SHIVAJI UNIVERSITY, KOLHAPUR

DEPARTMENT OF ZOOLOGY

Academic Flexibility

M.Sc. Sem. I to IV

(Implementation of unitization of syllabus and credit system)

and

P.G. Diploma courses (Four) in Applied Zoology

From

June, 2008 onwards

M.Sc. Zoology Academic flexibility

M.Sc. Part – I & II

Sem	Paper/Practical	Title of the paper/practical	Hours/ wk	CIE Marks	Exam marks	Total Marks
I	**Paper - I**	Biosystematics and Biodiversity	4	20	80	100
	Paper - II	Ecology and Environmental pollution	4	20	80	100
	Paper - III	Cell & Molecular Biology	4	20	80	100
	Paper – IV	Applied Entomology	4	20	80	100
	Practical I	Practical based on paper I and II	6	--		100
	Practical II	Practical based on paper III and IV	6	--		100
II	**Paper - V**	Physiological Chemistry	4	20	80	100
	Paper - VI	Quantitative Biology & Tools and Techniques in Biology	4	20	80	100
	Paper - VII	Elements of Physiology	4	20	80	100
	Paper – VIII	Biology of Parasites	4	20	80	100
	Practical III	Practical based on V and VI	6	--		100
	Practical IV	Practical based on VII and VIII	6	--		100
III	**Core course**					
	Paper – IX	Animals in Biotechnology	4	20	80	100
	Paper- X	Enzymology	4	20	80	100
	Elective Course					
	Special Course	Any one of the following (Optional)				
	Paper - XI					
	Cell Biology					
	Comparative Animal Physiology	Computational Molecular Biology	4	20	80	100
		Invertebrate Endocrinology	4	20	80	100
	Entomology					
	Sericulture	Basic Entomology	4	20	80	100
	Aquaculture & Fisheries	General Sericulture and Moriculture	4	20	80	100
		Fisheries Resources – Inland and Marine fisheries	4	20	80	100
	Food Science, Food Technology & Nutrition	Food Chemistry	4	20	80	100

III	**Core course Paper – XII**					
	Cell Biology	Molecular Biology of Gene	4	20	80	100
	Comparative Animal Physiology	Vertebrate Endocrinology	4	20	80	100
	Entomology	Agricultural Entomology	4	20	80	100
	Sericulture	Silkworm Biology and Rearing Technology	4	20	80	100
	Aquaculture & Fisheries	Fish Pathology and Reproductive Endocrinology	4	20	80	100
	Food Science, Food Technology & Nutrition	Food Processing and Packing	4	20	80	100
	Practical V	Practical based on IX and X	6		80	80
	Practical VI	Practical based on XI and XII or each Elective Subject.	6		80	80
IV	**Core course**					
	Paper – XIII	Animal Cell in Biotechnology	4	20	80	100
	Paper- XIV	Toxicology and Immunology	4	20	80	100
		Elective Course				
	Paper - XV	Any one of the following (optional)				
	Cell Biology	Cell in , Differentiation , Development Specialization	4	20	80	100
	Comparative animal Physiology	Animal Physiology	4	20	80	100
	Entomology	Insect Anatomy and Physiology	4	20	80	100
	Sericulture	Cytology, Genetics of Silkworm and Their Host Plants	4	20	80	100
	Aquaculture & Fisheries	Aquaculture Practices	4	20	80	100
	Food Science, Food Technology & Nutrition	Food Biotechnology	4	20	80	100

IV	**Elective course Paper – XVI**	Special Course Any one of the following (Optional)				
	Cell Biology	Cell Pathology	4	20	80	100
	Comparative Animal Physiology	Applied Physiology	4	20	80	100
	Entomology	Pest Management Concepts	4	20	80	100
	Sericulture	Seed and Silk Technology and Economics of Sericulture	4	20	80	100
	Aquaculture & Fisheries	Fishery Technology	4	20	80	100
	Food Science, Food Technology & Nutrition	Food Nutrition	4	20	80	100
	Practical VII	Practical based on XIII and XIV	6		80	80
	Practical VIII	Practical based on XV and XVI for each elective subject.	6		80	80
		Project Seminar, field visit & tour report Submission. (Individual or in group of 2 – 3 Students: Based on special papers) **Out of 80 marks 60 marks for Project, (10 marks for Seminar one on any elective paper & 10 marks for field visit / students tour report/ submission.)** • Project – 60 marks (Individual / group of 2-3 students: Based on elective papers) • Seminar – 10 marks (one on any elective paper. • Submission of students tour report,/ Submission or field visit / 10 marks.				

THEORY EXAMINATION
Nature of Question Paper

CIE — 20 Marks (objective type questions 20 items)
(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

Practical Examinations

Sem I
Sem II
SemIII
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.

Grades Points	Range of marks obtained out of 100 or in any fractions	
0	from 00	to 05
1	06	10
1.5	11	15
2	16	20
2.5	21	25
3	26	30
3.5	31	35
4	36	40
4.5	41	45
5	46	50
5.5	51	55
6	56	60
6.5	61	65
7	66	70
7.5	71	75
8	76	80
8.5	81	85
9	86	90
9.5	91	95
10	96	100

5. The grade points will be converted to Grades as under.

Grade Points	Grades
8.5 to 10	A
7.0 to 8.4	B
5.5 to 6.9	C
4.0 to 5.4	D
3.5 to 3.9	E
0 to 3.4	F

6. Each Theory paper at the Semester Exam will carry 4 (four) Credits. The Practical Course in one Semester will carry &8 Credits 2 practicals in all. Thus the total Credits, normally offered by each student per Semester is (4 X 4) + 8=24. The total M.Sc. course will be equivalent to 96 credits.

7. The calculation of Semester Grade point Average (SGPA), Cumulative Grade Point Average (CGPA), Final Grade Point Average (FGPA) will be made for each student as applicable after each Semester Course.
These calculations will be done using the standard procedure as spelt out in the scheme.
e.g.

1. Semester Grade Point Average (SGPA):

$$SGPA = \frac{(gl \times cl) + (g2 \times c2) + (g3 \times c3) + (g4 \times c4) + (g5 \times c5)}{\text{Total number of credit offered by the student during the Semester}}$$

$$SGPA = \frac{(gl \times 4) + (g2 \times 4) + (g3 \times 4) + (g4 \times 4) + (g5 \times 8)}{24}$$

where gl are Grade points scored by the students.

2. Cumulative Grade Point Average (CGPA) : e.g. after Second semester.

$$CGPA = \frac{(g1*c1) + (g2*c2) + \ldots + (g10*c10)}{48}$$

8. The SGPA for advancement to the next Semester should be 4.
The above may be kindly noted and approved.

P.G. DIPLOMA COURSES IN APPLIED ZOOLOGY
(FOUR COURSES)

Duration of the course:

The duration of post graduate diploma course shall be **one year** comprising two semesters. The candidate admitted to course shall be examined in both theory and practical at the end of each semester. The total marks for the examination shall be 700 marks Upon completion of the training, the successful candidate will be awarded a post graduate diploma in Applied Zoology (respective course undertaken) of Shivaji University, Kolhapur.

The division of 700 marks shall be as follows:

Theory	**Marks**	**Practicals**	**Marks**
Semester I Paper I & II	100 + 100	Practical I	100
Semester II Paper III & IV	100 + 100	Practical II	100
Project / Field work / Submission	100		
		Total	**700 marks**

2. Details of the syllabus for the post graduate diploma in Applied Zoology course wise will be as follows:
3. General rules of the admission, examination and fee structure will be as per University rules

Diploma Courses in Applied Zoology (Titles of the papers):

i. **Biodiversity and Conservation:**

Semester – I
Paper – I Biodiversity of Major Groups
Paper II Ethnobiology and Conservation

Practical - I

Semester II
Paper III Concepts of biodiversity
Paper – IV Biodiversity Conservation
Practical - II

ii. **Economic Entomology**

Semester – I
Paper – I Forest Entomology
Paper – II Medical Entomology
Practical – I
Semester – II

Paper III: Insect Culture and Pest Control

Paper IV: Veterinary Entomology

Practical – II

iii. **Aquaculture and Fisheries Technology**

Semester - I
Paper I: Biology of fishes
Paper II Fish culture practices
Practical – I
Semester - II
Paper III Fisheries Technology
Paper IV Pathology and Breeding of Ornamental Fishes
Practical – II

iv. **Immunocytotechnology**

Semester - I
Paper I Principles and Techniques of Biochemistry used in Immunology
Paper II The Immune system
Practical – I

Semester - II
Paper III Immunotechnology
Paper: IV Applied and Clinical Immunology
Practical - II

M.Sc. Zoology

Academic Flexibility
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 & multicellulor 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:

1. Alston, R.E. and B.L. Turner (1963): Biochemical systematics Prentices Hall Inc. Englewood Cliffs, N.J. 404 pp.
2. Avise, J.C. (1974): Systematic value of Electrophoretic data. Syst. Zool. 23 (4): 465 – 481.
3. 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.
4. 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.
5. Camp, W.H. (1951): Biosystematics Britania 7: 113 – 127.
6. CHamberlin, W.J. (1952): Entomological Nomenclature and Literature 3rd edition Dubuvue lowa William C. Brown Co.
7. Cole, A.J. (1969): Numerical taxonomy proceedings of the colliqui in numerical taxonomy held in the University of St. Andrews Sept. 1968. Academic Press, N.Y 324 pp.
8. Hennig, W. (1966): Phylogenetic systematics Univ. Illinois Press III, 263 pp.
9. Heywood, V.H. (1973): Taxonomy and Ecology Systematics Association special Vol. 5 Academic Press, London, and New York 370 pp.
10. Huxley, J.S. (ed.) The New Systematics Oxford Uiv. Press London 538 pp.
11. Jeffrey, C. (1977): Biological nomenclature Indian Ed. Oxford and IBH Pub. Co. New Delhi 72 pp.
12. Mayr, E. (1969): Proinciples of systematics Zoology Mc. Graw Hill N.Y. 428 pp.
13. Mayr, E. and E.G. Linsley and R.L. Usinger (1953): Methods and Principles of systematic Zoology, Mc Graw Hill N.Y. 328 pp.
14. Oman, P.W. and A.D. Cushmann (1948): Collection and Preservation of insects U.S. Dept. of Agric. Misc. Pub. 601: 1 – 42.
15. Pankhurst, R.J. (1978): Biological identification Edwards Arnold Ltd. London, 104 pp.
16. Pankhurst, R.J. (1984): Online identification programme version 4. British museum (Natural History) London.
17. Strickland, H.E. (1842): Rules of Zoological nomenclature Report of the 12th meeting of British Association held at Manchester in 1842 Brit. Assoc. Adv. Sci. Rept. 1842: 7 – 18.
18. Ernst Mayr (1969): Principles of Systematics Zoology TMH Ed. Tata McGraw Hill Publishing company Ltd. Bombay New Delhi.
19. Primack, R.B. (1950): A primer of conservation biology 3rd edition Sinuer Associates Inc. Publishers Sunderland Massachutts USA.
20. Ray Samit an Ray A.K. (2006): Biodiversity and Biotechnology New Central Book Agency (P) Ltd.

21. Kapoor, V.C. (2001): Theory and practice of Animal Taxonomy 5th edition Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
22. Wilson, E.O.: Biodiversity.
23. Knudsen, J.W.: Biological techniques collecting preserving and illustrating plant and animals.
24. Black Welder, R.E. and Blair W.F. Guide to the Taxonomic literature of vertebrates.
25. Alexander, R.M. The Chrodate.
26. Waterman, A.J. Chordate
27. Saxena and Saxena: Plant taxonomy
28. Vyas,Purohit, Grag: A text book of Angiosperms.
29. Chan and Noel Krieg: Microbiology
30. Sharma, K.: Text Book of Micorbiology
31. Sharma K Manual of microbiology
32. Prescott: Microbiology
33. Wilson, E.O. Biodiversity National Academy Press 1988.
34. Tandon, Biodiversity status and prospects
35. Ray: Biodiversity and Biotechnology
36. Y.A. Abrol: Biodiversity and its significance
37. Prithipalsingh: An Introduction to Biotechnology
38. Chanchan Modern Pattern of Biodiversity conservation.
39. K.V. Krishnamurthy: An advanced textbook on biodiversity, principles and practice.
40. Allen, J.M. The nature of biological diversity
41. S.K. Jain: Conservaiton Biology
42. Bowles, M.L. and Whelman, C.J. Restoration of endangered species
43. Norton, B.G. The Preservation of speices The value of Biological Diversity.

M.Sc. Zoology
Academic Flexibility
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:

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

ii. **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:

1. Begon, M.J.L. Harper and C.R. Townsend. Ecology. Individuals, Populations and Communities. Blackwell Science. Oxford, UK.
2. Cherrett, J.M. Ecological concepts. Blackwell Sci. Pub. Oxford. U.K.
3. Elseth, B.D. and K.M. Baumgartner. Population biology. Van Nostrand co., New York.
4. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.
5. Krebs, C.J. Ecology. Harper & Row, New York.
6. Krebs, C.J. Ecological methodology. Harper & Row , New York.
7. Ludwig, J.A. and J.F. Reynolds, (1988) statistical ecology. John Wiley & Sons, New York.
8. Pianka, E.R. Evolutionary ecology. Harper & Row, New York.
9. Ricklefs, R.E. and G.Miller. Ecology, W.H. Freeman & co., New York.
10. Roughgarden, J., Ecological methods.
11. Southwood, T.R.E.
12. Swartzman, G.L. and S.P. Kaluzny. Ecological simulation primer, Macmillan, New York.
13. Roof. D.A. The evolution of life histories. Theory and Analysis. Chapman & Hall, London, UK.
14. Odum E.P. Fundamentals of Ecology. W.B. Saunders publication, Philadelphia.
15. Odum E.P. Basic Ecology, Saunders publication, Philadelphia (1983).
16. Laurent Hodges. Environmental Pollution Halt, Rinehart & Winston, New York (1977)

M.Sc. Zoology
Academic Flexibility
M.Sc.-I Sem.- I
Paper - III
Cell and Molecular Biology

Unit –I: Nuclear Compartment:

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 phospholipasec).
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 Membrance 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. HoltgmanE The frontiers in Cell Biology series Academic Press.
19. Petty H.R 1993. Molecular Biology of Membrance Plenum.
20. Yeagle P.L. 1993. The Membranes of Cells 2nd ed.Academic Press.
21. Berger E.G. et.al. 1998. Reviews of Golgi Comlplex Trends Cell Biology Vol. 8 No.1.
22. Rapoport, T.A. etal. 1996. Protein Transport across the eukaryotic ER & Bucteria inner membrance Annu. Rev. Biochem. 65:271-303.
23. Robinron M.S. 1997. Coats & vesicle budding Tred Cell Biol. 799-102.
24. W.Baumeister etal. 1998- The Proteosome: Paradigm of a self compartmentalizing protease Cell 92:367-380.
25. Robison, M.S. etal 1996 Membrance 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. Nucleocytoplasnic 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
M.Sc.-I Sem.-I
Paper -IV– Applied Entomology

Unit –I:

1. Identification, Characteristics, Biology, Damage and Control of pests. Study of generalized insect: Grass hopper & Butterfly – Morphology and Anatomy.
2. **House hold pests**: Cockroaches, Ants, Crickets, Clothes Moths, Carpet beetles, Furniture beetles, Cigarette beetles, House hold hairy caterpillar, Silverfish, Book louse, Wasps.
3. **Stored grain pests**: Rice weevil, Rice moth, Termites, Khapra beetle, Pulse beetle, Rust red floor beetle.
4. **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 plagoeplheps, 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
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 curetting 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 Quadrate & 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, CO2 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.
25. Detection of heavy metal from the water sample.
26. Practicles 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
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. $MgCl_2$ influence on alcinopoilia.
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. Collection and Preservation of Insects.
8. Preparation of Permanent slides of Head, Thorax and Abdominal appendages. Whole mounts of small insects.
9. Study of Insect head and its appendages: Types of head, antennae and mouthparts.
10. Study of Thorax and its appendages: Types of wings and legs, mounting of halters.
11. Study of Abdomen and its appendages: Types of genitalia, cerci, tympanum, pseudo legs and sting.
12. Dissection of organ systems in five different types of insects.
13. Practicals based on Apiculture.
14. Any other practical/s set by the concerned teacher/ Department.
15. Study of generalized insect. Identification economic importance of following insect pests (6-8 pests from each category)
16. Pests of stored gains.
17. Household pests.
18. Pests of medical importance.
19. Pests of veterinary importance.
20. Forest pests.
21. Types of silk moths.
22. Rearing appliances of mulberry silk worm and demonstration.
23. Study of fornsre insects
24. Study of nutritional insects.
25. Life cycle and types of honey bees.
26. Lac insect economic importance.
27. Field visit for demonstration of pest damage.

M.Sc. Zoology
Academic Flexibility
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 glycogensis

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 leuketrins
Lipoprotein metabolism

Unit 4

4.0 Vitamins and coenzymes, stroids and nucleotides and amino acids metabolism

Fat soluble vitamins and water soluble vitamins.
Steroidal hormaones
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 an 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 Davdson and D E Smith- Text book of physiology and biochemistry
9. Mitlon and Toporely- Essentials of biochemistry
10. Outline of Biochemistry by Conn & Stump.

M.Sc. Zoology
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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, flurescent 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
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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:

1. Human Physiology – by A.C. Guyton. Saunders Company Londan, Toronto.
2. Shepherd G.M. Neuro Biology, New York Oxford University Press 1987.
3. Hurst J.W et al (eds) The Heart7th ed. New York McGraw- Hill Book Co. 1990.
4. Hand Book of Physiology Vols. Circulation. Renkin, E.M. & Micbel, C.C. (eds) Americal Physiological Society, 1984.

