"Dissemination of Education for Knowledge, Science and Culture"

-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur

(An Empowered Autonomous Institute)

DEPARTMENT OF ZOOLOGY

M.Sc. Part - I

Semester-I & II

SYLLABUS

As per NEP-2020

To be implemented from Academic Year 2025-26

Vivekanand College, Kolhapur
(An Empowered Autonomous Institute)
Department of Zoology
Departmental Teaching and Evaluation Scheme
Two - Years PG Programme
Department/Subject Specific Core or Major (DSC)
(As per NEP-2020 Guidelines)
Zoology
M. Sc. I Semester I & II

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
Semester-I										
1	DSC-I	DSC41ZOO11	Molecular Cell Biology	4	-	80	20	-	100	4
2	DSC-II	DSC41ZOO12	Applied Entomology	4	-	80	20	-	100	4
3	DSE-I	DSE41ZOO11	General Sericulture & Mulberry Cultivation	4	-	80	20	-	100	4
		DSE41ZOO12	Molecular Biology of the Gene							
		DSE41ZOO13	Animal Physiology							
		DSE41ZOO14	Basic Entomology							
		DSE41ZOO15	Fisheries Resources: Inland & Marine Fisheries							
4	RMD	RMD41ZOO11	Research Methodology	4	-	80	20	-	100	4
5	DSC-PR-I	DSC41ZOO19	Zoology Lab-I	-	12	-	-	150	150	6
Semester-I Total				**16**	**12**	**320**	**80**	**150**	**550**	**22**
Semester-II										
1	DSC-III	DSC41ZOO21	Physiological Chemistry	4	-	80	20	-	100	4
2	DSC-IV	DSC41ZOO22	Anatomy & Physiology	4	-	80	20	-	100	4
3	DSE- II	DSE41ZOO21	Silkworm Biology & Rearing Technology	4	-	80	20	-	100	4
		DSE41ZOO22	Developmental Biology							
		DSE41ZOO23	Applied Physiology							
		DSE41ZOO24	Insect Anatomy and Physiology							
		DSE41ZOO25	Fish Pathology & Reproductive Endocrinology							
4	DSC-PR-II	DSC41ZOO29	Zoology Lab-II	-	12	-	-	150	150	6
5	FPR/OJT-I	FPR41ZOO21	Field Project		4	-	-	100	100	4
		OJT41ZOO21	On Job Training							
Semester-II Total				**12**	**16**	**240**	**60**	**250**	**550**	**22**
Total (Semester I & II)				**28**	**28**	**560**	**140**	**400**	**1100**	**44**

Abbreviations: TH-Theory, PR-Practical, PRO- Project, ESE- End Semester Examination, CIE-Continuous Internal Examination

Note: 1.Passing percentage will be 40% 2. Separate passing for each Head - ESE, CIE and Practicals

Semester -I

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M. Sc. Part – I Semester -I Zoology

DSC-I: DSC41ZOO11: Molecular Cell Biology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, the student will have in depth knowledge of:

CO 1: Functioning of the nucleus and its importance.

CO 2: Structure and various functions of membrane, intracellular transport and sorting.

CO 3: Functioning of various cell organelles at molecular level.

CO 4: Cytoskeletal elements, Cell signalling and cell division.

Unit I: The Interphase Nucleus, Chromatin, and the Chromosome (15 Hrs.)

a) The ultrastructure of interphase nucleus, nuclear envelope, and nuclear pore complex, Nuclear import and export, Nucleolus
b) The DNA structure, Histone proteins, Packaging of DNA into chromatin
c) Euchromatin and Heterochromatin, The C-value paradox
d) Fine structure and classification of chromosomes

Unit II: Membrane transport, protein sorting and vesicular trafficking (15 Hrs.)

a) Biomembrane structure and functions.
b) Transport of Ions and Small Molecules across the membrane.
c) Transcellular transport.
d) Cell-cell junctions and their significance.
e) Protein sorting and vesicular trafficking.

Unit III: Cellular Respiration and Degradation (15 Hrs.)

a) Mitochondria: Biogenesis, membrane differences, structure, and functions.
b) Lysosomes: Origin, structural polymorphism and functions.
c) Peroxisomes: Biogenesis, ultrastructure and functions.
d) Endosomes: Late and early endosomes, assembly structure, and functions.
e) Proteasomes: Types, assembly structure and functions.

Unit IV: Cytoskeleton, Cell signaling and Cell division (15 Hrs.)

a) Cytoskeletal elements: microtubules, microfilaments, intermediate filaments and associated motor proteins

b) Cell signaling: Features of signal transduction, Molecular Mechanisms of Signal Transduction, Gated Ion Channels, Receptor Enzymes, G Protein-Coupled Receptors and Second Messengers, Regulation of Transcription by Steroid Hormones, Signaling by Mechanoreceptors, pain receptors, Taste receptors and olfactory receptors.

c) Cell Division: Cell cycle regulation, cyclin dependent kinases and check point pathways, Extracellular and Intracellular Cues Regulating Entry into Meiosis.

Suggested Readings:

1. Molecular Biology of the Cell (7th Ed.) by Bruce Alberts, Rebecca Heald, Alexander Johnson, David Morgan, Martin Raff, Keith Roberts, Peter Walter, John Wilson, Tim Hunt, New York: Garland Science; 2022
2. Molecular Cell Biology, 9th Ed. Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon, W H Freeman & Co. New York, US.
3. The cell: A molecular approach – Cooper
4. Molecular cell biology – Gerald carp

M. Sc. Part – I Semester -I Zoology

DSC-II: DSC41ZOO12: Applied Entomology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, Students will be able to

CO1: Demonstrate morphology and anatomy of insects.

CO2: Recognise various types of insect pests.

CO3: Work in Sericulture, apiculture and lac culture.

CO4: Appreciate the forensic entomology and nutritional entomology.

Unit I: **(15 Hrs.)**

a) Study of generalized insect: Grasshopper (Morphology and Anatomy, brief Account).
b) Types of Insect pests: Definition with suitable examples.
c) Types of Forest pests: Defoliators, Sapsuckers, Borers of trees, spike disease of Sandal, Soil insects damaging forest trees, control methods of forest pests.

