SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A' Grade

Revised Syllabus For

M. Phil./ Ph. D. Course Work

Zoology

Syllabus to be implemented from

June, 2020 onwards.

NEW/ REVISED SYLLABUS FOR
M. Phil./ Ph.D. Course Work: ZOOLOGY
(Introduced from June, 2020 onwards)

Paper: I
Title of paper: Research Methodology in Zoology

Specific Objectives: To develop technical skills in Research students.

Total Marks: 100

UNIT I: Scientific research, its Communication **15 hrs.**

1. **Concept of Scientific Research:** Nature and types of research; research methods, experimental design, research process (formulation of problem, literature survey, Developing working problem, designing methodology of data collection, Analysis of Data ad its presentation); Concept of good research.
2. **Literature Survey and Problem Definition:** Need for Reviewing Literature, what to review and for what purpose, Literature Search Procedure, Sources of Literature, Planning of Review work, Note Taking, Libraries and Documentation and management of bibliography with softwares (e.g. EndNote, Mendeley etc.).
3. **Planning of Research:** Selection of a Problem for Research, Formulation of the Selected Problems, Hypothesis formation, Measurements, Research Design/Plan.
4. **Research communication**: Writing review article, Research paper, Research project and Research Report and thesis.

UNIT II: Ethics in Zoological Research **15 hrs.**

1. Originality, Integrity, Intellectual Property Rights, Patents and Plagiarism in research.
2. **Ethical issues and bio-safety regulation:** DBT Guidelines for Bio-safety, Institutional Bio-safety committee and its functioning.
3. **Ethics in use of Experimental animals:** Institutional Animal ethics committee, and Institutional ethical committee, CPCSEA guidelines for animal experimentation, ICMR guidelines for experiments involving humans.

4. **Biodiversity laws:** Guidelines and regulations of Bioresources utilization for commercial and research purpose. The Biological Diversity Act, Wildlife (Protection) Act, Forest (Conservation) Conservation Act.

UNIT III: Biostatistics in Research **15 hrs.**

1. **Processing of data:** Classification and tabulation.
2. **Data Analysis: Descriptive-** Measurement of Central Tendencies, Measures of Variations, Correlation, Regression, multiple discriminant analysis (MDA), Analysis of Variance (ANOVA), Analysis of Co-Variance (ANCOVA), Multivariate analysis of variance (MANOVA), Multidimensional scaling.
3. **Inferential-** Hypothesis testing, T- tests, Chi-square test, post-hoc tests. Concept of probability.
4. Introduction to computer programs used for biostatistics: MS-Excel, SPSS, STATISTICA, PAST, r- statistics, PRIMER etc.

UNIT IV: Informatics in Zoological Research **15 hrs.**

1. Introduction to internet, Use of internet in Research activities, Cyber law, working knowledge of e-resources for research SciNet, JSTOR, Shodhganga, EBSCOhost and other online journals.

2. Databases: NCBI, Swiss-prot, PIR, PDB, KEGG, PubMed, The Catalogue of Life, Entomological databases; other Biodiversity databases.

3. Biological data archiving and retrieval: FASTA format, Accession, and GI-Number, BIN.

4. Concept of Geographic Information System and application of Global Positioning System in Biodiversity study.

Recommended Reading:

1. Kothari. C. R. 2004. Research Methodology: Methods and Techniques, New Age International (P) Limited, Publishers, New Delhi – 110002.
2. Jennifer Peat. 2002. Scientific Writing Easy when you know how. BMJ Books.
3. Brendan Hennessy. 2006. Writing Feature Articles, Fourth edition, Focal Elsevier.
4. Margaret Cargill and Patrick O'Connor. 2009. Writing Scientific Research Articles: Strategy and Steps. Willey-Blackwell, A John Wiley & Sons, Ltd., UK.
5. Rastogi, 2008, Fundamentals of Biostatistics, ANE Books
6. Sharma, 2008, Text Book of Biostatistics-I&II, Discovery Publishing
7. Snedecor & Cochran,1968, Statistical Methods, Oxford & IBH
8. Barnes & Gray, 2003, Bioinformatics for Geneticists. Wiley
9. Campbel, 2006, Discovering Genomics, Proteomics and Bioinformatics. LPE
10. Hunt & Livesey, 2006, Functional Genomics. Oxford

11. Lesk, 2006, Bioinformatics 2/e. Oxford
12. Mount, 2006, Bioinformatics 2/e. CBS
13. Westhead et al, 2003, Bioinformatics Instant Notes. Viva Books (Indian ed.)

NEW/ REVISED SYLLABUS FOR
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Paper: II
Title of paper: Research Advances in Zoology

Specific Objectives:

i. To develop subject specific skills in Research students.
ii. To understand and adopt advanced trends in Zoological research.

Total Marks: 100

UNIT I: Techniques in Biology **15 hrs.**

A) Cell and Tissue Staining Techniques

1. **Elements of microtomy**- pre-microtomy processes, microtomy process, post microtomy process.
2. **In situ and histological staining techniques**- Whole mount (In situ) staining techniques, microbial staining techniques.
3. **Histochemistry**: General Histochemistry, enzyme histochemistry, immunochemistry.
4. **Microscopy:** Light microscopy, electron microscopy (SEM and TEM), Fluorescence Microscopy, Confocal Microscopy, camera lucida, Image processing and Microscopic measurements.