5. Gayton A.C. et al. Circulation Overall regulation Annu Re. Physiol. 34: 13 1972.
6. Guyton A.C. 1980 Arterial pressure & Hypertension Philadelphia, W.B. Saunders Co- Cartiar output & its regulation 1973.
7. Kaplan N.M. et al 1989- The Kidney in Hypertension (Perspectives in hypertension vol.2) New York. Raven Press.
8. Guyton A.C. et al 1975 Dy namics & Control of the Body flerids Philadelphia, W.B. Saunders, Co., 1975.
9. Brenner B.M. & Rector, F.C. (Jr) 1986. The kidney 3rd ed. Philadelphia, W.B. Saunders Co., 1986.
10. Brooks V.B. 1986. The neural Basis of motor control New York, Oxford University Press.
11. Johnson L.R. et al Physiology of the gastrointestind tract 1987 New York Raven press.
12. Thampson J.C. et al (eds) Gastrointestinal Endocrinology. New York McGraw Hill book co., 1987.
13. Setchell K.D.R. et al eds 1988. The Bile Acids New York Plenum Pub. Corp.
14. Guthrie H.A. 1988. Introductory Hutrition 7th ed. St.Lonis C.V. Mosby Co.,
15. Felig P et al (eds) 1987. Endocrinology & Metabolism New Your MacGraw- Hill Book Co.,
16. DeGroot L.J. et al 1989. Endocrinology 2nd ed. Philadelphia, W.B. saunders Co. 1989.
17. Kannan, C.R. 1988. The adrenal gland New York Plenum Pub. Corp.
18. Wozney J.M. et al 1988. Novel regulators of bone formation: Molecular clones & cultivates science 242: 1528.
19. Martin R.B. & Burr D.B. 1989. Structure, function & adaptation of compact Bone New York, Raven Press 1989.
20. Knobil E. et al (eds) The physiology of Reproduction New York, Raven Press 1988.
21. Leung P.C.K. et al (eds) Endocrinology & Physiology of reproduction New York Plenum Pub. Corp. 1987.

M.Sc. Zoology
Academic Flexibility
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 Dicidcoclium.
Nematocles: Wuchreia, Ancylostoma, Trichinella Strongyloides, Entrobius, 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) 2nd 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) 2nd Ed. C.V. Mosby Co. St. Lohis ISSR.
7. Introduction Animal Parasitology – By Smit. D.G. (19977) 2nd Ed. Johns Willey Sons New York.
8. The Biology of parasitism and introduction to the study of associate organism- by White field, P.J. (1977) University Parks Press Baltimore.
9. Animal Parasitism – by Read C.P. Prenters Hall of India Pvt. Ltd., New Delhi.
10. Helminths, Arthropods & Protozoo of domesticated Animals. By E.J.L. soulsby, ELBS publication London Ed. 1969 ed.
11. Parasitology – by Chandler and Chands,
12. A Text book of Parasitology by S.S. Kelkar and Rohini S. Kelkar, Bombay popular prakashan.

M.Sc. Zoology
Academic Flexibility
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.

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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 trysin detection.
2. Glucose tolerance test.
3. Blood clotting time.
4. Blood – analysis (glucose, proteins, albumin RBC cant WBC cant. Differential WBC cant.
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
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 fig.
   - 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

   i) In vivo models of hepatitis diabetes , Hypercholesterolemia, atherosclerosis, senescence and their use & its use in drug testing.

   ii) Cloned animals
   Preparation, maintenance and uses

   iii) 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. melanogaste,* 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 tertogenic 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.

1. Genetics Gardner
2. Brace Albert
3. Strickberger.

M.Sc. Zoology
Academic Flexibility
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 bisphosphate 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:

1. Fundamentals of Enzymology : Price N.C. and L. Stevens e.. Oxford New York.
2. Dixon, M., Webb, E.C; et al. (3rd Ed.) Longman, London.
3. Methods in Enzymology all volumes.
4. Scopes, R.K. Protein Purification, Principles and Practice.
5. Ferdinand, W. (1976) fundamentals of enzyme kinetics, Butterworths, London.
6. Enzyme by Palmer.
7. Niggins, I.J. Best D.J. and Jones, J. Biotechnology – Principles and applications, Black well, scientific oxford (1985).
8. Bulock, J. and Kristiansen, B- (1987) Basic biotechnology.

M.Sc. Zoology
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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
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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 -I I:

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 Tembare 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
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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.
Thysonura.
Diplura
Proturo.
Collembola.

Pterygote orders.
Ephimerida.
Plecop-ters.
Odonata
Embioptera
Orthoptera
Phasmida.
Dermaptera.
Blatteria.
Montodea
Isoptera.
Psocoptera.
Mallophaga
Anoplara
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 roof 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 RESOURSES – INLAND AND MARINE FISHERIES.

1. Management of Marine Fisheries: J.A. Gullad.
2. Fishery Science: W.C. Royce.
3. Ecology, Utilization and Management of marine fisheries; G.A.Rounsefell.
4. Fisheries development of India: U.K. Shrivastava and M. Dharma Reddy.
5. Aquaculture research needs for 2000 AD: Jaw. Kai. Wang and P. V. Dehadari.
6. Fish farming hand book: E.E. Brown and J.B. Gratzek.
7. Fresh water biology: K.F. Lagler.
8. Fish and Fisheries of India: V.G. Jhingran.
9. Advances in aquaculture: T.V.R. pillay.
10. Fishes an introduction to ichthyology: P.B. Moyle and J.J. Cech.
11. Fishery management: S.C. Agarwal.
12. Applied fishery science (Vol. I & II): S.M. Shafi.

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

Food Chemistry

Unit- 1:

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

Unit-2:

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

Unit- 3:

6. **Meat and Meat products.**
    a. Animal structure.
    b. Postmortem changes.
    c. Color of the meat.
    d. Cured smoked meat.
    e. Changes in meat on cooking.
    f. Tenderness.

7. **Vegetables and fruits.**
    a. Classification, Composition, Selection, Fungus as a food, Algae as a food.
    b. Fruits – Classification, Composition, past harvest changes and storage Ripening of fruits, Enzymatic Browning and Non enzymatic browning.

Unit-4:

8. **Sugar and Related products.**
    a. 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
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.
4.6 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.
- 6.5 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
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.
1.4 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 Metzhter.
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:
Jowar stem borers, midgefly, aphid, Rice grasshopper, Leaf hoopers, Striped borer,
2.0 Pest of pulses:
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):
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:
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:
Borers, purilla, Sugarcane woolly aphid, whitefly, mealy bug, termites.
6.0 Pest of fiber crops:
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:
Mustard aphid, Mustard Sawfly, groundnut aphid, groundnut stemboser, the white grub, aphid.

Unit –IV:
8.0 Pests of vegetable crops:
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 shoothole borer.
10.0 Pest of spices and Narcotic:

Chillithrips, caster 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-Lana – 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:

1. **Inactivation of Micro-organisms from food.**
    a. Detection of Micro-organism.
    b. Microbial Inactivation of the food.
    c. Control of Micro-organisms.
    d. Cleaning and sanitization of equipments in food processing.
2. **Processing of Edible oil and fats.**
    a. Source and distribution of oil and fats.
    b. Preservation of oils.
    c. Uses of edible oil.

Unit-2:

3. **Processing of fruits.**
    a. Sources and distribution of fruits.
    b. Processing of fruits.
    c. Preservation of fruits.
    d. Nutritive values of processed fruits.
    e. Use of food in medicine.
4. **Food processing of cereals.**
    a. Flouring of cereals.
    b. Processing and preservation of cereals.
    c. Nutritional values of processed cereals.

Unit-3:

5. **Food processing in Bakery and Dairy.**
    a. Food processing and preservation in bakery and Dairy.
    b. Nutritional value of Bakery products.
    c. Economic value of Bakery product.
6. **Processing and preservation of Meat, Fish and other sea food.**
7. **Food fermentation** – nutritive value of fermented food.
8. **Food Packing.**
    a. History of packaging and labeling.
    b. Material used in packing.
    c. Appropriate form of packaging used for varieties of food & its uses.
    d. Role of packaging in food Industries.
    e. Packaging and labeling.

Unit-4:

9. **Technological development in food packaging.**
    a. Recycling of packaging material.

b. Resource recovery in food industry.
c. Legal responsibility of manufacturer.

10. Food marketing.

a. Role of packaging at the point of sale and self service retailing.
b. Commutative function of packaging.
c. Cost of packaging relative to product cost.
d. Effect of packaging of food waste.
e. 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
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, thymactomy, spleenectomy, Gonadoctomy and Steroidal hormone supplementation study
4. CCl4 toxicity *in vivo.*
5. Paracetamol toxicity *in vivo.*
6. Studies of drug induced and natural ageing
7. Study of Diabetes Models- Allexan 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 Drossophila silkworm for endocrinological studies, larval mutants of silkworm.
11. Study of Angiogenesis in chick emlnyo – 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
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 praticals.
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 praticals expected to be completed.)
(At least 5 to 6 Practicals from 1 to 10 practicals expected to be completed)

M.Sc. Zoology
Academic Flexibility
M.Sc.-II Sem.-III
Practical – VI
Comparative Animal Physiology Practical-I
Endocrinology

1. Invertebrate Animals: (Four practicals)
   Dissection so as to expose the endocrines system of representative from following group of animals.
   a. Pila.
   b. Leech.
   c. Earthworm.
   d. Bivalve
   e. Prawn
   f. Crab
   g. Scorpion
   h. Cockroach / Grasshopper
   i. Bugs
   j. Dragon flies / Naiads
   k. Butterfly /Moth-larvae (Caterpillar)
   l. Honey bee / wasps
   m. Beetles
   n. Houseflies
   o. Snail & slugs
2. Histological preparations from selected above mentioned animals (four practicals).
3. Histochemical analysis of neurosecretary material from selected above mentioned animals. (Three practicals)
4. Anatomy of male & female reproductive system of the selected above mentioned animals. (Four practicals)
5. Demonstration of role of brain hormone in metamorphosis (ligature or Quatrisation Experiment) in silkworm. (One practical).