Unit II: **(15 Hrs.)**

a) Stored grain pests: Rice weevil, Rice moth, Khapra beetle, Pulse beetle, Rust red floor beetle, Angoumois grain moth.
b) Veterinary entomology: Farm animal pests- Horse fly, Blowfly, Stable fly, Louse fly, Warble fly, Screw worm, Cattle louse, bird louse, Flea

Unit III: **(15 Hrs.)**

Sericulture: History of Sericulture, Life cycles of Mulberry and Non-mulberry Silkworms, Rearing technology of mulberry silkworm, Diseases and pests of Mulberry silkworm, Moriculture and cultural practices, Diseases and pests of Mulberry.

Unit IV: **(15 Hrs.)**

a) Apiculture: The honey bees, Social organization of honey bees, Life history of honey bees, Methods of bee keeping.
b) Lac culture: Lac insect- Taxonomy, distribution and life history, Host plants and lac insects, Strains of lac insect and their propagation, Cultivation practices, Lac extraction and uses.
c) Forensic entomology: History, Corpse associated arthropod classes, Role of arthropods in forensic entomology, Examples.

d) Nutritional entomology: Advantages of eating insects (Entomophagy), Examples of insects generally consumed, Nutritional value, Entomophagy as a source of income.

Suggested Readings:

1. Ambrose, D.P. (2015). The Insects. Structure, Function and Biodiversity. Kalyani publishers, New Delhi. 626pp.
2. Herms W. B. (1961). Medical Entomology. The Macmillan Company, New York And Brett-Macmillan Limited, Galt, Ontario. pp. 616.
3. Srivastava K. P. (1996). A Textbook of Applied Entomology, Volume- II. Kalyani Pulblishers, New Delhi. pp. 487.
4. David B. V. and Ramamurthy V. V. ((2015). Elements of Economic Entomology. Brillion Publishing, New Delhi. pp. 398.
5. Shukla G. S. and Upadhayay V. B. (2011) Economic Zoology. Rastogi Publications, Meerut, India. pp. 487.
6. Tembhare, D. B (2013). Modern Entomology. Himalaya Publishing House, India. pp 502.

M. Sc. Part – I Semester -I Zoology

DSE-I: DSE41ZOO11: General Sericulture and Mulberry cultivation

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, students will be able to,

CO1: Appreciate the scope of sericulture and its distribution

CO2: Illustrates various aspects of soil requirement for mulberry cultivation.

CO3: Demonstrate various methods of mulberry cultivation and its management

CO4: Identify and manage various mulberry pest and diseases.

Unit-I: History and scope of Sericulture (15 Hrs.)

General account of global production of mulberry and non-mulberry silk, Silk route, Geographical distribution of mulberry and non-mulberry sericulture, Scope of sericulture in India

Unit-II: Soil science and requirements for mulberry (15 Hrs.)

Classification of different types of soil, Physical and chemical properties of soils, Soil testing and Management, Selection and preparation of land for mulberry cultivation Agro climatic zones and agro-climatic conditions for mulberry cultivation, Site suitability for mulberry garden establishment

Unit-III: Mulberry cultivation practices and management (15 Hrs.)

Characteristic features of popular mulberry varieties of tropical and temperate regions

Propagation of Mulberry- Scope and significance of sexual and asexual propagation, Methods of mulberry propagation

Mulberry crop production- Planning for establishment of mulberry garden Concept and establishment of mulberry garden for chawki & late age worms,

Water management- Concept of irrigation, Methods of irrigation, Frequency of irrigation and importance Entrepreneurship in mulberry sapling production, Kisan nursery

Unit-IV: Management of Mulberry Pests and Diseases (15 Hrs.)

Pests: Lepidopteran pests, Coleopteran pests, Orthopteran pests, Dipterans pests, Hemipteran pests (Sap feeders), white fly. Diseases: Fungal diseases - Root rots, Powdery mildew disease. Leaf spot, Leaf rust etc. Bacterial diseases - Leaf blight diseases, Root knot diseases, Viral diseases - Mulberry leaf mosaic disease, Nematode diseases

Suggested Reading:

1. Anonymous (1972): FAO Manuals on Sericulture Vol. I – IV
2. Hanumappa (1978): Sericulture for Rural Development, Himalaya Publications, Delhi.
3. King, L.A. and Posse R.D. (1990): Baculovirus Expression System? Chapman and Hall, London.
4. Koshy, T.D. (1990): Exports and Development, Ashish Publications, New Delhi.
5. Singh, B.D.: Plant breeding, Kalyani Publishers, New Delhi.
6. Anonymous (1972): Hand Book of silk rearing, Agriculture techniques Manual I., Fuji Publication, Tokyo.

7. Jolly, M.S.: Appropriate Sericultural Techniques CSR and TI Mysore.

8. FAO, Volumes (1-4), Central Silk Board, Bangalore

9. Handbook on pest and disease control of mulberry and silkworm, Economic and Social Commission for Asia and Pacific, United Nations.

M. Sc. Part – I Semester -I Zoology

DSE-I: DSE41ZOO12: Molecular biology of the gene

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, student will be able to

CO1: Understand the genetic mapping techniques and blotting techniques.

CO2: Understand the importance of satellite DNA, Transposable DNA, Organelle DNA in human genome.

CO3: Discuss the of concept of gene, gene structure and transcription, post transcriptional control of gene expression.

CO4: Understand the significance of recombinant DNA technology and genetic manipulations by Knockout, transgenesis techniques and genome editing tools and applications.

Unit - I: Molecular Genetic Technique **(15 Hrs.)**

1. Chromosome as a carrier of genes
2. Linkage groups, genetics maps, crossing over and genetic recombination
3. Genetic recombination analysis in Drosophila
4. Hybridization techniques –Southern blotting, Northern blotting, In situ hybridization, DNA microarray

Unit - II: Genes, Genomics and Chromosome **(15 Hrs.)**

1. Simple sequence DNA – satellite DNA
2. Transposable DNA elements
    a) DNA Transposons
    b) LTR Retrotransposons
    c) Non LTR Retrotransposons (SINES and LINES)
3. Organelles DNA
    a) Mitochondrial DNA
    b) Chloroplast DNA
4. Genomics- Genome wide Analysis of Gene Structure and Expression
5. Morphology and Functional Elements of Eukaryotic Chromosomes
    a) Chromosome number, size and shape at metaphase
    b) Banding patterns
    c) Chromosome painting and DNA sequencing

Unit - III: **(15 Hrs.)**

1. Gene and its expression:

a) Concept of gene

b) Transcriptional control of gene expression in prokaryote (Lac, trp - operon).

2. Transcriptional control of gene expression in eukaryotes:

a) RNA polymerases and gene control.

b) Regulatory sequences in protein coding gene.

c) Activators & Repressors of Transcription.

d) Regulation of transcription factor activity.

e) Regulation of elongation and termination of transcription.

f) Other eukaryotic transcription systems.

