acute toxicity by using static renewal bioassay test ( In fish / Insect).



10. Determination of LC50 of toxicant in fish / stored grain pest by employing ) probit analysis.
11. Effect of toxicant (sublethal dose) on fish gill and alimentary tract in fish and in insect on alimentary canal haemolymph (Mulberry silkworm)
12. Detection of heavy metal from animal issue by AAS (Lead/cadmium/chromium).
13. Detection of pesticide by TLC method from water sample (organochlorine/ organophosphate).
14. Paw edema test.
15. Granulometa – Quantification by weight and differential cell count.
16. Splenectomy.
17. Study of spleen replica for germinal centers.
18. Separation of immunoglobulin by Electrophoresis.
19. Immuno diffusion technique of agar gel diffusion.
21. RBC rosette technique.
22. Harem agglutination inhibition test.
23. Blood group analysis.
24. Histology of lymphoid organs spleen, thymus, lymph node & Bone marrow.
25. Any other practical / experiments set by the Department..

Any 10-11 practicals (At least five from 1 to 8 & five from 9 to 24 practical) are expected to be taken.

**M.Sc. Zoology**  
**Academic Flexibility/College P.G. Centre ( Y.C.I.S.)**  
**M.Sc.-II Sem.-IV**  
**Practical – VIII**  
**Cell Biology Practical- II**  
**Practical based on Paper – XV & XVI**

Mitosis in rat bone marrow.  
 Meiosis in rat & grass-hopper testis.  
 Meiotic non-disjunction in human (Identification based on pictures.)  
 Dorsal nerve root development in chick embryo (Colchicine treatment & observation of cells by fulgure technique).  
 Eye lenses differentiation in chick embryo.  
 Nervous system development in chick embryo.  
 Study of Angiogenesis in chick embryo.

Demonstration of stem cells renewing by mitosis (liver cells Intestinal crypt cells. Bone marrow cells – demonstration of cell division by fulgure technique).

Demonstration of neurons in cerebral cortex of rat.

Demonstration of pituitary cells.

Demonstration of pancreatic islet cells (L, B, Cell types).

Demonstrations of muscle striations (PAS method, phase contrast method) smooth muscle cells observations.

Demonstration of autophagocytosis in striated & smooth muscle cells (Phase contrast & Janus green B staining).

In vitro cell degeneration of liver (histology – nuclear (E+H, Fulgure) alterations lysosomal acid phosphatase alterations in rat).

In vivo cell degeneration – of kidney by Induced ischemia (histology, nuclear alterations – E+H, fulgure).

Age related lipid peroxidation in various organs of rat / mouse.

Demonstration of lipofuscin granules in brain of aged (natural & induced) rat / mouse.

Drug induced lipid peroxidation in liver & kidney (CCl<sub>4</sub> / any suitable drug).

Any other practical / experiments set by the Department.

Project work / Review article.

(It is expected to complete 10-11 practicals from the above.)  
( At least 5 from 1 to 8 & five from 9-18)

**M.Sc. Zoology**  
**Academic Flexibility? College P.G. Centre (S.G.M.)**  
**M.Sc.-II Sem.-IV**  
**Practical – VIII**  
**Comparative Animal Physiology Practical-II**

### **Practical based on Paper – XV & XVI**

Oxygen consumption in crab / fish / prawn.

Estimate Nitrogenous excretory product of animals from different habitat.

Estimation of sugar in Rat / Sheep / Human blood.

Effect of insulin on the blood sugar of Rat.

Estimation of lactate content of Rat/ Human blood.

Bleeding time & clotting time in human blood.

Estimation of chloride content in Rat / Human blood.

Capillary circulation in tailfin of fish.

Effect of temperature on the fish / unio insect heart.

Study of circulation in Pila / crab by dye injection method.

Nerve muscle preparation and simple muscle twitch in fowl.

Absorption spectra of blood pigments.

Detection of Allentoin in mammalian Urine.

Vaginal smear technique.

Study of placental types.

Tracheotomy in white rats.

Study of Uterine smooth muscles.

Study of Contraceptive devices.

Determination of peak expiratory flow rate (PEFR) by Wrights peak flow meter.

Study of finger ergometry.

Determination of grip strength.

Study of physical fitness index by step test method.

Project work / Review article.

Any other practical set by the concerned teacher.

(It is expected to take 10-11 practicals from 1-22 practicals)

**M.Sc.-II Sem.-IV**  
**Practical – VIII**  
**(Based on paper – XV & XVI)**  
**Sericulture Special**

1. Visit to commercial grainage centre.
2. Study of grainage Building & grainage equipments.
3. Cutting of seed cocoons – sex separation by pupal method.
4. Study of acid treatment for artificial hatching.
5. Identification of textile fibers by physical & chemical tests.
6. Identification of defective cocoons & their percentage in a lot of cocoon.
7. Determination of average filament length & average denier single cocoon reeling.
8. Study of reeling machines.
9. Determination of diagramming & bleaching of silk fiber.
10. Silk dyeing (1) Acid dye (2) Basic dye (3) Mordant dye.
11. Characterization of silkworm breeds / races.
12. Evolution of heterosis & over dominance of different combinations.
13. Study of inbreeding depression.
14. Identification of mutants.
15. Study of morphology of mulberry.
16. Cytological technique.  
Preparation of temporary slide – demonstration of Somatic chromocome number.
18. Any practical set by concern teachers.
19. Project work / Review article.