Vertebrate Animals: Endocrinology

6. Anatomy & histology of endocrine organs of selected vertebrate from following.
   a. Fish – Labeo
   b. Bird (fowl / pigeon / Quial)
   c. Rat / Mouse / Rabbit.
      (Pituitary gland, Adrenal gland, Thyroid gland, Pancrease, Gonadal endocrine gland).

7. Effect of adrenalin and acetyl choline/ epinephrine on fish chromatophore.
8. Induction of Alloxan diabetes in the mouse / Rat. Gonadetomy, Pancreotomy, Thyradactomy in the Rat / Mouse.
9. Study of sperm count.
10. Study of morphological abnormalities of sperms.
11. Capacitation and motility of sperms.
12. Demonstration of artificial insemination.
13. Study of oestrous cycle by vaginal smear method in Rat.
14. 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)

1. Identification of important food fishes, prawns and molluscs upto the species level (Freshwater and Marine)
2. Estimation of the rate of oxygen consumption in fish
3. Dissection of fish to expose – a) Pituitary gland b) Urinogenital system
4. Fecundity assessment in fish
5. Preparation of permanent slides of different types of scale
6. Demonstration of induced breeding technique by ovaprim / ovatide.
7. Estimation of DO, CO_2, Alkalinity, Inorganic nitrate and Phosphate from water sample
8. Qualitative analysis of digestive enzymes
9. Identification of diseased fish – Bacterial, fungal and viral infections (Slides)
10. Examination of fish for protozoan parasite
11. Examination of fish for helminth parasite
12. Blood glucose estimation in fish
13. Sexual dimorphism and secondary sexual characters in fishes
14. Short term bioassay of LC50 determination (Demonstration)
15. Study of permanent histo-pathological slides of important tissues in fishes exposed to toxicants.
16. Any other experiment set by the teacher/ Department.
17. Field trips and study tours to fish farms, fisheries institute, or national laboratory etc. is compulsory.
18. 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 halters.
4. Study of Abdomen and its appendages.
   - Types of gentalia, 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)

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

M.Sc. Zoology
Academic Flexibility
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, CO2 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, CO2, O2 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
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 2nd 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 Co oper, E.L. The immune system.
Smialo wicz 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 oyhers – 2001.

M.Sc. Zoology
Academic Flexibility
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
4.4 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 (Mylinated) 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:

1. Cell & Molecular Biology by Gerald Karp (2005) published by John Wiley & sons.
2. 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
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 CO2 and vascular fluids

Unit III :

4.0 Respiratory pigments:

4.1 Haemoglobin, Chlorocruorin (annelids), Hemocynins, nemerythrin.

4.2 Phylogeny of efficient O2 transport, O2 equilibrium curves, CO2 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 Wthout special excreation tubules.

5.2 Contractile vacuoles, storage excretion.

5.3 Excretory tubules- nephridia, Malphighian tubules, vertebrate nephron- Pronephridia(Acoelomate and psedocoelomate), Metanephredia (Coelomates – Annelids, Mollusk),

5.4 Urine formation in mammals , Regualtion, 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 Proprioreceptors.
- 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;Enrlich P.R; Introduction to Insects
Clarks,L.R.,P. W. Geir, R.D. Hughes and R.F.Morris (1968) Ecology of Incets 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 Inverttebrates
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 & inbreed line. Heredity traits and effect of environment of them. (egg, larva, cocoon, pupa and adult characters)
Mendel's principles –
Dominances, Segregation, Mundelein 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 voltinism, moultinism, 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 verities and their maintenance.

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

2. Cytologial aspects ofmulberry 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 – Parthinogenesis and polyploidy.
6. Objectives of plant breeding.
7. Genetic Viability and it's role in plant breeding.
8. Methods of reproduction and breeding methods in self pollinated and cross pollinated plants.
9. Breeding for draught 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:

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

Unit-III:

6. Determining Micro-organisms and their product in food – Culture, Microscopic and sampling method, membrance tillers, Microscopic colony counts, Agar droplets, Dry films, Dye reduction, Roll tubes, Microbiological Examination of surtaxes. Air sampling.
7. Genetically modified foods – soybean, maize canola and oil seeds.
8. Detoxification of food toxin.
9. 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. **Nutracenticals –** Terpenes, caratonoids limonoids, polyphenols and phytosterols – vitamin and caratonoid rich plant products.

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: Cell Pathology

Unit I

1.0 Cell in stress and death

1.1 Hypertrophy, Hyperplasty, Atrophy, polyploidy, modulation , metaplasia and displacia.

1.2 Biotransfomration 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 heterozygocity / 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 Defeinitions 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 lipofuschin 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 & Rafampicin).
6.3 Protein synthesis(Duramycin, Cyclohexamide, 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:

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

M. Sc. Zoology
Academic Flexibility
M. Sc. II, Semester – IV
Comparative Animal Physiology
Elective Paper- IV

Paper- XVI: Applied Physiology

Unit I

1.0 Physiological compensation for environmental variation

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

Unit II

2.0 Gases exchange:

2.1 O2 in environment: Composition of environment, species differences in O2 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 O2 toxicity, effect of the environment on O2 demand.
2.7 Temperature, salinity and photoperiod.
2.8 CO2

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

3.1 Harmful effects, photodynamic action, sustan and sunhum,
3.2 Pigmentation and significance, Photoreceptor pigments-Caritenoids, visual pigments and visual cycles, phototactic responses,

3.3 Biological clocks, circulation rhythms innar periodicity
3.4 Photoperiodism: Dermal light sense, Localized photoreceptors- eyes and their cells and phylogeny (photopic and scotopic eyes)
3.5 Color vision polarized light- sensitivity, arrhythmic eye, papillary response, adaptations.
3.6 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.
3.7 Chemo receptors, mechanoreceptors,(Statocysts, tactile hairs, chordolonal sensilla)
3.8 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. Insecticity 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:

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

35. Silkworm rearing and disease of silkworm (1956): Printed by the Director of printing, Stationary and publications at the Government Press.
36. Gopalchar, A.R.S. (1978): Three decades of Sericultural progress, CSB, Bangalore.
37. Narasimpanna, M.N. and Ullal, R.S. (1981): Hand book of practical Sericulture, CSB Publication.
38. Tanaka, Y. (1964): Sericology, CSB Publication Bangalore.
39. Ullal, S.R. (1968): Sericulture in USSR A study report, CSB, Bangalore.
40. Berch (1979): Insect Pheromones.
41. Boyer, H.W. and Nicosia S. (1979): Genetic Negineering, Elsetie/ North Holland, Biomedical Press, Amsterdam, New York.
42. Davidson, G. (1974): Genetic control of Insect Pests, Academic Press, London.
43. Gorbman, A and Bern, H. (1974): Text Book of Comparative endocrinology Wiley Eastern, New Delhi.
44. Imms, A.D. (1961): General Text book of Entomology Edn. 9 Rev. by O.W. Rochards and R.G. Davis.
45. Lavine, L. (1969): Biology of the gene, Saint Louis, Mosby.
46. Odum, E.P. (1971): Fundamentals of Ecology, Philadelphis, Saunders.
47. Wigglesworth, V.B. (1956): Insect Physiology Edn. 5 Rev. Methuen, London.
48. Novak, V.J.A. (1995): Insect hormones Chapman and Hall, London.
49. Chapman, R.R. (1985): Insect Structure and Functions, ELBS Publ. New Delhi.
50. Ganga, G and Chetty, S.J. (1997): An Introduction to Sericulture, 2nd Edition, Oxford and IBH Publishing Co. Ltd. New Delhi.
51. Mohan Rao M.M. (1988): A text Book of Sericulture BSP Publications, Sultan Bazar, Hyderabad.
52. Ahuja, H.L. Advanced Economic Theory, S. Chand and CO. Ltd. New Delhi.
53. Stonier and Hauge: A Text book of Economic Theory.
54. Crop production, Sericulture and Apiculture Part VI, Report of the National Commission on Agriculture, 1976.
55. Hisao, Aruga: Principles of Sericulture. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
56. Sinha, H.: The Development of India Silk. Oxford and IBH Publishing Co. Ltd. New Delhi.
57. Devaika Lecturers in Sericulture.
58. 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 nutritionist in food.
iii. Selection of food for balanced dies.
iv. The energy value of nutrients.
v. Nutritional foods and fallacies.
   a. Presentation of food for a esthetic.
   b. Social,
   c. Economical and
   d. Nutritional appear.
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. Maternofoctal nutrition.