3. Post transcriptional gene control and nuclear transport:

a) Processing of pre m-RNA.

b) Regulation of pre m-RNA processing.

c) Macromolecular transport across the nuclear envelope.

d) Cytoplasmic mechanisms of post transcriptional control.

Unit - IV: Genetic engineering **(15 Hrs.)**

a) Recombinant DNA technology

b) Selection, screening and analysis of recombinants

c) Knockout gene technique

d) Production of transgenic mice

e) CRISPR-Cas9 based genome editing 12

Suggested Readings:

1. Molecular Cell Biology by Lodish *et. al.*

2. Molecular Biology of the gene by Watson

3. Principles of Gene Manipulation by S. B. Primerose

M. Sc. Part – I Semester -I Zoology

DSE-I: DSE41ZOO13: Animal Physiology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon completion of the course, students will be able to

CO1: Describe various aspects of neuromuscular physiology.

CO2: Illustrate the anatomy and physiology of sense organs.

CO3: Understand various concepts of reproductive physiology.

CO4: Know various techniques used in reproductive biology.

Unit - I: Membrane and Neuromuscular physiology **(15 Hrs.)**

a) Membrane Physiology and its potential.
b) Anatomy of nervous system – Neuroglia and neurons.
c) Physiology of nerve fiber its excitation and conduction.
d) Anatomy and physiology of skeletal, cardiac and smooth muscle
e) Neuromuscular junction- physiology and transmission.

Unit - II: Physiology of Sense organs **(15 Hrs.)**

a) Anatomy and physiology of Eye and Optics of eye.
b) Anatomy and physiology of Ear.
c) Anatomy, Histology and physiology of tongue.
d) Chemical Senses- Smell

Unit - III: Physiology of Reproduction **(15 Hrs.)**

a) Anatomy and physiology of male reproductive system.
b) Anatomy and physiology of female Reproductive system.
c) Maturation, capacitation of germ cells and fertilization.
d) Embryonic development.
e) Birth control measures.

Unit - IV: Recent trends in Reproductive biology **(15 Hrs.)**

a) Prenatal diagnostic tests
b) IVF and Embryo Transfer
c) Stem cells and Tissue culture.
d) Modern techniques in developmental biology.

Suggested Readings:

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 Dynamics& 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. SaundersCo., 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 gastrointestinal 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

M. Sc. Part – I Semester -I Zoology

DSE-I: DSE41ZOO14: Basic Entomology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course students will be able to

CO1: Gain knowledge about how insects originated and evolved, the distribution and diversity of insects, and why insects continue to dominate the world.

CO2: Get an in-depth knowledge of the structure of the head, thorax, and abdomen of insects and their various appendages which are very important for insect identification.

CO3: Get a detailed study of the historical background of insect classification, the types and components of insect classification, and an explanation of which insects belong to the different orders within the classification of insects.

Unit - I: introduction to insects and body plan **(15 Hrs.)**

1. Insects

1.1.Origin and evolution of insects.

1.2. Distribution and Diversity of Insects.

1.3. Dominance of insects.

2. Body segmentation

2.1 Tagmosis

2.2 Modification

3. HEAD

3.1 Types and segmentation

3.2 Cranium

3.3 Tentorium

3.4 Cephalic appendages

4. CERVIX

Unit - II: Insect body plan **(15 Hrs.)**

1. Thorax

1.1 Skeleton

1.2 Segmental regions – Tergum, Sternum and Pleuron

1.3 Thoracic appendages- Legs and Wings

2. Abdomen

2.1 Typical Abdomen

2.2 Skeleton

2.3 Abdominal appendages- Pregenital, Genital and post-genital.

Unit – III: Systematics **(15 Hrs.)**

1. Insect classification

1.1 Historical background

1.2 Types of Classification 1.3 Components of classification

1.4 Type specimen

2. Apterygote orders

2.1 Entognathus: Collembola

2.2 Ectognathus: Thysanura

3. **Pterygote orders**

3.1 Odonata, Embidina, Phasmida, Orthoptera , Isoptera, Blattaria, Anopleura.

Unit – IV: Systematics **(15 Hrs.)**

1. Pterygote orders

1.1 Hemiptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera.

While describing Insect orders, details of the Habitat, External Morphology, Internal anatomy and Classification upto families with examples are expected.

Suggested Reading:

1. Ambrose, D.P., 2015. The Insects. Structure, Function and Biodiversity. Kalyani publishers, New Delhi. 626pp.
2. Chapman, R. F. (1998). The Insect structure and function, 4th Ed. Cambridge University Press, UK. PP 747.
3. Gillot, C. (1980). Entomology, 3rd Ed. Plenum Press, New York, pp 730.
4. Gullan, P. G. and Cranston, P. S., 2010. The insects. An outline of Entomology. Wiley Blackwell. pp. 565.
5. Mani, M. S. (1968). General Entomology. Oxford & IBH Publishing Co., pp 597.
6. Snodgrass, R. E. (1935). Principles of Insect Morphology, Tata Mc Graw -Hill, New York. pp 667.
7. Tembhare, D. B (2013). Modern Entomology. Himalaya Publishing House, India. pp 502.
8. Wigglesworth, V.B., 1939. The Principles of Insect Physiology. Sixth ed. Methuen and Co. Ltd., London. pp 741.

M. Sc. Part – I Semester -I Zoology

DSE-I: DSE41ZOO12: Fisheries Resources: Inland and Marine Fisheries

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, students will be able to,

CO1: Understand concepts of inland and marine fisheries resources

CO2: Learn about various technical aspects of fisheries.

CO3: Demonstrate various techniques in fishery management.

CO4: Appreciate fishery economics and its extension.

Unit - I: **(15 Hrs.)**

A. Marine Capture Fisheries: Coastal fisheries: Sardine, Mackerel and Bombay duck; Off-shore fishery: Sole, Tuna, and Pomphret; Crustacean fishery and Molluscan fishery

B Unit - II: **(15 Hrs.)**

A. Freshwater Fisheries of India: Riverine fisheries, Reservoir fisheries, and Sewage fed 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. Marine Fisheries: Stratification of Marine habitat, and Groups of Marine Fishes

Unit - III: **(15 Hrs.)**

A. Management of Inland Fishery Resources:

Fishery management in rivers and reservoirs; Reproduction, Competition, and Predation in fishes, 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, 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; iv) Monitoring control and surveillance.