B) Physiological and biochemical techniques

1. **Hematological Techniques**: Blood composition, hematological techniques.
2. **Isolation, separation and purification of techniques:** Sample collection, preservation and preparation for biochemical study; Centrifugation, spectroscopy, chromatography, electrophoresis.
3. **Biochemistry:** Techniques for qualitative and quantitative detection of carbohydrates, lipids, Proteins and hormones, tracer techniques.
4. **Enzymology techniques:** Chemistry and classification, qualitative and quantitative detection and enzyme activity.

UNIT II: Recent trends in Biotechniques **15 hrs.**

1. **Nucleic acid Biotechniques**: Salient features, laboratory Biotechniques- Isolation, Primers and its design, PCR, RT-PCR, Blotting and Hybridization techniques (GISH and FISH), Microarray, DNA sequencing, Whole genome sequencing.
2. **Genetic engineering:** Enzymes in recombinant DNA technology, Cloning Vehicles, Analysis and expression of cloned genes in host cell, Gene libraries, Transgenesis and knockout gene technology and their applications, Application and impact of recombinant DNA technology.
3. **Immunological techniques:** Immunoassay, Immunoprecipitation, Immunoelectrophoresis, Immunofluorescence, immunohistochemistry. Radioimmunoassay of hormones: Principle of radioimmunoassay, radioimmunoassay (RIA) techniques for hormones, ELISA.
4. **Animal cell and tissue culture:** Salient features, cell culture techniques, cell culture and immunocytochemistry, stem cell culture, Production of hybridomas.
5. Proteomics and Genomics bioinformatics: Proteomics-proteomic analysis by mass spectrometry, Protein visualization, structure comparison, homology modelling. Genomics-genome wide analysis of gene structure and expression.

UNIT III: Recent advances in Evolution and Behaviour 15 hrs.

1. Concept and theories of evolution
2. Organic evolution
3. Origin of life and origin of species
4. Phylogeny: concepts and methods in phylogeny analysis
5. Feeding learning, social and sexual behaviour.
6. Circadian rhythms, parental care and mimicry.
7. Migration of insects, fishes and birds.
8. Methods in field biology: methods in study of behaviour, habit characterization, ground and remote sensing methods

UNIT IV: Recent advances in biodiversity and ecology studies 15 hrs.

1. Strategies for ecological studies – Field, Experimental and Modelling.
2. Community sampling and sampling methods and measurements, Ecological parameters and its measurement, methods for water analysis and importance Radio-isotopes in ecology study.
3. Principles and methods of taxonomy, Methods in scientific collection of animal specimens, its preservation and labelling.
4. Zoological nomenclature, International Code for Zoological Nomenclature, ZooBank, its purpose and utilization.

5. Role computer in Collection, preservation and maintenance of animals for biodiversity study
6. Methods in Biodiversity and ecosystem conservation.

Suggested Readings:

1. Thompson S.W. (1966) – Selected Histochemical and Histopathological Methods. Pub. C.C.T.I., USA.
2. Gabe M. (1976) – Histochemical techniques. Pub. Springer Verlag, New York.
3. De Robertis *et al.* - Cell Biology. Pub. W.B.S.C.P., London.
4. Stoward P.J. – Fixation in Histochemistry. Pub. Chapman and Hill, London.
5. Roe, Crabtree and Kahn – DNA Isolation and Sequencing. Wiley.
6. Southwood Kt T.R.E. and P.A. Henderson (2000) Ecological Methods (3rd Edition), Blackwell Science Ltd. Oxford, UK.
7. David Wainhouse (2005) Ecological Methods in Forest Pest Management, Oxford University Press Inc., New York
8. Bruce McCune and James B. Grace (2002) Analysis of Ecological Communities, MjM Software Design, Gleneden Beach, Oregon.
9. Futuyama D. J. (2005) Evolution, Sinauer Associates Inc. Sunderland USA.

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Paper – III: (Elective Paper)

Total Marks – 100: (80 Marks for theory exam and for 20 Marks for presentation of review of published papers in National/ Internationals Journals for Ph. D. course work and 10 + 10 marks seminar and review of papers respectively for M. Phil. Course)

Title of Paper – ADVANCES IN PEST MANAGEMENT

Specific Objectives:

- To provide comprehensive knowledge on Insect Pests and their damage assessment
- To provide insights in Integrated Pest Management

UNIT I: **15 hrs.**

1. Definition of Pest, General characters, Habitats, Damage, Economic Threshold Level, Economic Injury Level, Causes for insect assuming pest status, Types of damage to plant by insects and their estimation.
2. Ecological Pest Management : Cultural, Mechanical, Physical, Genetic and Legal control of Insect Pests
3. Natural determinants of growth and metamorphosis
4. Insect behaviour and physiological interpretations: a. mating b. Oviposition c. Parental care

UNIT II: **15 hrs.**

5. Components of Biological control
   a. Biodiversity of biocontrol agents: Parasitoids, Predators and microbial agents
   b. Biology and habitat of Bio Control Agents
   c. Mass production of Biological Control Agents
   d. Utilization of Biological Control Agents in Biological Pest Control
   e. Insect parasitism, Insect host parasite relation and crop pest biocontrol agents interactions.