Unit-III:

3. Food Nutrition and consequences.

i. Physical and psychological consequences of over nutrition and under nutrition.
ii. Physical and psychological conseques 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. Nutracenticals.

i. Polynutrients – Trepans, 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
M.Sc.-II Sem.-IV
Practical – VII
Practical based on Paper – XIII & XIV

1. Preparation of glasswares 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 alimentarytract in fish and in insect on alimentary canal haemolymph (Mulberry silkworm)
12. Detection of heavy metal from animal issue by AAS (Lead/cadmium/chbromium).
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. Spleenectomy.
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
M.Sc.-II Sem.-IV
Practical – VIII
Cell Biology Practical- II
Practical based on Paper – XV & XVI

1. Motosis in rat bone marrowe.
2. Meiosis in rat & grass-hopper testis.
3. Meiotic non-disjunction in human (Identification based on pictures.)
4. Dorsal nerve root development in chick embryo (Colchicines treatment & observation of cells by fulguen technique).
5. Eye lenses differentiation in chick embryo.
6. Nervous system development in chick embryo.
7. Study of Angiogenesis in chick embryo.
8. Demonstration of stem cells renewing by mitosis (liver cells Intestinal crypt cells. Bone marrone cells – demonstration of cell division by fulguen technique).
9. Demonstration of neurons in cerebral cortex of rat.
10. Demonstration of pituitary cells.
11. Demonstration of pancreatic islet cells (L, B, Cell types).
12. Demonstrations of muscle striations (PAS method, phase contrast method) smooth muscle cells observations.
13. Demonstration of austochardria in striated & smooth muscle cells (Phase contrast & Janus green B staining).
14. In vitro cell degeneration of liver (histology – nuclear (E+H, Fulguen) alterations lysosmaloby acid phosphatase alterations in rat).
15. In vivo cell degeneration – of kidney by Induced ischemia (histology, nuclear alterations – E+H, fulguen).
16. Age related lipid peroxidation in various organs of rat / mouse.
17. Demonstration of lipofuschin granules in brain of aged (natural & induced) rat / mouse.
18. Drug induced lipid peroxidation in liver & kidney (CCl_4 / any suitable drug).
19. Any other practical / experiments set by the Department.
20. 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
M.Sc.-II Sem.-IV
Practical – VIII
Comparative Animal Physiology Practical-II
Practical based on Paper – XV & XVI

1. Oxygen consumption in crab / fish / prawn.
2. Estimate Nitrogenous excretory product of animals from different habitat.
3. Estimation of sugar in Rat / Sheep / Human blood.
4. Effect of insulin on the blood sugar of Rat.
5. Estimation of lactate content of Rat/ Human blood.
6. Bleeding time & clotting time in human blood.
7. Estimation of chloride content in Rat / Human blood.
8. Capillary circulation in tailfin of fish.
9. Effect of temperature on the fish / unio insect heart.
10. Study of circulation in Pila / crab by dye injection method.
11. Nerve muscle preparation and simple muscle twitch in fowl.
12. Absorption spectra of blood pigments.
13. Detection of Allentoin in mammalian Urine.
14. Vaginal smear technique.
15. Study of placental types.
16. Tracheotomy in white rats.
17. Study of Uterine smooth muscles.
18. Study of Contraceptive devices.
19. Determination of peak expiratory flow rate (PEFR) by Wrights peak flow meter.
20. Study of finger ergometry.
21. Determination of grip strength.
22. Study of physical fitness index by step test method.
23. Project work / Review article.
24. Any other practical set by the concerned teacher.

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

M.Sc. Zoology
Academic Flexibility
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 hoemolymph.
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:

1. Analyzing food for nutritional labeling & hazardous contamination.
2. Agri. Food quality: An Interdisciplinary Approach Fenwich, G.R.et.al.eds.
3. Agricultural and food Policy 3rd Edition Knutson R.D.
4. Cheese and Butter: Production and Processing Technology by cheke, V & A Sheepard.
5. Biodiversity & Food Security By Kumar Shashi.
6. Bio separation Process in Food By Singh R.K.
7. Control Food borne micro organisms By Juneja V.K.
8. Complex Carbohydrates in foods By Cho S.S.
9. Drying & Dehydration of Foods By loesecke H.W.
10. Effective Food Service Management By Singh Y.P.
11. Element of Food and Nutrition 2nd Edition By Dowd, Mary T & Alberta Dent.
12. Food Biotechnology by Knorr, Dietrich ed.
13. Food Proteins & their Applications by Damodaran Shrinivasan & Alain Para feds.
14. Food Safety & Toxicocity by Devries, John ed.
15. Food Science and processing Technology in Vol. 2 By Mirajkar Mridila & Sreelata Manon.

16. Food Lipids: Chemistry nutrition & Biotechnology By Chaturvedi.
17. Food chemistry by L.H. Meyer.
18. Basic food microbiology – Banwart.
19. Technology of food preservation – Desroster.
20. Food science – by Potter.
21. Fundamentals of Dairy Chemistry – Webb.
22. Modern food Microbiology by J.M. Jay van Nostrand Reinhold Company New York.
23. Food Science- Fox A Brian and All an.
24. Pelezar M.J. Microbiology.
25. Extraction of protein from milk, eggs.

Syllabus

P.G. Diploma Courses in Applied Zoology

P.G. Diploma in Biodiversity Conservation

Semester – I
Paper – I
Biodiversity of Major Groups

Units I: Biodiversity: Introduction, definition, Genetic, Species and Ecosystem diversity. Biodiversity at global, national and local levels. Threats to Biodiversity: Habitat loss, Endangered and endemic species of India.

Unit II: Diversity of protozoan and micro invertebrates (Helminths, Annelids and Molluscs) Diversity of Arthropods

Unit III: Diversity of freshwater fishes, herpatofauna and birds

Unit IV: Diversity of Thalophytes, Bryophytes, Pterydophytes and Gymnosperms

Unit V: Diversity of Angiosperms

Paper II

Ethnobiology and Conservation

Unit I: Ethno biology, Important plant and animal genetic resources conserved by ethnic societies of the world, Traditional medicines and their present status in India, use of animal parts or products in medicine.

Unit II: Commercialization and patenting of ethnic drugs used by traditional healers, biopyracy of medicinal plants and animals,, promotion of ethno biology and traditional medicine in India.

Unit III: Conservation movements: Age old and modern conservation movements of the world – a review, International biodiversity conservations and protocols, conservation movements in India – Devrai's, Bishnoi's, Chipko movement, Apico movement etc.

Unit IV: Genetic diversity of bacteria and virus: General characteristics and classification, replication, cultivation / culture of viruses, microbial association and biodiversity, microbial interactions with microbes, plants

and animals, microbial products influencing plant and animal growth, soil microbes and their association and role in habitat.

Unit V: Concepts of ecosystem and its energetic: Energy flow and nutrient cycles, biogeochemical cycles.

Semester II
Paper III
Concepts of biodiversity

Unit I: Concept of biodiversity: Biodiversity the natural biological capital of the Earth, Its importance at global, national and local level, biodiversity at genetic, species, ecosystem and agro level, biodiversity in terrestrial environment: Forest, grassland, desert. Aquatic environment: Marine, freshwater, estuarine, wetlands and mangroves.

Unit II: Biodiversity in man made environment: Agriculture fields, composts, dams and lakes, zoos and botanical gardens, exobiology: man in space, possibility of extra terrestrial life (as assignment only).

Unit III: Biodiversity distribution: Hot spots of biodiversity of the world, biogeographical classification of India, India as a mega diversity nation.

Unit IV: Natural resource economics and values: social, cultural, religious, ethical values of biodiversity, aesthetic and option values of biodiversity, Biodiversity: means of production or products, Consumptive use, productive use, biomass for business.

Unit V: National and International agencies of environment: Elementary idea of International Biological Programme (IBP), Man and Biosphere Programme (MAB), Environment Protection Agency (EPA), International Union For Conservation of Nature (IUCN), State Pollution Control Board, NGO's working on Environmental Issues.

Semester II
Paper - IV
Biodiversity Conservation

Unit I: Wildlife conservation: Principles of wildlife conservation, necessity of wildlife conservation, modes of conservation, social forestry, agro forestry and urban forestry programme, in situ vs. ex situ conservation, wildlife conservation activities, economics of wildlife conservation, species recovery vs. reintroduction.

Unit II: Wildlife Management: Principles, concept and importance of wildlife management, computers in wildlife management, administration, policy and law in wildlife management, wildlife management of national parks and sanctuaries in India, conservation projects of India, wildlife management success stories.

Unit III: Case studies: success and failure – project tiger, project elephant, project rhino, project crocodiles and turtles breeding, basmati and haldi patents. An elementary idea of natural resources and management, land use pattern – past and present, effect of human activities on soil quality, Introduction to waste land management and its practices, soil erosion and conservation, conservation of water, need and importance to it, practice of it, Introduction to waste water management, sewage water management

Unit IV: Cell culture techniques: Design and functioning of tissue culture laboratory, cell proliferation measurements, cell viability testing, culture media preparation and cell harvesting methods. Microbiological techniques: media preparation and sterilization, inoculation and growth monitoring, biochemical mutants and their use, microbial assays, Ecological restoration: role of ecological restoration in conservation and some of the concerns of restoration ecology, role of invasive species, scales of management and cultural context.

Unit V: Biodiversity information and biological Databank: Computer aided technique for data presentation, data analysis, and special software's for identification of species, bio complexity issues in biodiversity, need of metadata standard and ontology. Conservation and prevention acts in India: The environment protection act, 1986; The wildlife protection act, 1971, 1972; The forest (conservation) act, 1980; The biodiversity act.