Unit - IV: **(15 Hrs.)**

Economics of Fisheries and Extension Programme:

Marketing and economics of fish farming, Co-operative fisheries societies, Role of government agencies in extension programme, Fisheries education, Training and extension, Problems of fisheries.

Suggested reading:

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. Part – I Semester -I ZOOLOGY

RMD: RMD41ZOO11: Research Methodology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, students will be able to,

CO 1: Understand various separation techniques.

CO 2: Know in detail spectroscopy and principles and types of microscopes and immunological techniques

CO 3: Appreciate and apply various concepts of biosystematics.

CO 4: Apply various statistical methods in research.

Unit I: Separation techniques: **(15 Hrs.)**

a) **Centrifugation techniques**. Basic principles of sedimentation and centrifuges and their uses, differential centrifugation, density gradient centrifugation.

b) **Chromatographic techniques** – Chromatography theory & practices, Molecular Sieve chromatography, affinity chromatography, ion exchange chromatography, HPLC, GLC, Thin layer chromatography.

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

Unit II: **(15 Hrs.)**

a) **Spectroscopic techniques**: UV and Visible light Spectroscopy, Spectrofluorimetry.

b) **Microscopy**: Light microscope, phase contrast microscope, fluorescence microscope, Electron Microscope (SEM & TEM).

c) **Immunological techniques** -Immunoprecipitation, Labelling antibodies, immunoblotting, immunoassays, immunohisto/cytochemistry.

Unit III: **Biosystematics** **(15 Hrs.)**

a) **Taxonomy:** Introduction to taxonomy, Stages and importance of taxonomy; Problems, Aim and Tasks of Taxonomy.

b) **Modern Trends in Taxonomy:** Morphological approach, immature stages and Embryological approach, Ecological, behavioural and Cytological approach, Biochemical and Numerical taxonomy.

c) **Kinds of Classification.**

Unit IV. Biostatistics in research **(15 Hrs.)**

a) Application of statistics in Biology.

b) Measures of Central tendency: Arithmetic mean, mode and median.

c) Measures of dispersion: Range, quartile deviation, mean deviation, Standard deviation, coefficient of variation.

d) Probability and Probability distribution - Introduction, addition and multiplication theory; Binomial, Poisson and Normal distribution.

e) Correlation and Regression

f) Hypothesis testing and test - Student t-test, Chi- square test ($\chi 2$), Analysis of Variance

Suggested Readings:

1. Principles and Techniques in Biochemistry and Molecular Biology by Wilson and Walker
2. Cell: A molecular approach By Cooper
3. Molecular Biology of the Cell by Lodish *et al.*
4. Fundamentals of Statistics- Gupta S. C., 2018
5. Basic Biostatistics and its applications- Datta A. K
6. Biostatistics and Biometry- Parihar and Parihar, 2018
7. An Introduction to statistical Methods, (23rd Edt.) by C. B. Gupta and Vijay Gupta, 2009.
8. Biostatistics by S. K. Pundir, 2022.
9. Introduction to Biostatistics by Larry Winner, Department of Statistics, University of Florida.
10. Camp, W.H. (1951): Biosystematics Britania 7: 113 – 127.
11. Huxley, J.S. (ed.) The New Systematics Oxford Uiv. Press London 538 pp.
12. Jeffrey, C. (1977): Biological nomenclature Indian Ed. Oxford and IBH Pub. Co. New Delhi 72 pp.
13. Mayr, E. (1969): Principles of systematic in Zoology Mc. Graw Hill N.Y. 428 pp.
14. Mayr, E. and E.G. Linsley and R.L. Usinger (1953): Methods and Principles of systematic Zoology, Mc Graw Hill N.Y. 328 pp.

M. Sc. Part – I Semester -I Zoology
DSC- PR-I: DSC41ZOO19: DSC Zoology Lab-1

Practicals based on

Molecular Cell Biology (DSC41ZOO11), Applied Entomology (DSC41ZOO12), General Sericulture & Mulberry Cultivation (DSE41ZOO11), Molecular Biology of the Gene (DSE41ZOO11), Animal Physiology (DSE41ZOO12), Basic Entomology (DSE41ZOO14), and Fisheries Resources: Inland & Marine Fisheries (DSE41ZOO15)

Credits: 06 **Marks-150**

A. Practical Based on Paper Advanced Cell Biology (DSC41ZOO11)

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
3. Demonstration of Nucleus 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. Demonstration of mitochondria
7. Effect of tonicity of solutions on plasma membrane –
    a) Isotonic, Hypotonic, Hypertonic
    b) Fragility test of RBC & Osmotic Resistance.
8. Any other practical set by concern teacher.

B. Practical Based on Paper Applied Entomology (DSC41ZOO12)

1. Study of generalized insect. Identification economic importance of following insect pests (6-8 pests from each category)
2. Pests of stored gains.
3. Household pests.
4. Pests of medical importance.
5. Pests of veterinary importance.
6. Forest pests.

7. Types of silk moths.
8. Rearing appliances of mulberry silk worm and demonstration.
9. Study of forensic insects
10. Study of nutritional insects.
11. Life cycle and types of honey bees.
12. Lac insect economic importance.
13. Field visit for demonstration of pest damage.
14. Field visit for collection of insects.
15. Any other practical set by concern teacher.

C. Practical Based on (As per the elective chosen by a student)

C1. Practical Based on General Sericulture & Mulberry Cultivation (DSE41ZOO11):

1. Demonstration of mulberry cultivation.
2. Preparation of mulberry saplings
3. Demonstration of pruning and application of chemical fertilizers
4. Preparation of herbarium of mulberry and non-mulberry host plants.
5. Study of anatomy of leaf, stem and petiole
6. Collection and preservation of mulberry pests
7. Study root and foliar diseases of mulberry
8. Any other practical set by the concerned teacher.

C2. Practical Based on Paper Molecular Biology of the Gene (DSE41ZOO12)

1. Isolation of DNA
2. Isolation of RNA
3. Estimation of DNA
4. Estimation of RNA
5. Separation of DNA by Agarose gel electrophoresis
6. Separation of RNA by Agarose gel electrophoresis.
7. Spectrophotometric analysis of nucleotides.
8. Spectrophotometric analysis of amino acids.
9. Isolation of Histones
10. Estimation of Histones.
11. Demonstration of Histones.
12. Estimation of phosphate from isolated nucleic acids.