UNIT III: **15 hrs.**

6. Crop resistance to pest insects: Pest suppression by harmonious, coordinated and fortuitous biological means

7. Insecticides: Organic insecticides, mode of action of insecticides, metabolism of insecticides
8. Haemolymph proteins of insects and sex specific proteins of insects
9. Insect hormones and pheromones: Chemistry and functions of hormones and pheromones.

UNIT IV: **15 hrs.**

10. Advances in Integrated Pest Management.
11. Integrated Pest Management Models in-
    a. Paddy
    b. Sugarcane
    c. Cotton
    d. Grapes
    e. Vegetables

Recommended Reading:

1. Agrochemicals and Pest Management By T. V. Sathe: 2003.
2. Molecular Entomology By J. H. Law: 1987.
3. The Principles of Insect Physiology By U. B. Wigglesworth.
4. Biological Insect Pest Suppression By Coppel and Martins: 1971.
5. Insect Pest Predators By Sathe and Bhosale: 2001.
6. Insect Predators and Pest Management ByPatil and Sathe: 2003.
7. Biological Pest Control By Sathe and Bhoje 2000.
8. Indian Pest Parasitoids By Sathe et al., 2001.
9. FAO Manual on Sericulture: Vol. No. 2.
10. Introduction to Sericulture By Ganga and Chetty.
11. Text Book of Applied Entomology Vol. 2 By K. P. Srivastava.
12. Physology of Insecta Vol 1 to 5 By Morris Rockstein.
13. Comprehensive Insect Physiology, Biochemistry and Pharmacology Vol. 1 to 12 By Kerkut and Gilbert.
14. Modern Entomology By D. B. Tembhare
15. Entomology By Gillot, C.
16. IMMs General Text Book of Entomology By Richards and Davis.
17. Cotton pests and biocontrol agents by T.V. Sathe and G. S. Margaj, 2001. DPH, New Delhi.
18. Insects Pest Management Ecological Approach by T.V. Sathe and Jyoti Oulkar. 2010. DPH, New Delhi.

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Title of Paper – BIOLOGICAL INSECT PEST CONTROL

Specific Objectives: To provide thorough knowledge on Biological control, types of biological control agents, augmentation, field efficacy, Impact assessment and conservation techniques

UNIT I: **15 hrs.**

1. Historical account: Early history, mid history and recent developments.
2. General aspects of biological pest control, significance and scope (national, international).
3. Identification, habitats, distribution and morphological features of biological pest control agents.
   a. Parasitoids: Hymenoptera, Diptera, Strepsiptera and other insect orders.
   b. Predators: Insects (Coleoptera, Neuroptera, Hemiptera, Odonata, Lepidoptera, Thysanoptera), Invertibrates and Vertibrates.

UNIT II: **15 hrs.**

4. Biology of Biocontrol agents: *Trichogramma,* Ichneumonids, Braconids, Tachinids and Chalcids.
5. Rearing Techniques for following biocontrol agents:
   a. Parasitoids: *Trichogramma spp., Chelonus blackburni, Bracon brevicornis, Meteorus dichomeridis, Campoletis chlorideae*.
   b. Predators:
   Lady bird beetle: *Cryptolaemus montrouzieri*, Hemipterans, Lace wing: *Crysoperla carnea*, *Menochilus sp.*, Dragonflies, Toad, Shrews and Guppy fish.
   c. Bacteria: *Bacillus thurienginesis*
   d. Viruses: NPV.
   e. **Fungi:** *Beauveria bassiana*, *Metarhizium anisopale*

UNIT III: **15 hrs.**

6. Use of parasitoids and predators in classical biological insect pest control programmes (case studies in India and Abroad at least 3 cases from each group).
7. Economics and marketing of Biopesticides (Biocontrol agents)
8. Application of insect defence in insect pest management: Parasitoids, fungi, bacteria, viruses and nematodes.

UNIT IV: **15 hrs.**

Bio-control in Agro-ecosystem through Management

9. Introduction, Role and impact of Biological control agents and their Biological characteristics.
10. Role and impact strategies of biological control, Conservation and Habitat management.
11. Case studies of Biological Pest control in Paddy, Sugarcane, Cotton and Vegetables.

Recommended Reading:

1. Agrochemicals and Pest Management by T. V. Sathe: 2003
2. Biological Insect Pest Suppression by Coppel and Martins: 1971
3. Insect Pest Predators by Sathe and Bhosale: 2001
4. Insect Predators and Pest Management by Patil and Sathe: 2003
5. Biological Pest Control by Sathe and Bhoje 2000
6. Indian Pest Parasitoids by Sathe et al., 2001
7. Text Book of Applied Entomology Vol. 2 by K. P. Srivastava
8. Entomology by Gillot, C.
9. Imms General Text Book of Entomology by Richards and Davis
10. Cotton pests and biocontrol agents by T.V. Sathe and G. S. Margaj . 2001. DPH, New Delhi.
11. Insects Pest Management Ecological Approach by T.V. Sathe and Jyoti Oulkar. 2010. DPH, NewDelhi
12. Vermiculture and Organic farming by T. V. Sathe. 2004. DPH, New Delhi

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Paper - III (Elective Paper)

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Title of Paper – INSECT PARASITOIDS

Specific Objectives: To provide detail knowledge about concept of Insect Parasitoids, their biology, Tritrophic interactions, augmentation, impact analysis and conservation methods

UNIT I: **15 hrs.**

1. Definition of parasite, parasitoid and predator.
2. Insect parasitoid taxonomic relationships
3. Insect parasitoid biological relationships
4. Life cycle studies in selected parasitoids: Braconids, Ichneumonids, Chalcids and Trichogrammatids.
5. Mass production techniques for above representative parasitoids.