Semester – I
Biodiversity and Conservation
Practical - I

1. Study of fauna of different zoogeographical regions. Minimum three examples from each region.
2. Study of flora of different phytogeographical areas. Minimum three examples from each region.
3. Biodiversity studies of a) Fishes, b) Amphibians, c) reptiles, d) aves, e) mammals available in the local area
4. Isolation of microbes from air, soil and water.
5. Ethnozoological collection and traditional uses.
6. Qualitative analysis of phytoplankton, cyanobacteria and other algae.
7. Qualitative analysis of zooplanktons.
8. Preparation of nutrient broth, nutrient agar and PDA.
9. Simple staining of bacteria.
10. Gram staining of bacteria.
11. Isolation and pure culture I streak plate, II. Pour plate
12. Isolation of coliform bacteria from sewage water.
13. Isolation and identification of microbes (fungi, bacteria) from soil.
14. Preparation of growth curves using bacterial culture.
15. Measurement of primary productivity and net productivity in water body by light and dark bottle method.
16. Camera Lucida diagrams of organisms (fungi, bacteria, protozoan, and cyanobacteria).
17. Visits: To forest, water, grass land ecosystems

Semester – II
Biodiversity and Conservation
Practical - II

1. Study of community characteristics by quadrat and transect method.
2. Study of ecosystem (soil, water, forest) and submit detail report.
3. Study of important timbers and their pests.
4. Sampling techniques and experimental design.
5. Poster / power point presentation design.
6. Preparation of culture media.
7. Isolation of DNA from blood, plant tissues and bacteria.
8. Harnessing information through internet.
9. Preparation of data base of local medicinal plants / animals.
10. Using softwares for identification of species.
11. Accessing existing data base on the WWW
12. *in vitro* culture / propagation of medicinal plants.
13. Infield / in plant training on biodiversity conservation related issues
14. Visit to: National Tissue culture and Molecular Biology Laboratories.
15. Project work

Reference Books:

1. Ethnobiology: Rajiv Sinha and Shweta Sinha 2001.
2. Ethanobotany: Rajiv K. Sinha
3. Ethanobotany: Pravin Chandra Chadda.
4. A Handbook of Ethnobotany: S.K. Jain and V. Mudgal
5. Ethnobotany and Medicinal Plants of Indian Subcontinents: J.K. Maheshwari, 2000
6. Ethanomedicine and Human Welfare, Ali Khan and Atiya Khanum, 2004.
7. Microbiology by Pelczar and Noel Krieg.
8. Biotechnological applications of Microbes: Ajit Verma and Gopi K. Podila
9. Manual on Microbiology: K. Sharma

10. Microbiology: Prescott
11. Ecology: Chandel and Shukla
12. Ecology: V.K. Shukla
13. Ecology: Odum
14. Ecology: Rickfy
15. Wildlife Biology: Dasman
16. Wildlife in India: Soharia
17. Book on India Animals: Parter
18. Fundamentals of Wildlife Management: Rajesh Gopal
19. Biodiversity: E.O. Wilson, National Academy Press.
20. Biodiversity Status, Prospects: Tandon
21. An Introduction to Biodiversity: Prithipalsingh
22. Conservation Biology: S.K. Jain

P.G. Diploma in Immuno Technology

Paper I

Principles and Techniques of Biochemistry used in Immunology

Unit: I

a. Properties of cells, bacteria and viruses

b. Biological molecules

c. Bioenergetics of enzymes.

d. Acid bases and buffers

Unit: II Centrifugation:

a. Differential

b. Ultracentrifugation

Unit: III Study of microscopes

a. Light microscope

b. Fluorescence microscope

c. Electron microscope

Unit: IV Separation techniques

a. Chromatographic separation

b. Gel electrophoresis

c. Immnoelectrophoresis

d. Protein purification and separation

Unit: V

a. Microtechniques

a. Histology and histochemistry

b. Radioisotopic techniques

c. Biostatistics

d. Bioinformatics

Paper II

The Immune system

Unit I:

a. An overview of the immune response

i. Innate immune response

ii. Specific acquired immune response

b. Antibodies:

i. The division of labour

ii. Cellular basis of antibody production.

iii. Acquired memory

iv. Vaccination depends on acquired immunity.

c. Membrane receptors for antigen:

i. The B cell and T cell receptors for antigen

ii. NK receptors

iii. The major histocompatibility complex (MHC)

d. Interactions with antigens:

i. Thermodynamics of antigen and antibody interaction

ii. Processing of antigens.

iii. Stimulation by antigens.

iv. Adjuvants

v. Heptane

Unit: II

a. The anatomy of the immune response:

i. Lymphoid tissue

ii. Lymphocyte and lymphnodes

iii. Spleen

iv. Skin and mucosal immunity

v. Site of antibody synthesis

Unit III:

a. Lymphocyte activation
b. The production of effectors
    i. Cytokines and T cell effectors
    ii. T cell effectors
    iii. Proliferation, and maturation of B cell response
    iv. Memory cells
c. Control mechanisms:
    i. Role played by antigens and complement antibody
d. T cell regulation, Jerne's network hypothesis and manipulation of the immune response through idiotypes, the influence of genetic factors, regulation by immunoendocrine net work and other factors like diet, exercise, trauma and age.

Unit IV: Ontogeny and Phylogeny

a. Hematopoietic stem cells
b. T cell differentiation
c. T cell ontogeny
d. T cell tolerance

Unit V: B cells

a. Differentiation of B cells
b. Development of B cell specificity
c. Tolerance in B lymphocyte
d. Ontogeny of natural killer (NK) cells

Adversarial strategies during infection:

a. Inflammation
b. Phagocytosis and complement
c. Intracellular bacteria, Listeria, Tuberculosis and Leprosy.
d. Immunity to infection by viruses, fungi and parasites.

Semester - II
Paper III
Immunotechnology

Unit I:

a. Production of monoclonal antibodies
b. Production, purification and estimation of monoclonal antibodies.
c. Modulation of biological activity by antibodies.
d. Evaluation of biological activity of antibodies.

Unit II:

a. Identification of antigen by immunofluorescence microscope.
b. Identification of antigen by immunohistochemical methods.
    i. Using light microscope
    ii. Using electron microscope
    iii. Immuno electrophoresis
c. Immunoassay of antigen by antibody (ELISA)
d. Immunoprecipitation of antigen complexes

Unit III:

a. The nephelometric assay for antigen.
b. Immunoblotting (Western blotting)
c. Epitope mapping: T cell epitopes and B cell epitopes
d. Agglutination of antigen coated particles and detection of immune complex formation.

Unit IV:

a. Isolation of leucocytes
b. Assessment of functional activity of phagocytic cells and apoptosis.
c. Precursor frequency and analysis of functional activity by cellular reconstitution.
d. Genetic engineering of the cell and gene.

Unit V: Immunology *in vivo*

a. Paw edima test
b. Granuloma test
c. Splenectomy and its effect
d. Hybridomas

Paper: IV
Applied and Clinical Immunology

Unit: I

a. Vaccination
b. Current vaccines
c. Vaccines under development
d. Vaccines against parasitic disease
e. Vaccines for protection against bioterrorism
f. Immunization against cancer
g. Adjuvants

Unit II: Immunodeficiency

a. Innate immune mechanisms
b. Primary B cell and T cell deficiency, combined immunodeficiency
c. Reproduction and immunology
d. Human perspective: Autoimmuno diseases
e. Acquired immunodeficiency syndrome

Unit III: Hypersensitivity

a. Anaphylactic hypersensitivity
b. Cytotoxic hypersensitivity
c. Immune complex hypersensitivity
d. Delayed hypersensitivity
e. Innate hypersensitivity

Unit IV: Transplantation

a. The genetic control
b. Consequences of MHC in compatibility
c. Graft rejection
d. Xenografting
e. Stem cell therapy
f. Fetus allograft

Unit V: Tumor immunology

a. Cellular transformation and immune surveillance
b. Tumor antigen
c. Escape mechanism
d. Lymphoproliferative disorders
e. Cancer immunotherapy

Semester – I
Immuno Technology
Practical – I

1. Dissection of lymphatic organs.
2. Study of bone marrow cells
3. Separation of leucocytes by density gradient centrifugation
4. Study of spleen and effect of spleenectomy on bone marrow cells and blood cells.
5. Paw edema test
6. Granulomata test
7. Production of antibodies
8. Isolation and separation of antibodies by affinity chromatography
9. Western blotting technique
10. Animal cell culture
11. Bacterial cell culture

Semester II

Immuno Technology

Practical - II

1. Electrophoretic separation of antibodies.
2. Immunoelectrophoretic separation of antigens.
3. Immunohistochemical demonstration of antigen using biotinylated secondary antibody and extra Avidin.
4. Immunohisotchemical demonstration of antigen using enzyme labeled secondary antibody.
5. Immunodetection of antigen by immunofluorescence microscope.
6. Immunoassay of antigen by ELISA
7. Estimation of immunoglobulins
8. Demonstration of phosphatidylserine using fluorescently labeled (FITC) annexin V.
9. Examples based on biostatistics
10. Examples based on bioinformatics
11. Project work

Reference Books:

Immunotechnology:

1. Rott's Essential Immunology: 2006
2. Datta, S.K. (2000) Positive Selection for autoimmunity
3. Janeway, C. A. Jr. and Travers, P. (1996): Immunobiology
4. Cell and Molecular Biology by G. Karp
5. Biochemistry and Molecular Biology by K. Wilson and J. Walker
6. Basic and Clinical Immunology: D.P. Stites, A.I. Terr and T.G. Parslow
7. Notes in Immunology: P.M. Lydyard, A. Whelan and M.W. Fangers
8. Immunology: Cuby, J.
9. Fundamentals of Immunology by Pol, W.E.
10. Cellular and Molecular Immunology by Abbas, A.K., Lichtman, A.H. Pober J.S.