13. Separation of proteins by SDS-PAGE
14. Western blotting
15. Northern blotting
16. Southern blotting.
17. Isolation of plasmids.
18. Any other practical set by concerned teacher.

C3. Practical Based on Paper Animal Physiology (DSE41ZOO13)

1. Study of Equipment's used in Animal Physiology laboratory.
2. Study of different Animal Models for Physiology Experiments.
3. Introduction to Animal House, Breeding and Rearing.
4. Study of Anatomy of Vertebrate model RAT/ MICE.
5. Study of Reproductive Cycle by Vaginal smear technique in RAT/ MICE.
6. Study of Histology of Male and Female Reproductive System in RAT/ MICE.
7. Study of Skeletal, Cardiac and Smooth Muscles in RAT/ MICE.
8. Study of sperm count in RAT/ MICE
9. Study of placental type in different animals.
10. Study of operative procedure for i) Pancreatectomy ii) Gonadectomy iii) Hysterectomy.
11. Study of Action potential in sciatic nerve. (Chemical and Voltage).
12. Collection of CSF in RAT/ MICE.
13. Study of Contraceptive devices/ Birth control measures.
14. Estimation of Protein content of RAT/ MICE blood.
15. Estimation of Glycogen content of RAT/ MICE (All muscles and liver)
16. Study of body temperature by using thermometer.
17. Visit to the IVF laboratory.
18. Any other practical set by concerned teacher

C4. Practical Based on Basic Entomology (DSE41ZOO14):

1. Collection and preservation of insects.
2. Study of mouth parts in insects.
3. Study of antennae in insects.
4. Mounting of tentorium.

5. Study of types of wings in insects.

6. Study of types of legs in insects.

7. Study of abdominal appendages in Cockroach and Grasshopper.

8. Study of locally available insect orders with examples.

9. Any other practical set by concerned teacher.

C5. Practical Based on Fisheries Resources: Inland & Marine Fisheries (DSE41ZOO15)

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

2. Estimation of the rate of oxygen consumption in fish

3. Fecundity assessment in fish

4. Slides of different types of scale

5. Demonstration of induced breeding technique by ovaprim /ovatide.

6. Estimation of DO, CO2, Alkalinity, Inorganic nitrate and Phosphate from water sample

7. Qualitative analysis of digestive enzymes

8. Any other practical set by concerned teacher.

Semester -II

M. Sc. Part – I Semester -II Zoology

DSC-III: DSC41ZOO21: Physiological chemistry

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, students will be able to,

CO1: Understand the basic principles of Physics and Chemistry applicable in biology.

CO2: Understand the Metabolism of carbohydrates and its energetics.

CO3: Understand the chemistry of amino acids, proteins and nucleic acids.

CO4: Understand metabolism of lipids and their physiological significance.

Unit I: Chemical foundations of Biology **(15 Hrs.)**

a) Structure of atom,
b) Types of bonds, Van der Waal's electrostatic forces of attraction, hydrophobic interactions.
c) Chemical structure and properties of water, pH, pKa, buffers,
d) Thermodynamics in biological system: Enthalpy, Entropy and Gibb's free energy.

Unit II: Carbohydrate metabolism **(15 Hrs.)**

a) Structure, classification and functions of carbohydrates,
b) Glycolysis, regulation and energetics,
c) TCA cycle, regulation and energetics,
d) Electron transfer system structure and mechanism of action, oxidative phosphorylation and ATP generation,
e) Glycogenesis, glycogenolysis and gluconeogenesis
f) Pentose phosphate pathway and its significance

Unit III: Amino acids, Proteins and nucleic acids **(15 Hrs.)**

a) Amino acids: Classification of amino acids, biosynthesis and Oxidation of amino acids.
b) Proteins: Protein structure and functions: Primary, secondary, tertiary and quaternary structure
c) Nucleic acids: Structure of nucleotides. Structure of DNA and RNA, De novo and salvage pathway of synthesis of nucleotides

Unit IV: Lipid metabolism **(15 Hrs.)**

a) Lipids- structure, classification and functions, Steroidal hormones: structure and functions.
b) Catabolism of fatty acid – Beta oxidation, Carnitine shuttle, Significance of beta oxidation. Bioenergetics of Beta oxidation

c) Biosynthesis of saturated and unsaturated fatty acids.

d) Biosynthesis of triglycerides,

e) Biosynthesis of membrane phospholipids.

f) Biosynthesis of cholesterol

g) Biosynthesis of prostaglandins and leukotriene Lipoprotein metabolism

Suggested Readings:

1. Lehninger-Principles of Biochemistry: Nelson and Cox
2. Biochemistry:, Tymoczko, Berg, Stryer
3. Review of physiological chemistry: H. Harper

M. Sc. Part – I Semester -II Zoology

DSC-IV: DSC41ZOO22: Anatomy and Physiology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, students will be able to,

CO1: Learn about anatomy of digestive system and nutrition.

CO2: Understand various concepts of respiratory physiology.

CO3: Understand various aspects of circulatory physiology.

CO4: Illustrate anatomy and physiology of excretory and endocrine organs.

Unit I: Physiology of Digestive System: **(15 Hrs.)**

a) Anatomy and physiology of gastrointestinal tract, Salivary gland, Pancreas and Liver.
b) Digestion and absorption in gastrointestinal tract
c) Balanced diet, obesity and starvation.
d) Vitamins and their role in nutrition.

Unit II: Physiology of Respiration: **(15 Hrs.)**

a) Anatomy and physiology, respiratory tract and pulmonary ventilation.
b) Pulmonary air volumes and capacities.
c) Exchange of Oxygen and carbon dioxide.
d) Control of respiration.

Unit III: Physiology of Circulation: **(15 Hrs.)**

a) Blood, Composition of blood, blood coagulation.
b) Blood groups and blood transfusion.
c) Anatomy and physiology Heart and blood vessels, Heart blood supply.
d) Conduction system and pace maker.
e) Electrocardiogram, Cardiac Cycle and heart sound.

Unit IV: Physiology of Excretion and Endocrine System: **(15 Hrs.)**

a) Anatomy and physiology of the kidneys, nephron and mechanism of urine formation.
b) Urinary bladder, process of micturition, Hemodialysis and Artificial kidney.
c) Anatomy and physiology of Pituitary gland and Adrenal gland.
d) Anatomy and physiology of Thyroid and Parathyroid gland.