UNIT II: **15 hrs.**

6. Host finding and selection by Parasitoids:
    i. Habitat selection
    ii. Host location
    iii. Patch time allocations
    iv. Host age selection
    v. Host specificity
    vi. Host density
    vii. Parasitoid density
    viii. Intrinsic rate of increase in parasitoids.

UNIT III: **15 hrs.**

7. Physiological and Molecular Interactions of Parasitoids with their Hosts:
    i. Influence on reproductive strategies
    ii. Defence
8. Effect of parasitoids on Phytophagous Insect Communities.

UNIT IV: **15 hrs.**

9. Introduction, Role and impact of parasitoids, Biological characteristics, Case studies on successful release programs of parasitoids in Paddy, Sugarcane, Cotton and Vegetable ecosystems.
10. Conservation strategies for parasitoids andtheir Habitat management.

Recommended Reading:

1. Insect parasitoids by Waage. J. K. and Greathead D. 1986. Academic press, London.
2. Biotechnological Approaches in Entomology by T.V. Sathe. 2008.

Manglam Publications, Delhi, pp 1-244.
3. Host selection by insect parasitoids by Vinson S.B. 1976. Annual Reivew of Entomology 21, 109-134.
4. Biological Insect Pest Suppression By Coppel and Martins: 1971
5. Insect Pest Predators By Sathe and Bhosale: 2001
6. Insect Predators and Pest Management By Patil and Sathe: 2003
7. Biological Pest Control By Sathe and Bhoje 2000
8. Indian Pest Parasitoids By Sathe et al., 2001
9. Text Book of Applied Entomology Vol. 2 By K. P. Srivastava
10. Entomology By Gillot, C.
11. Imms General Text Book of Entomology By Richards and Davis
12. Cotton pests and biocontrol agents by T. V. Sathe and G. S. Margaj. 2001. DPH, New Delhi.
13. Insects Pest Management Ecological Approach by T. V. Sathe and Jyoti Oulkar. 2010. DPH, New Delhi
14.Vermiculture and Organic farming by T. V. Sathe. 2004. DPH, New Delhi. pp 1-122.

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Title of Paper – Biopesticides

Specific objectives: To inculcate the concept of Biopesticides and their role in Sustainable and eco-friendly insect pest management

UNIT I: Pests, Pesticides and Biopesticides **15 hrs.**

Introduction, Historical aspects of Pests and their outbreaks, scope of synthetic and bio-pesticides in Pest Management, pesticide paradox, Insecticide resistance, Insect resurgence, Pesticide poisoning, Contaminations of food commodities, Effect on non-target organisms.

UNIT II: Predators and parasitoids **15 hrs.**

Introduction, History and scope of bio-control agents, Biological control approaches, Predators and parasitoids, Augmentation, conservation, Field efficacy, Integrated biological control, Potential and constraints.

UNIT III: Microbial control **15 hrs.**

Introduction, History and scope of microbial control, Bacterial pathogens: *Bacillus thuringiensis*, *Bacillus sphaericus,* Viral pathogens: Baculovirus and its mode of action, Fungal pathogens, *Beauveria bassiana*, *Metarhizium anisopilae*, host range and Protozoan pathogens, Nematodes and their mode of action. Strategies for utilization of microbes.

UNIT IV: Botanical pesticides **15 hrs.**

Introduction, History and scope of botanical pesticides, Promising plant species and their extracts and essential oils, Behaviour and physiology affecting phytochemicals: Neem and Pongamia (Karanja), Mode of action, Hormonal mimics and antagonists, Biological origin of IPM concept, Biotechnological approaches for sustainable pest management.

Recommended readings:

1. Dhaliwal, G. S. and Arora, R. (2006) Role of phytochemicals in integrated pest management. Harwood Academy Publishers, Netherlands.

2. Ware, G. W. (2000) Pesticides: theory and application. Freeman and Company, New York
3. Dhaliwal, G. S. and Koul, O. (2008) Biopesticides and pest management. Kalyani Publishers, New-Dehli.
4. Vincent, C. (2002) Biopesticides the origin of vegetables. Lavoisier Publishers, New York
5. Dhaliwal, G. S. and Arora, R. (2006) Integrated pest management: concepts and approaches. Kalyani Publishers, New-Dehli.
6. Dwijendra Singh (2014) Advances in Plant Biopesticides (eBook) Springer New Delhi Heidelberg New York Dordrecht London.

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Title of Paper – BIODIVERSITY

Specific Objectives: Imparting significance of Biodiversity, prospects and conservation for its sustainable use.