P.G. Diploma in Applied Zoology

AUQACULTURE AND FISHERIES TECHNOLOGY

Semester - I

Paper I: BIOLOGY OF FISHES

Unit-I:

1) Systematic position and trends in classification:

a) Jawless vertebrates (Agnatha)
b) Cartilaginous fishes (sharks, rays and skates)
c) Lung fishes
d) Bony fishes

Unit-II:

2) Integumentary system

a) Functions of the skin in fishes
b) Types of scales
c) Origin of scales
d) Uses of scales and coloration

Unit-III:

3) Digestive system

a) Food and feeding
b) Alimentary canal
c) Digestive glands
d) Physiology of digestion
e) Growth of fishes

Unit-IV:

4) Respiratory system

a) Types of gills: Structure and functions of gills
b) Mechanism of respiration
c) Accessory respiratory organs

Unit-V:

5) Reproductive system

a) Male reproductive organs
b) Female reproductive organs
c) Sexual maturity and reproductive cycles
d) Viviparity and gestation
e) Hormonal regulation of reproduction

Paper II

FISH CULTURE PRACTICES

Unit I:

Introduction, definition, history and importance of aquaculture, present status and scope of aquaculture, classification of aquaculture.

Inland Culture practices:

a) Culture of Indian Major Carps

b) Culture of *Cyprinus carpio*

c) Freshwater pearl culture

d) Culture of freshwater prawns

e) Construction, Management, and economics of Fish farm

f) Construction, Management, and economics of Prawn farm

Unit- II: Marine culture practices:

a) Culture of salmon fish

b) Culture of Eel fish

c) Culture of Sturgeon fish

d) Culture of Milk fish

Unit-III: Molluscan Culture

a) Species of edible molluscs

b) Culture of edible mussels, oysters, clams and gastropods.

c) Techniques of natural seed collection and breeding under controlled conditions.

d) Methods of culture: Bottom culture, raft culture, long line culture.

e) Pearl oyster culture: Species involved, seed collection, techniques of pearl culture, prospects in India.

Unit-IV: Brackish water culture practices:

a) Culture of black tiger shrimp, *Penaeus monodon*: Seed production, grow out management.

b) Culture of lobster.

c) Harvesting and marketing

Unit-V: Sea Weed culture:

a) Commercially important sea weeds, their distribution

b) Methods of culture of sea weeds.

c) Prospects of sea weed culture in India.

d) Uses of sea weeds and their products.

Semester - II

Paper III

FISHERIES TECHNOLOGY

Unit I: Fishing methodology Techniques (Crafts and gears):

a) Conventional fishing methods

b) Unconventional fishing methods

c) Modern fishing methods

d) Regulations of fishing operations

Unit I: Fertilization and artificial feeding

a) Need for fertilization

b) Types of fertilizers

c) Artificial feed formulation

Unit III: Post harvest Technology

a) Nutritional importance of fish

b) Traditional methods of fish preservation

c) Modern methods of fish preservation

d) Fish products and by-products

Unit IV: Seed Transportation and cryopreservation

a) Causes of fish seed mortality in transport

b) Methods of packing and transport

c) Use of chemicals in live fish transport

d) Cryopreservation techniques

Unit V: Biotechnology in aquaculture:

a) Improved diagnostic reagents

b) Hormones, feeds and vaccines

c) Genetic manipulation

Paper IV

PATHOLOGY AND BREEDING OF ORNAMENTAL FISHES

Pathology

Unit I: Pathology: General Consideration

a) Introduction

b) Signs of sickness

c) Defensive devices against diseases

d) Diseases of fishes and prawns – nutritional, intrinsic, pathogens and parasites

Unit II Abiotic factors influencing disease

Unit III Disease caused by viruses:

a) Morphology, chemical composition and replication

b) Major viral diseases of fishes

c) Viral diseases of prawns

Unit IV: Disease caused by bacteria:

a) Fish pathogenic bacteria

b) Common bacterial diseases

c) Control measures

a. Disease caused by protozoan and fungi and their control.

b. Helminths, Crustaceans and their control measures

Unit V: Epizootic ulcerative syndrome disease:

a) Present state of knowledge

b) Treatment recommended

c) Socio – economic impact

Breeding of ornamental fishes

a) Setting up and maintenance of aquarium

b) Common ornamental fishes

c) Breeding of live bearer fishes

d) Breeding of egg laying fishes

e) Breeding of egg dropper fishes

f) Breeding of bubble nest builder fishes

g) Common diseases of ornamental fishes

P.G. Diploma in Applied Zoology
Semester I
Practical – I
Aquaculture and Fisheries:

1. Identification of important food fishes, prawns and molluscs up to species level (Fresh water and marine)
2. Estimation of rate of oxygen consumption in fish.
3. Dissection of fish to expose –
   i. Pituitary gland
   ii. Urinogenital system
4. Fecundity assessment in fish
5. Preparation of permanent slides of different types of scales
6. Demonstration of induced breeding technique by ovarian or ovatide injection.
7. Estimation of DO, Co_2, Alkalinity, inorganic nitrate and phosphate from water sample.
8. Qualitative analysis of digestive enzymes.
9. Blood glucose estimation in fish
10. Sexual dimorphism and secondary sexual characters in fishes.
11. Study of permanent histopahthological slides of important tissues in fishes exposed to toxicants.
12. Field trips and study tour to fish farm, fishery institution, national laboratories etc. is compulsory
13. Estimation of primary productivity of water sample by light and dark bottle experiment.
14. Qualitative and quantitative study of zooplanktons.

Semester II
Practical – II
Aquaculture and Fisheries

1. Identification of cultivable fishes, prawns and molluscs.
2. Study of different nets, crafts and gears. (models or drawings)
3. Estimation of glycogen, protein and lipid from fish tissue.
4. Study of fish products and bi - products
5. Study of fertilization and feed formations.
6. Identification and control measures of aquatic weeds and insects.
7. Assessment of pollutants from farm water – heavy metal and pesticides.
8. Method of fish preservation and canning
9. Identification of diseased fish – bacterial, fungal and viral infection.
10. Examination of fish for protozoan parasite.
11. Examination of fish for Helminth parasite.
13. Project work or review article.

Reference Books:

Aquaculture and Fisheries Technology

1. Applied Fishery Science Vol. 1 and 2 – S. M. Shafi
2. Aquaculture – The farming and Husbandry of Freshwater and Marine Organisms – John E. Bardach, John H. Ryther and William O. McLarney
3. Aquaculture Resarch Needs for 2000 A.D. – Jaw-Kai-Wang and P. V. Dehadrai
4. Aquarium – Mohan Babare and Shivaji Choudhari
5. Aquatic Animal Quarantine and Health Certification in Asia - Publication of FAO of the United Nations, Rome
6. Asian Fish Health Bibliography and Abstracts I: Southern Asia – Edited by J. R. Arthur
7. Fin - fishes – Aquarium Fish from East Coast of India – K. Sujatha (IAAB, Publication)
8. Fish and Prawn Diseases in India – Diagnosis and Control – M. K. Das and R. K. Das
9. Fish Nutrition – Hoar and Randall
10. Fish Nutrition – J. E. Halver
11. Fish Physiology – Hoar and Randall

12. Fisheries Education and Training in Asia: Workshop Proceedings – Special publication No. 2 by Asian Fisheries Society
13. Fisheries in the Food Economy – Publication of FAO of the United Nations, Rome
14. Global Fisheries: Perspectives for the 1980s – Edited by Brian J. Rothschild
15. Ichthyology (2nd Edition) – Lagler, Bardach, Miller and Passino
16. Marine Fisheries – D. V. Bal and K. Virabhadra Rao
17. Methodology for Water Analysis – M. S. Kodarkar
18. Methods for Diagnosis and Treatment of Fish Diseases – CICFRI Publication
19. Records of the Zoological Survey of India (Ichthyotauna) – B. E. Yadav
20. Technologies for Inland Fisheries Development – V. V. Sugunan and U. Bhaumik.

P.G. Diploma in Applied Zoology (Economic Entomology)

Economic Entomology Paper – I (Semester - I)

FOREST ENTOMOLOGY

Unit -I:

Introduction to Entomology: Structure, development and classification of insects and Arachnids - Structure of head, thorax and abdomen and their appendages, of generalized insects. Insect development, Broad classification of insects up to orders and economically important families. Anatomy of organ systems of insects in brief.

Unit:-II:

Insect Diversity: Structure of forest and insect abundance, Impact of forest loss and regeneration on, abundance of insects like beetles: A case study of tropical forest, an overview of invertebrate response to forest fragmentation.

Unit-III:

Forest pests: Current status and future threats, the impacts of climate change and pollution on forest pests insects of tropics, Herbivory in forests: from centimeters to mega meters, Population Ecology of forest insects, Host specificity and adaptations in forest insects.

Unit-IV:

Studies on the insect pests i. e. Defoliators, sap Suckers, gall formers, borers, of economically important forests trees (about 20).

Unit-V:

Forest litter insect communities - Dynamics of litter decomposition, diversity of litter micro arthropods: A bioecological assessment, trophic systems in forest litter communities. Insect Conservation: Conservation corridors and tropical forest insects, insect conservation.

Economic Entomology Paper - II

Medical Entomology

Unit:-I:

General Consideration - Arthropods: Vertebrate, pathogen, relationship, history, epidemiology, insect as vector, relationship of host pathogen and vector, arthropods transmitted pathogens to man as host.