Suggested Readings:

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) American 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 Dynamics & Control of the Body fluids 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 gastrointestinal tract 1987 New York Raven press.
12. Thompson 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 Nutrition 7th ed. St. Lonis C.V. Mosby Co.,
15. Felig P et al (eds) 1987. Endocrinology & Metabolism New Your Mac Graw- 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.

M. Sc. Part – I Semester -II Zoology

DSE-II: DSE41ZOO24: Silkworm Biology & Rearing Technology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, students will be able to,

CO1: Understand biology of various silkworms.

CO2: Illustrate anatomy and physiology of silkworm.

CO3: Appreciate rearing and management of silkworms.

CO4: Understand various silkworm diseases and their management.

Unit - I: Silkworm Biology (15 Hrs.)

Classification and Geographical distribution of Silkworm races Life cycle of mulberry silkworm Life cycle of non-mulberry silkworms Eri, Muga and Tasar

Unit - II: Anatomy and Physiology of mulberry silkworm (15 Hrs.)

Digestive system, Circulatory system, Excretory system, Nervous system, Respiratory system, Reproductive system and Endocrine system Anatomy, silk gland structure and function

Unit - III: Rearing technology and management practices (15 Hrs.)

Principles of silkworm rearing, Environmental conditions for silkworm rearing Rearing Equipments, Management of rearing house and disinfection Types of rearing houses, Types of silkworms and methods of commercial rearing Chawki Rearing concept, shoot feeding and shelves rearing technology

Unit - IV: Silkworm diseases and management (15 Hrs.)

Protozoon diseases, Bacterial diseases, Viral diseases, Fungal diseases and their management practices Pests, Predators, Parasites of mulberry and non-mulberry silkworm and management

Suggested Reading Material:

1. Sarkar, D.C. (1988): Ericulture in India, CSB, Bangalore.
2. Annual report of Central Sericultural Research and Training Institute, Mysore.
3. Annual report of Central Sericultural Research and Training Institute, Bangalore.
4. Annual report of Central Tasar Research Institute, Ranchi.
5. Annual report of Central Muga Research Institute, Assam.
6. A Treatise on acid treatment of silkworm eggs, CSR and TI, Mysore.
7. Tips for successful silkworm cocoon crops, CSR and TI, Mysore.
8. Tips for successful bivoltine silkworm cocoon crops, CSR and TI, Mysore.

9. M.V. Samson, Chandrashekharaih, P. Gowde and Saheb B. (1995): Monograph on silkworm loose egg production, SSTC, CSB, Bangalore.
10. FAO, Volumes (1-4), Central Silk Board, Bangalore

M. Sc. Part – I Semester -II Zoology

DSE-II: DSE41ZOO22: Developmental Biology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, students will be able to,

CO1: Understand the fundamentals of basic concepts of development of animals

CO2: Appreciate the molecular basis of gametogenesis, fertilization and mechanism of blastulation.

CO3: Understand the process of gastrulation and neurulation

CO4: Appreciate animal development at molecular and genetic level.

Unit – I: An introduction to developmental biology: (15 Hrs.)

Introduction, features of animal development, eukaryotic heritage, development among the unicellular eukaryotes, control of developmental morphogenesis and differentiation, origin of sexual reproduction, colonial eukaryotes, the evolution of differentiation, developmental pattern among metazoans

Unit - II: Gametogenesis, fertilization and early embryonic development (15 Hrs.)

a) Production of gametes,
b) Cell surface molecules in sperm-egg recognition in animals,
c) Process of fertilization, cleavage,
d) Blastulation in sea urchin, Amphioxus, Zebra fish, frog, chick and mammal.
e) Implantation in mammals

Unit – III: Gastrulation and Neurulation (15 Hrs.)

a) Gastrulation and formation of germ layers in sea urchin, frog, birds, reptiles and mammals;
b) Molecular mechanism of left –right axis formation- in amphibian, mammal and reptile
c) Neurulation-body segmentation, Hox gene control development

Unit – IV: Morphogenesis and organogenesis in animals (15 Hrs.)

a) Cell aggregation and differentiation in *Dictyostelium*- Life cycle of Dictyostelium, cell-cell signaling, cell adhesion molecules in *Dictyostelium*
b) Axes and pattern formation in *Drosophila*-Development of fruit fly, maternal effect gene,
c) Organogenesis – vulva formation in *Caenorhabditis elegans*-cell-cell interactions and chance in the determination of cell types
d) Eye lens induction- Cascades of induction –reciprocal and sequential inductive events

Suggested Readings:

1. Developmental Biology By Gilbert
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. Cell & Molecular Biology by Gerald Karp (2005) published by John Wiley & sons.
5. Cell & Molecular Biology by E.D.P. De Robertis

M. Sc. Part – I Semester -II Zoology

DSE-II: DSE41ZOO23: Applied Physiology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, students will be able to,

CO1: Appreciate aspects of environmental physiology.

CO2: Understand various aspects of exercise physiology.

CO3: Explain basics concept of ergonomics and occupational physiology

CO4: Understand the ergonomics of various Equipments.

Unit - I: Environmental Physiology **(15 Hrs.)**

a) Physiology of high altitude.
b) Space Physiology and Weightlessness.
c) Physiology of deep sea diving.
d) SCUBA and its bio-applications.

Unit - II: Exercise Physiology **(15 Hrs.)**

a) Fundamental of physical and mental exercise.
b) Energy for exercise - Aerobics and Anaerobics.
c) Exercise physiology- Muscles in exercise, Respiratory exercise, Cardiovascular system exercise, Nervous system exercise and thermodynamics of exercise
d) Hormonal changes and exercise.
e) Exercise, meditation and mental health.

Unit - III: Ergonomics of Bio-equipment' **(15 Hrs.)**

a) Laboratory equipment's- Ergonomics and its applications.
b) Ergonomic working and applications of Sphygmomanometer, ECG and TMT.
c) Ergonomic working and applications of Spirometer and Grip ergometer.
d) Ergonomic working and applications of Ultrasound and C. T. Scan.
e) Ergonomic working and applications of Endoscopy and tissue biopsy.
f) Ergonomic working and applications of MRI and EEG.

Unit – IV: Ergonomics and Occupational Physiology **(15 Hrs.)**

a) Man- machine and working environment.

b) Occupational hazards or diseases and its management
c) Muscular atrophy and dystrophy.
d) Biological and mental stresses
e) Problems of Child labour.

Suggested Readings:

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) American 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 Dynamics& Control of the Body fluids 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 gastrointestinal tract 1987 New York Raven press.