UNIT I: INTRODUCTION TO BIODIVERSITY **15 hrs.**

1. Biodiversity Science and its assessment

1.1.Concept & definition, scope and constraints of biodiversity science.
1.2 Factors promoting high diversity.
1.3 Measures of Biodiversity- Species Richness and Species Evenness.
1.4 Biodiversity assessment Softwares

2. Values, Uses and indices of Biodiversity

2.1 Diversity indices, information statistic indices
2.2 Biodiversity values-Consumptive, Productive Use, Social, Ethical, Aesthetic & Option Values.
2.3 Uses of biodiversity.

UNIT II: LEVELS OF BIODIVERSITY **15 hrs.**

1. Species Diversity

1.1 Species inventory, history and origin, species richness, future ofspecies diversity studies.
1.2 Taxonomical, Biological, Ethological, Biochemical and Molecular Approches.

2. Genetic Diversity

2.1 Nature and origin of genetic variation,
2.2 methods based on DNA, chromosomes and the determinants of genetic diversity.

3. Ecosystem Diversity

3.1Classification

3.2Measuring ecosystem diversity

UNIT III: THREATENED TAXA, HOT SPOTS & ASSESSMENT OF BIODIVERSITY **15 hrs.**

1. Threats to Biodiversity

1.1 Issues relating to threats to biodiversity, approach to combat threats to biodiversity.

2. Listing of threatened Biodiversity
2.1 Red Data Book, Extinct, Endangered, Vulnerable, Rare and Intermediate

3. Biodiversity at Global, National and Local Level.

4. Biodiversity Hot Spots

UNIT IV: CONSERVATION BIOLOGY **15 hrs.**

1. Biodiversity Conservation:
1. 1 In –situ and Ex-Situ conservation,
1. 2 Role of universities and colleges in conservation, biodiversity awareness programs, biodiversity education resources, media and sustainable development.

2. Endangered and Endemic Species of India
2.1 Common Plant species
2.2 Common Animal species

3. Conservation through Gene Banking

Recommended readings:

1. An advanced Textbook on Biodiversity by K. V. Krishnamurti.

2. Biodiversity and biotechnology by Ray and Ray. 2010.

3. Biodiversity: Concept, Conservation and Biofuture by Mandal and Nandi. 2009.

4. Advancement in insect biodiversity by Rajiv K.Gupta.2004.

5. Molecular Entomology by J.H. Law 1987.

6. Text Book for Environmental Studies by Erach Bharucha/UGC, New Delhi. 2004

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Paper III: ANIMAL PHYSIOLOGY (Optional paper)

Total Marks -100: (80 Marks for theory exam and 20 Marks for Presentation of review of published papers in National / International Journal's for Ph. D course Work and 10 + 10 Marks seminar and review of papers respectively for M. Phil. Course)

Title of Paper – Ergonomics and Occupational Physiology

Specific Objectives:

i) To impart basic knowledge about mechanics of working equipment.
ii) To study changes in the biological parameters during exercise.

Unit-I: Nutrition and physical Performance **15 hrs.**

i) Biomechanics of Carbohydrates, Fat and Proteins.
ii) Role of Vitamin, mineral and water for physical Performance
iii) Energy value, Energy transfer, Energy expenditure during work.
iv) Physical exercise and Environmental Stress.
v) Balanced Diet and working physiology.

Unit-II: Applied and Exercise Physiology **15 hrs.**

i) Fundamentals of Physical exercise - Aerobic and Anaerobic power.
ii) Obesity, Starvation and working capacity.
iii) Weight control through Exercise and Diet.
iv) Physical fitness and Risk Factors.
v) Effect of Exercise on physical Fitness.
vi) Recovery from exercise.
vii) Doping- Biochemical and Molecular Interpretation.
viii) Physiological profiles- training and adoption.

Unit-III: Work performance and Environmental stress **15 hrs.**

i) Work performances against Biotic and Abiotic factors
ii) Exercise at medium to high altitude.
iii) Working in the water and in deep sea.
iv) Exercise and physico-chemical changes.
v) Exercise and body temperature managements.
vi) Physical and mental performances at extreme heat and cold
vii) Aging and work performances.
viii) Effect of meditation on work performances

Unit IV: Ergonomics of Bio-equipment **15 hrs.**

i) Man and women at work- physiological and biochemical changes during work.
ii) Ergonomics of Laboratory equipment's.
iii) Ergonomic equipment's and applications of cotton industry.
iii) Ergonomic equipment's and applications of fabrication industry.
iv) Ergonomic equipment's and applications of biomedicines.
v) Ergonomic equipment's and applications of constructions industry.

vi) Ergonomic equipment's and applications of coal and mining.
vii) Ergonomic equipment's and applications of agricultures and bio-fertilizers.

Recommended Reading:

1. Elder k. and Dale B. 200. In vitro fertilization 2nd (ED), Cambridge University Press.
2. Guyton A.C. 1986. Textbook of Medical Physiology 7th (ED), W.B. Saunders Company Igaku / Saunders.
3. Guyton A.C. 1992. Human Physiology and Mechanism of Diseases 5th (ED), W.B. Saundes Company Igaku / Saunders.
4. Kessele R.G. 1998. Basic Medical Histology, Oxford University Press New York.
5. Mcardle W., Katch V. and Katch F. 1986. Exercise Physiology, Lean and febiger, Philadelphia.
6. Sherwood L., Klandorf H. and Yancey P. animal Physiology from Genes to Organisms, Thomson Learning Academic Resource Centre.
7. Tortora G. and Grabwski S. 1993. Principle of anatomy and Animal Physiology, Harper Collins College Publishers.