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-IV**  
**Practical – VIII**  
**(Practical based on paper – XV & XVI)**  
**Entomology special practical**

1. Dissection of following organ systems of five available insects.
  1. Digestive system.
  2. Nervous system.
  3. Reproductive system.
2. Histology of digestive system, Neuroendocrine system & reproductive system.
3. Study of haemocyte types & their total haemocyte count.
4. Demonstration of chitin by using chitosan test.
5. Uptake of dyes by the malpighian tubules.
6. Chromatographic analysis of amino acids in insect haemolymph.
7. Estimation of digestive enzymes Amylase / Invertase / Trehalase.
8. Collection and preservation of insect pests.
9. Collection and preservation of Biological pest control agents.
10. Study of insecticide appliances.
11. Insect pest damage detection.
12. Identification and economic importance of parasitoids (Biocontrol agents).
13. Identification and economic importance of insect predators.
14. Identification and economic importance of vertebrate pest biocontrol agents.
15. Field visit for collection and demonstration of pest damage.
16. Study of weed controlling insects.
17. Any practical set by concerned teacher.
18. Project work / Review article.

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-IV**  
**Practical – VIII**  
**(Practical based on Aquaculture and Fisheries– XV & XVI)**

1. Identification of culturable fishes, prawns and mollusks.
2. Study of different nets, crafts and gears (models/drawings).
3. Estimation of glycogen, protein and lipids from fish tissue.
4. Study of fish products and by-products.
5. Cranial nerves of Labeo.
6. Identification and control measures of aquatic weeds and insects
7. Assessment of pollutants from farm water – heavy metals and pesticides
8. Estimation of primary productivity of water sample by light and dark bottle experiment.
9. Qualitative and quantitative study of zooplanktons.
10. Method of fish preservation and canning.
11. Project report / Review article.
12. Any other experiment set by the concerned teacher.

**M.Sc. Zoology**  
**Academic Flexibility**  
**M.Sc.-II Sem.-IV**  
**Practical – II**  
**Food Technology**

1. Manufacturing of Margarine.
2. Study of Microscopic structure of starches before and after gelatinization and retrogradation.
3. Demonstration of effect of shredding, dicing, steaming and pressure cocky and various ph on the structure of the pigments.
4. Isolation of cellular from Aspergillums Nigeria.
5. Isolation of protease from Aspergillums oryzae.
6. Detection of micro-organism in semiprocessed of food.
7. Effect of antioxidants on proteins.
8. Recombinant DNA technology.
9. Detection of heavy metals in processed milk and meat and in sucrose.
10. Effect of iodized salt and iron fortified salt on blood glucose and hemoglobin.
11. Preparation of gelatin from meat.
12. Estimations of B. complex vitamin from processed milk.
13. Bioavability of calcium in old animals.

**Books:**

Analyzing food for nutritional labeling & hazardous contamination.  
Agri. Food quality: An Interdisciplinary Approach Fenwich, G.R.et.al.eds.  
Agricultural and food Policy 3<sup>rd</sup> Edition Knutson R.D.  
Cheese and Butter: Production and Processing Technology by cheke, V & A Shepard.  
Biodiversity & Food Security By Kumar Shashi.  
Bio separation Process in Food By Singh R.K.

Control Food borne micro organisms By Juneja V.K.  
Complex Carbohydrates in foods By Cho S.S.  
Drying & Dehydration of Foods By loesecke H.W.  
Effective Food Service Management By Singh Y.P.  
Element of Food and Nutrition 2<sup>nd</sup> Edition By Dowd, Mary T & Alberta Dent.  
Food Biotechnology by Knorr, Dietrich ed.  
Food Proteins & their Applications by Damodaran Shrinivasan & Alain Para feds.  
Food Safety & Toxicocity by Devries, John ed.  
Food Science and processing Technology in Vol. 2 By Mirajkar Mridila & Sreelata Manon.  
Food Lipids: Chemistry nutrition & Biotechnology By Chaturvedi.  
Food chemistry by L.H. Meyer.  
Basic food microbiology – Banwart.  
Technology of food preservation – Desroster.  
Food science – by Potter.  
Fundamentals of Dairy Chemistry – Webb.  
Modern food Microbiology by J.M. Jay van Nostrand Reinhold Company New York.  
Food Science- Fox A Brian and All an.  
Pelezar M.J. Microbiology.  
Extraction of protein from milk, eggs.