12. Thompson 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 Nutrition 7th ed. St. Lonis C.V. Mosby Co.,

15. Felig P et al (eds) 1987. Endocrinology & Metabolism New Your Mac Graw- 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.

M. Sc. Part – I Semester -II Zoology

DSE-II: DSE41ZOO24: Insect Anatomy and Physiology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course,

CO1: Students will understand the integument and anatomy, physiology of the digestive system of insects

CO2: Students will understand the respiratory, circulatory and excretory system of insects.

CO3: Students will understand the nervous and endocrine system of insects.

CO4: Students will understand the reproductive system and embryonic development of insects.

Unit – I:

1. **THE INTEGUMENT:** **(15 Hrs.)**

1. Structure of Integument.
2. Physiology of Integument.
3. Functions of Integument.

2. DIGESTIVE SYSTEM AND ITS PHYSIOLOGY

1. The Alimentary canal and associated glands.
2. Digestion and Absorption
3. Enzyme dynamics.

Unit – II: **(15 Hrs.)**

1. RESPIRATION

1. Organs of Respiration- Tracheae, Tracheoles, Airsacs and Spiracles.
2. Types of tracheal systems.
3. Mechanism of gaseous exchange within tracheole
4. Respiration in aquatic and parasitic insects.

2. CIRCULATION

1. Structure of Circulatory organs- Dorsal vessel and Accessory pulsatile structures.
2. Haemolymph- Composition and function.
3. Haemocytes- Types and function.
4. Mechanism of Circulation.

3. EXCRETION

1. Excretory organs – Malpighian tubules and other excretory structure.
2. Physiology of Excretion
3. Osmoregulation.

Unit – III: **(15 Hrs.)**

1. NERVOUS SYSTEM

1. Neuron- structure and type
2. Central nervous system.
3. Physiology

2. ENDOCRINE SYSTEM.

1. Endocrine organs.
2. Neurosecretory cells
3. Hormones and their functions

Unit – IV: **(15 Hrs.)**

1. REPRODUCTION.

1. Male Reproductive system.
2. Female Reproductive system.
3. Physiology and reproduction.

2. EMBRYONIC DEVELOPMENT

1. Cleavage and Blastoderm Formation.
2. Formation and Growth of germ band.
3. Gastrulation.
4. Formation of amnion
5. Segmentation

Suggested Readings:

1. Ambrose, D.P., 2015. The Insects. Structure, Function and Biodiversity. Kalyani publishers, New Delhi. 626pp.
2. Chapman, R. F. (1998). The Insect structure and function, 4th Ed. Cambridge University Press, UK. PP 747.
3. Gillot, C. (1980). Entomology, 3rd Ed. Plenum Press, New York ,pp 730 .
4. Gullan, P. G. and Cranston, P. S., 2010. The insects. An outline of Entomology. Wiley Blackwell. pp. 565.
5. Mani, M. S. (1968). General Entomology. Oxford & IBH Publishing Co., pp 597.
6. Snodgrass, R. E. (1935). Principles of Insect Morphology, Tata Mc Graw -Hill, New York. pp 667.
7. Tembhare, D. B (2013). Modern Entomology. Himalaya Publishing House, India. pp 502.
8. Wigglesworth, V.B., 1939. The principles of Insect Physiology. Sixth ed. Methuen and Co. Ltd., London. pp 741.

M. Sc. Part – I Semester -II Zoology

DSE-II: DSE41ZOO25: Fish Pathology and Reproductive Endocrinology

Credits: 04 **Theory: 60hrs.** **Marks-100**

Course Outcomes: Upon successful completion of this course, students will be able to,

CO1: Understand fish diseases and their management

CO2: Utilize the knowledge of larvivorous fish in relation to public health

CO3: Understand the effect of aquatic pollutants on fish health.

CO4: Appreciate fish reproduction and its hormonal regulation.

Unit - I: Fish Pathology and Cure **(15 Hrs.)**

Signs of sickness in fishes, defensive devises in fishes against diseases, diseases of fishes, intrinsic causes of diseases, diseases caused by pathogens and parasites; their symptoms and treatments

Unit - II: **(15 Hrs.)**

A. Larvivorous Fish about Public Health: Essential characters of Larvicidal Fish, Larvicidal fishes in India, Classification of Fishes based on Mosquitocidal activity

B. Aquatic Pollution: Introduction, water pollution: causes and types, Major sources of aquatic pollution and their effects on fish and fisheries

Unit - III: **(15 Hrs.)**

A. Fish Health in Relation to Environment:

Abiotic factors influencing disease outbreak in fish, Effect of industrial waste on diseases and pathogens; Effect of agriculture waste on diseases and pathogens, Effect of pesticides 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 - IV: **(15 Hrs.)**

Reproductive Endocrinology: Pituitary gonadotropins: role of gonadotropins in pre-spawning behaviour, role of gonadotropins in spawning behavior, Hormonal regulation in fish reproduction

Suggested reading:

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. Applied Fishery Science Vol. I & II : S.M. Shafi.

M. Sc. Part – I Semester -II Zoology
DSC- PR-II: DSC41ZOO29: DSC Zoology Lab-II

Practicals based on

Physiological Chemistry (DSC41ZOO21), Anatomy & Physiology (DSC41ZOO22), Silkworm Biology & Rearing Technology (DSE41ZOO21), Developmental Biology (DSE41ZOO22), and Applied Physiology (DSE41ZOO23), Insect Anatomy and Physiology (DSE41ZOO24), Fish Pathology & Reproductive Endocrinology(DSE41ZOO25)

Credits: 06 **Marks-150**

A. Practical Based on Paper Physiological Chemistry (DSC41ZOO21)

1. Estimation of glycogen.
2. Estimation of lipids & phospholipids.
3. Estimation of Vitamin C.
4. Estimation of Cholesterol.
5. To find saponification value for a given fat.
6. Preparation of phosphate buffer pH measurement.
7. To estimate free amino acids by Ninhydrin method.
8. To estimate protein content by Biuret method/ Lowry et.al./ Bradford method.
9. Estimation of glucose.
10. Estimation of casein from milk.
11. Estimation of Uric acid
12. Extraction of Starch.
13. Extraction of Glycogen.
14. Any other practical set by the concerned teacher

B. Practical Based on Paper Anatomy & Physiology (DSC41ZOO22)

1. Determination of Bleeding time
2. Determination of Clotting time
3. Estimation of Hemoglobin (Hb) concentration and oxygen carrying capacity
4. Enumeration of Red blood corpuscles (R.B.C)
5. Enumeration of white blood corpuscles (W.B.C)
6. Differential count of W.B.C.