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Paper III: ANIMAL PHYSIOLOGY (Optional paper)

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Title of Paper- Advances in Reproduction

Specific objectives:

i) To provide knowledge about reproduction and developmental physiology.
ii) To study modern technologies in the field of reproduction.

UNIT I: Reproductive System **15 hrs.**

i) Physiology of Male reproductive system.
ii) Physiology of Female reproductive System.
iv) Capacitation of Sperm- biochemical mechanism.
v) Birth control- Natural, Artificial and Environmental components.
vi) Aging and reproductive system.
viii) Genetic counselling and reproduction.

UNIT II: Development and Inheritance **15 hrs.**

i) Physiology of Gametogenesis and fertilization.
ii) Biology of Myometrium and Cervix.
iii) Prenatal Diagnostic test and advantages and disadvantages
iv) Endocrinology of Pregnancy and Parturition, control of parturition.
v) Physiology of Lactation inheritance.

UNIT III: Reproductive Technology **15 hrs.**

i) Artificial insemination, semen analysis sperm preparation for ICSI.
ii) Invitro-fertilization. (IVF)
iii) Mechanism of Cryopreservation.
iv) H.Y. Antigen and Sex Determination.
v) Pheromones and Reproduction: Signalling, Chemical communications.

UNIT IV: Endocrinology and reproduction **15 hrs.**

i) Pituitary hormones.
ii) Thyroid metabolic hormones.
iii) Male gonadal hormones.
iv) Femalegonadal hormones.
v) Physiological, Biochemical and Molecular Approches in above (i-iv).
vi) Pregnancy and developmental Physiology

Recommended Reading:

1. Devis A., Blakely A. and Kidd C. 2001. Human Physiology, Harcourt Publishers Limited, Churchill, Livingstone.
2. Elder K. and Dale B. 2000. In vitro fertilization 2nd (Ed), Cambridge University

Press.
3. Guyton A.C. 1986. Textbook of Medical Physiology 7th (Ed), W.B. Saunders Company Igaku / Saunders.
4. Guyton A.C. 1992. Human Physiology and Mechanism of Diseases 5th (Ed), W.B. Saunders Company Igaku / Saunders.
5. Kessel R.G. 1998. Basic Medical Histology, Oxford University Press New York.
6. Mcardle W., Katch V. and Katch F. 1986. Exercise Physiology, Lea and Febiger, Philadelphia
7. Sherwood L., Klandorf H. and Yancey P. 2005. Animal Physiology from Genes to Organisms, Thomson Learning Academic Resource Centre.
8. Tortora G. and Grabwski S. 1993. Principle of anatomy and Animal Physiology, Harper Collins College Publishers.

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Paper III: ANIMAL PHYSIOLOGY (Optional paper)

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Title of Paper – Animal Physiology and Toxicology

Specific Objective:

i) To find toxicity features of biochemical components.
ii) Assessment of toxicity limits for various chemical doses.

Unit –I: Scope of Toxicology **15 hrs.**

i) History, Definition, Disciplines of toxicology.
ii) General concept of toxicology.
iii) Toxicants and their Classification.
iv) Immunotoxicants: Types, Biochemical and Molecular mechanisms.
v) Animal models and toxicological methods

Unit –II: Environmental pollution and public health **15 hrs.**

i) Principal consequences of Environmental pollution.
ii) Air, Water and Soil pollution.
iii) Impact of Air, Water and Soil pollution against testing animal.
iii) Radioactive and noise pollution: Physiological and Molecular interpretation.
iv) Bioaccumulation and Biomagnification.

Unit –III: Toxicological testing methods **15 hrs.**

i) Toxic metals – types, characters of toxic metals.
ii) Toxicity tests – Acute toxicity test andchronic toxicity test.
iii) Toxicity testing methods – Behavioural, organ dependent.
iv) Toxicological testing with statistical methods.
v) Use of computer applications for toxicological testing.

Unit – IV: Dose-response relationship **15 hrs.**

i) Selection of doses, Types, cumulative response,threshold limit.
ii) Qualitative Mode of action of toxicants –atcellular level
iii) Quantitative Mode of action of toxicants – at biochemical level
iii) Modifying factors of toxicity of xenobiotic chemical.
iv) Biotransformation of toxicants – oxidation, reduction.
v) Resent techniques to calculate Dose-response relationship.

Recommended Reading:

1. Albert,A. 1960. Selective Toxicity, Wiley, New York.
2. Ariens,E.J., Simonis, A.M. and Offermerier, J. 1976. Introduction to General Toxicology.
3. Boyland, E. and Goulding, R. 1968. Modern Trends in Toxicology,

Butterworths, London.
4. Butte, G.C. (Ed) 1978. Principal of Ecotoxicology. SCOPE 12,ICUSSCOPE, John Wiley and Sons, New York.
5. Carsons, R. 1962 Silent Spring. Houghtan Mifflin, Boston .
6. Casarett, L.J. and Doull, J. 1980. Toxicology, A Basic Science of Poisons, 2ed. The Macmillian Co., New York.
7. Duffs,J.H. and Worth Howard, G.J. 1996. Fundamental Toxicology for Chemicals. Royal Society of Chemistry, Cambridge (U.K.).
8. Fairhall, L.T. 1969. Industrial Toxicology, Hafner Publishing Co., NewYork.'
9. Frank C. Lu. 1985. Basic Toxicology (Fundamentals, Target Organs and Risk Assessment). Hemisohere Publishing Corporation,Washington.
10. Pande, K., Shukla, J.P. and Trivedi, S.P. 2006. Fundamentals of Toxicology, New Central Book Agency (P) Ltd, Kolkata,India.