Unit-II:

Blatterians, Coleopterans, Lepidopterans and hymenopterans, Hemipterous, Lice (Body louse and head louse), black flies, sand flies, biting midges.

Unit-III:

Mosquitoes: Culex, Culiseta, Aedes and Anopheles

Unit-IV:

House fly and other Muscoid flies -

Unit-V:

Fleas, ticks, mites, venomous insects

For Unit 2 to 5: Study of medically important insects in relation with the following: Classification, biology, disease, pathogen, victim, vector, reservoir, distribution, importance, pathology, immunology, prevention and control measures.

Economic Entomology Paper - II

Insect Culture and Pest Control Semester - III

Unit-I:

Tasar Culture

Introduction and Scope of non mulberry sericulture,
Non mulberry silk varieties and fauna,
Tropical tasar & temperate tasar – brief morphology, anatomy, arboriculture, grainage, ethology, rearing, pathology, parasites and predators, biochemistry, silk reeling and spinning

Unit-II:

Apiculture

Introduction, The Honey bees behaviour, Beekeeping, bee products, some useful information for the prospective beekeepers.

Lac Culture

Introduction, historical, t, distribution, life history, host plants, strains of lac insects, propagation of lac insects, cultivation practices: local and improved, pruning, lac extraction, lac production in India, enemies of lac insects.

Unit-III:

Insect pests and Natural Control

Origin of insect pests, crop loss estimation, dynamics of insect population, Natural control – cultural methods, host plant resistance – principles, concept, characteristics, mechanism, basis and factors affecting.

Unit-IV:

Chemical Control

Chemical control - insecticide classes, inorganic , organic insecticides – natural and synthetic, insecticide formulation, Insecticides application, dilution, mode of action of insecticides, metabolism of insecticides, resistance to insecticides, insecticide appliances, hazards.

Unit-V:

Integrated Pest Management

Use of antifeedents, attractants, repellents and chemosterilants in insect control, Biological Control: biocontrol agents, microbial control, hormonal control, pheromone control, genetic control, methods of insect pest control, Concept of Integrated Pest Management – Origin, definition, concept of injury level, Strategy of IPM and potential of IPM.

Economic Entomology Paper: IV
Veterinary Entomology

Unit-I:

Introduction to live stock entomology: History, organization, education, professional and research status. principles of host plant and parasite relationship: Ecological, types of parasites, host specificity, damage to livestock, nature of damage and its consequences to livestock, and other arthropods associated losses to livestock and determination of injury of threshold level.

Unit-II:

Flies of veterinary importance – biting and non biting and myiasis producing flies.

A. Biting flies: Mosquitoes, Simulium sp., Culicoides sp. (Leptoconops spp.), Tabanus sp., Stomoxys calcitrons (L.) Haematobia irritans, Malophagus avinus.

B. Non biting flies:

i. Obligate ectoparasite: Musca autumnalis, Hippelates sp. Hydrotaea sp.

ii. Facultative ectoparasites and Saprophytes: *Musca domestica, Muscina species, Ophyra species, Fannia species, Hermetia illucens, Eristalis tenax, Psychoda species*

Unit-III:

C. Myiasis producing flies:

a. Obligatory myiasis: *Cochliomyia hominivorax, Hypoderma lineatum, Gasterophilus intestinalis, Oestrus ovis, Wohlfahrtia vigil, Cuterebra species, Oedemegena terandi, Cephenemyia species.*

Unit-IV:

Lice and fleas affecting livestock:

Lice affecting livestock:

a. **Important species of biting lice:** *Heterodoxus spiniger, Trichodectus canis*
b. **Sucking lice:** Haematopinus, Linognathus, Solenopotes.
c. **Fleas affecting livestock and pests :** *Ctenocephalides, Pulex irritans, Xenopsylla cheopis, Echidonophaga gallinacean, Tunga penetrans* etc.

Unit-V:

Ticks, Mites affecting livestock:

Mites:

a. Externally parasitic mites: *Ornithonyssus, Liponyssoides sanguineus, Dermanyssus gallinae, Cheyletiella* etc.
b. Internally parasitic mites : *Sternostoma tracheacolum, Laminosioptes cysticola, Pneumonyssoides canium, Ofodectes*.
c. Scab forming (subcutaneous) mites : *Psorergates, Demodex mange mites Psoroptes cuniculi* etc.
d. Miscellaneous mites : Macrocheles

Arthropod pests of beef cattles:

Fly pests: Horn fly, Stable fly, face fly

Cattle grubs: Hypoderma lineatum

Mosquitoes: Family culicidae, Horse flies, black flies, biting midges, mites etc.

Cornified beef: Stable fly, house fly, biting midges, mosquitoes, cattle grubs, cattle etc.

Arthropod pests of swine: Lice and mites, biting flies, mosquitoes

Arthropod pests of sheep: Flies, mosquitoes, sheep lice tick etc.

Arthropod pests of poultry, horse and pet animals:

Poultry:

a. Ectoparasites of poultry: Ornithoyssus sylviarum, chicken mite, chicken body louse, bed bug, fowl tick.
b. Flies associated with poultry: House fly, black garbage fly, stable fly, darkling beetle, mosquitoes.

Horses:

a. Flies: House fly, horn fly, stable fly, face fly.
b. Mosquitoes
c. Biting flies
d. Cattle grubs
e. Lice

Pet animals:

Tick, parasitic mites, fleas

For Unit 4 to 5: Studies of veterinary importance of insects in relation with the following - Classification, biology, disease, pathogen, victim, vector, reservoir, distribution, importance, pathology, prevention and control measures.

Economic Entomology Semester – I
Practical – I

1. Collection and preservation of forest insect pests.
2. To study morphology, anatomy of some selected forest insect pests.
3. To rear some economically important and locally available insect pests.
4. To study the insect pests of economically important (at least 20) trees belonging to sap suckers, defoliators and borers categories.
5. To study the population dynamics and nature of damage caused by forest insect pests.
6. To study the litter invertebrates including insect.
7. To study litter microbes.
8. Study of medically important insects and other arthropod pests (locally available)
9. Studies on the biology of medically important, locally available common insect pests of medical importance.
10. Studies on the pathogenicity of common insect vectors.
11. Immunodignostic study of some pathogen diseases transmitted by insect.
12. Study on ticks, mites and venomous insects.
13. Any other practical set by teacher.

Semester – II
Practical – II

1. To study morphology of tasar silkworm.
   a. Eggs
   b. Larva
   c. Pupa and
   d. Adult
2. To study anatomy of tasar silkworm:
   a. Digestive system
   b. Nervous system
   c. Reproductive system
   d. Excretory system
   e. Respiratory system
3. Rearing of tasar silkworm
4. Study of diseases in tasar silkworm
5. Estimation of digestive enzymes: Amylase, Inverters, protease, trehalase
6. To study toxicity assessment by using Ach, ASE
7. Study of different types of honey bees
8. Morphology and anatomy of honey bee
9. Beekeeping practices / methods
10. To study biology of Lac insects
11. Study of veterinary insect pests
12. Morphology of veterinary insects:
    a. Flies
    b. Lice and Fleas
    c. Ticks and mites
    d. Cattle pests
    e. Sheep and swine pests
    f. Poultry, horse and pet animals pests.
13. Study of appliances of Sericulture, apiculture and Lac culture.
14. Immunodiagnosis of some diseases of veterinary animals transmitted by insects.
15. Project work

Reference Books:

1. A Text Book of Applied Entomology: K.P. Shrivastava

2. Forests and Insects: Allan D. Watt, Nigel E. Stork and Mark D. Hunter
3. Integrated Pests Management Concept and Approaches: G.S. Dhaliwal and Ramesh Arora
4. Forest Litter Insect Communities Biology and Chemical Ecology: T. N. Ananthakrishnan
5. Imms Text Book of Entomology: O.W. Richards and R.C. Devis, Vol. I and II
6. Principles of insect Morphology: R.E. Snodgrass
7. Insect Structure and Function: R.F. Chapman
8. General and Applied Entomology: K.K. Nayar, T.N. Ananthakrishnan and M.B. Devid
9. Embryology of Insect: A.O. John and F.H. Butt.
10. Fundamentals of Entomology: Elzinga R.J.
11. Modern Classification of Insects: Mani M.S.
12. Insect Physiology and Anatomy: Pant N.S. and Ghai S.L.
13. General Entomology: M.S. Mani
14. Ecology of insect population: Clarks L.R.P., W. Geir, R.D. Hughes and R.F. Morris
15. Introduction to insect behavior: Atkins M.D.
16. An Introduction to insect physiology: Bursell, E.
17. College Entomology: Essig E.O.
18. A Text Book of Agricultural Entomology: Pruth, H.S.
19. Beekeeping in India: Wadhwani A.M. and Chhabra N.N.
20. Indian Forest Insects of Economic Improtance: Stebbing E.F.
21. Forest Entomology Ecology and Management: Kulman, H.M.
22. Modern Bee Keeping: Ghosh, C.C.
23. Handbook of Bee culture: John Dasich
24. Lac cultivation in India: Glover P.M.
25. Sericulture Manual: Krishnaswami, S.
26. Non mulberry silks: FAAO Agricultural Services Bulletin Rome Jolly, M.S.
27. An Introduction to Sericulture: Ganga G. and Sulochanan Chetty.