7. Erythrocyte sedimentation rate (E.S.R)
8. Detections of digestive enzymes
9. Anatomy and histology of digestive and endocrine glands
10. To estimate amylase from saliva
11. To study normal constituents of urine
12. Measurement of breathing rate, heart beat and study of heart sound.
13. Any other practical set by the concerned teacher

C. Practical Based on As per the elective chosen by a student

C1. Practical Based on Paper Silkworm Biology & Rearing Technology (DSE41ZOO21)

1. Morphology of egg, larva, pupa and adult of mulberry and non-mulberry silkworms
2. Dissection of Digestive system of silkworm
3. Dissection of Nervous system of silkworm
4. Dissection of Circulatory system of silkworm
5. Dissection of male reproductive system of silkworm
6. Dissection of female reproductive system of silkworm
7. Mounting of silk gland
8. Rearing of silkworm to study its life cycle.

C2. Paper Developmental Biology (DSE41ZOO22)

1. Study of eye lens differentiation in chick embryo.
2. Study of nervous system development in chick embryo.
3. Study of Angiogenesis in chick embryo.
4. Study of Dorsal nerve root development in chick embryo
5. Effect of colchicine on development of dorsal nerve root in chick embryo
6. Demonstration of stem cells
7. Study of gastrulation in amphioxus and frog
8. Study of partial hepatectomy in mice.
9. Any other experiments / practical set by the Department.

C3. Practical Based on Paper Applied Physiology (DSE41ZOO23)

1. To determine atmospheric pressure of air.
2. Determination of Peak Expiratory and Inspiratory Flow rate.
3. Study of Physical fitness by Step Test method

4. Determination of Grip strength.

5. To study effect of work load on finger muscle by Finger Ergometer.

6. To find out Blind spot of eyes.

7. Study of dermatoglyphics of Fingers and Palm.

8. Estimation of lactate content of RAT/ MICE blood

9. Estimation of Chloride content in rat blood.

10. Estimation of calcium content of RAT/ MICE blood.

11. Study of bio-equipment and their ergonomics features.

12. Visit to the industrial area to study man- machine environment.

13. Any other practical set by concerned teacher.

C4. Practical Based on Paper Insect Anatomy and Physiology (DSE41ZOO24):

1. Dissection of any pest to study the digestive, nervous and reproductive systems.
2. Study of Total Haemocyte Count (THC) in insects.
3. Study of Differential Haemocyte Count (DHC) in insects.
4. Chromatographic analysis of amino acids in insect haemolymph/any tissue.
5. Estimation of digestive enzymes in insects (amylase/invertase/trehalase).
6. Study of uptake of dyes in Malpighian tubules.
7. Study of phagocytosis in insect haemocytes.
8. Determination of moisture given out by insects during respiration.
9. Qualitative estimation of nitrogenous waste products in the excreta of Cockroaches.
10. Any practical set by the concerned teacher.
11. Project Work.

C5. Practical Based on Paper Fish Pathology & Reproductive Endocrinology (DSE41ZOO25)

1. Identification of diseased fish – Bacterial, fungal and viral infections (Slides)
2. Blood glucose estimation in fish
3. Sexual dimorphism and secondary sexual characters in fishes
4. Short term bioassay of LC50 determination (Demonstration)
5. Field trips and study tours to fish farms, fisheries institute, or national laboratory etc.
6. Any practical set by the concerned teacher / Department.

Nature of Question Paper and Scheme of Marking

Instructions:

1) Question 1 is compulsory
2) Figure to right indicate full marks
3) Draw neat labelled diagrams wherever necessary
4) Use of calculator is allowed

Time:3 hours **Total Marks :80**

Theory Papers

Q.1. Select correct alternative and rewrite the sentence (16)

i)……

A) B) C) D)

ii)……..

A) B) C) D)

iii)…….

A) B) C) D)

iv)……...

A) B) C) D)

v)…….

A) B) C) D)

vi) ……..

A) B) C) D)

vii)…….

A) B) C) D)

viii)……..

A) B) C) D)

ix)……..

A) B) C) D)

x)……..

A) B) C) D)

xi)……..

A) B) C) D)

xii)……..

A) B) C) D)

xiii)……..

A) B) C) D)

xiv)……..

A) B) C) D)

xv)……..

A) B) C) D)

xvi)……..

A) B) C) D)

Q.2. Attempt any two (32)

i)

ii)

iii)

Q.3. Attempt any four (32)

i)

ii)

iii)

iv)

v)

vi)

Instruction to paper setter: Equal weightage should be given to all units

SCHEME OF MARKING (THEORY)

Sem.	Core Course	Marks	Evaluation	Paper	Answer Books	Standard of passing
I	I	80	Semester wise	Each paper of 80 marks	As per Instruction	40% (32 Marks)
II	II	80	Semester wise	Each paper of 80 marks	As per Instruction	40% (32 Marks)

SCHEME OF MARKING (CIE) Continuous Internal Evaluation

Sem.	Core Course	Marks	Evaluation	Paper	Answer Books	Standard of passing
I	I	20	Semester wise	One	As per Instruction	40% (8 Marks)
II	II	20	Semester wise	One	As per Instruction	40% (8Marks)

SCHEME OF MARKING (PRACTICAL)

Sem.	Course	Marks	Evaluation	Answer Books	Standard of passing
I	DSC-PR-I	150	Semester wise	As per Instruction	40% (60 Marks)
II	DSC-PR-II	150	Semester wise	As per Instruction	40% (60 Marks)

- A Separate passing is mandatory

Practical:

Practical DSC-PR-I	**150 Marks**
Based on DSC-I and DSC-II, DSE-I	**50 Marks**
Que. 1 Experiment/Experiments Based on **DSC-I**	20
Que. 2 Experiment/Experiments Based on **DSC-I**	20
Que. 3 *Viva voce*	05
Que. 4 Journal	05
Based on DSC-II	**50 Marks**
Que. 1 Experiment/Experiments Based on **DSC-I**	20
Que. 2 Experiment/Experiments Based on **DSC-I**	20
Que. 3 *Viva voce*	05
Que. 4 Journal	05
Based on DSE-I	**50 Marks**
Que. 1 Experiment/Experiments Based on **DSC-I**	20
Que. 2 Experiment/Experiments Based on **DSC-I**	20
Que. 3 *Viva voce*	05
Que. 4 Journal	05

For passing, student must score minimum 60 marks out of 150 in practical examination