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Paper III: ANIMAL PHYSIOLOGY (Optional paper)

Total Marks -100: (80 Marks for theory exam and 20 Marks for Presentation of review of published papers in National / International Journal's for Ph. D course Work and 10 + 10 Marks seminar and review of papers respectively for M. Phil. Course)

Title of Paper – Systemic Pathology

Specific Objectives:

i) To study different types of pathological conditions.
ii) To analyse biochemical changes during inflammation.

Unit- I: Introduction to Pathology **15 hrs.**

i) Introduction, divisions and development of pathology.
ii) Pathogenesis of Cell Injury and Irreversible Cell Injury
iii) Changes after Cell Death.
iv) Adaptive Disorders- Atrophy, Hypertrophy, Hyperplasia, Metaplasia and Dysplasia.
v) Homeostasis- Water and Electrolyte Balance, Acid-Base Balance and Pressure Gradients and Fluid Exchanges.

Unit-II: Environmental and Nutritional Diseases **15 hrs.**

i) Environmental Diseases- Chemical and Drug Injury, Injury by Physical Agents.
ii) Metals and Trace Elements induced pathology
iii) Obesity and Starvation
iv) Disorders of Vitamins Diet and Cancer,
v) Protein-Energy Malnutrition,.
vi) Disorders of Vitamins.
vii) Diet and Cancer,

Unit- III: Cancer Biology **15 hrs.**

i) Nomenclature, Classification and Characteristics of Tumours
ii) Pathogenesis of Cancer, Epidemiologic Factors, Molecular Basis of Cancer, 201
iii) Carcinogens and Carcinogenesis- Chemical, Physical and Biologic Carcinogenesis.
iv) Pathological Diagnosis of Cancer
v) Cancer and Stem Cells.

Unit-IV: Inflammation and Healing **15 hrs.**

i) Introductions and types of Inflammatory Cells.
ii) Acute Inflammation- Factors, Morphology, Effects and Fate
iii) Chronic Inflammation- Factors, Morphology, Effects and Fate.
iv) Healing- Regeneration and Repair mechanism
v) Healing in Specialised Tissues
vi) Stem Cell Concept of Healing

Recommended Reading :

1. Devis A., Blakely A. and Kidd C. 2001. Human Physiology, Harcourt Publishers Limited, Churchill, Livingstone.
2. Elder K. and Dale B. 2000. In vitro fertilization 2nd (Ed), Cambridge University Press.
3. Guyton A.C. 1986. Textbook of Medical Physiology 7th (Ed), W.B. Saunders Company Igaku / Saunders.
4. Guyton A.C. 1992. Human Physiology and Mechanism of Diseases 5th (Ed), W.B. Saunders Company Igaku / Saunders.
5. Kessel R.G. 1998. Basic Medical Histology, Oxford University Press New York.
6. Mcardle W., Katch V. and Katch F. 1986. Exercise Physiology, Lea and Febiger, Philadelphia
7. Sherwood L., Klandorf H. and Yancey P. 2005. Animal Physiology from Genes to Organisms, Thomson Learning Academic Resource Centre.
8. Tortora G. and Grabwski S. 1993. Principle of anatomy and Animal Physiology, Harper Collins College Publishers.
9. Textbookof PATHOLOGY- Harsh Mohan, Jaypee Brothers Medical Publishers (P) Ltd. ISBN: 978-93-5152-369-7, *Seventh Edition:* 2015.

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Paper - III (Elective Paper)

Total Marks – 100: (80 Marks for theory exam and for 20 Marks for presentation of review of published papers in National/ Internationals Journals for Ph.D. course work and 10 + 10 marks seminar and review of papers respectively for M.Phil. Course)

Title of Paper – Insect Anatomy and Physiology

Specific objectives: To provide deep insights about organ systems and their mode of function in Insects

UNIT I: The Integumentary, Digestive and Circulatory System **15 hrs.**

1. Integument
- 1.1 Structure of integument
- 1.2 chemical composition of cuticle
- 1.3 Moulting
- 1.4 Sclerotization
- 1.5 Functions of the cuticle

2. Alimentary canal, digestion and absorption
- 2.1 Alimentary canal and associated glands.
- 2.2 Digestion and Absorption

3. Nutrition
- 3.1 Nutritional requirements
- 3.2 Balance of nutrients
- 3.3 Symbiotic microbes

4. Circulatory system, Haemolymph and immune systems
- 4.1 Circulatory system
- 4.2Immunity
- 4.3 Circulatory mechanism

UNIT II: Reproduction and development **15 hrs.**

1. Reproductive system: male
- 1.1 Anatomy of the internal reproductive organs
- 1.2 Spermatozoa and spermatogenesis
- 1.3 Transfer of sperm to the female
- 1.4 Other effects of mating
- 1.5 Sperm capacitation

2. Reproductive system: female
- 2.1 Anatomy of the internal reproductive organs
- 2.2 Oogenesis
- 2.3 Ovulation
- 2.4 Fertilization of the egg

2.5 Oviposition

3. The egg and embryology

3.1 The egg
3.2 Embryology
3.3 Viviparity
3.4 Polyembryony
3.5 Parthenogenesis
3.6 Pedogenesis

4. Postembryonic development

4.1 Hatching
4.2 Larval development
4.3 Metamorphosis
4.4 Control of postembryonic development
4.5 Polyphenism
4.6 Diapause

UNIT II: The Ventilatory System and Homeostasis **15 hrs.**

1. Gaseous exchange

1.1 Tracheal system
1.2 Spiracles
1.3 Cutaneous respiration
1.4 Gaseous exchange in terrestrial insects
1.5 Gaseous exchange in aquatic insects
1.6 Gas exchange in endo-parasitic insects
1.7 Respiratory pigments
1.8Physiology of Respiration

2. Excretion and salt and water regulation

2.1 Excretory system
2.2 Nitrogenous excretion
2.3 Urine production
2.4 Water regulation
2.5 Non-excretory functions of the Malpighian tubules
2.6 Nephrocytes
2.7 Detoxification

UNIT IV: Communication **15 hrs.**

A. Physiological Co-ordination within the Insect

1. Nervous system

1.1 Basic components
1.2 Functional Morphology of Nervous system
1.3Nervous integration

2. Endocrine system

2.1 Endocrine organs

2.2Functions
2.3Transport of hormones
2.4 Mode of action of hormones

B. Perception of the Environment

1. Vision

1.1 Compound eyes
1.2 Functioning of the eye
1.3 Vision
1.4 Dorsal ocelli
1.5 Stemmata

2. Sense Organs

2.1 Mechanoreception
2.2 Chemoreception

3. Effector organs

3.1 Sound Production
3.2Bioluminescence

Recommended 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, Fourth ed. Cambridge University Press, New York. pp.770. http://dx.doi.org/10.1017/CBO9780511818202
3. Gillot, C., 1980. Entomology.Plensum Press, New York. pp729.
4. Gullan, P. G. and Cranston, P. S., 2010.The insects.An outline of Entomology.Wiley Blackwell.pp. 565.
5. Imms, A.D., 1963. A general textbook of entomology. Ninth ed. revised by Richards O.W. and Davies R.G., Asia Publishing House, Mumbai. pp.886.
6. Mani, M.S., 1982. General Entomology. Third and Revised ed. Oxford and IBH Publishing Co., New Delhi. pp.912.
7. Snodgrass, R.E., 1935. Principles of insect morphology. McGraw-Hill Book Company, New York. 667pp.
8. Tembhare, D.B., 2010. Techniques in Life Sciences.Himalaya Publishing House, Mumbai. 463pp.
9. Triplehorn, C.A. and Johnson N.F., 2005.Borror and Delong'sIntroductionto the Study of Insects. 7th Ed.Brooks/Cole, a division of Thomson Learning, Inc. 864pp
10. Wigglesworth, V.B., 1972. The principles of insect physiology. Seventh ed. English language book Society and Chapman and Hall Ltd. London. 827pp.

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Paper - III (Elective Paper)

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Title of Paper: EXTERNAL ANATOMY AND SYSTEMATICS OF INSECTS

Specific Objective: To impart knowledge on Evolution, body organization and Taxonomy of Insects

UNIT I: ORIGIN, PHYLOGENY, FOSSILS AND SYSTEMATICS OF INSECTS **15 hrs.**

1 Origin, phylogeny and insect fossils.
2 Methods In Entomology
1.1 Collection, Preservation and curation
1.2 Identification
3. **Biological Classification**
3.1 Classification Characters, types and components of biological classification
4. Nomenclature
4.1 Scientific names and common names
5. Types

UNIT II: BODY PLAN **15 hrs.**

1. Head
1.1 Segmentation and Structure
1.2 Neck
1.3 Appendages
2. Thorax
2.1 Structure and segmentation
2.2 Legs
2.3 Wings
3. Abdomen
3.1Segmentation and Structure
3.2 Modification

UNIT III: CLASSIFICATION OF INSECTS **15 hrs.**

1 Entognathus Apterygota
1.1 Orders: Protura,Collembola, Diplura

2 **Ectognathus Apterygota**
2.1 Orders: Archeognatha, Thysanura

3 Paleopterous Exopterygota
3.1.1 Orders: Ephemeroptera, Odonata

4 Neopterous Exopterygota-I
4.1 Orders: Plecoptera ,Phasmida, Orthoptera, Dermaptera, Isoptera, Blattaria, Mantodea.

5 Neopterous Exopterygota-II
5.1 Orders: Mallophaga, Anopleura, Thysanoptera, Hemiptera

UNIT IV: CLASSIFICATION OF INSECTS **15 hrs.**

1 Endopterygota-I
1.1.1 Orders: Coleoptera, Neuroptera

2 Endopterygota-II
2.1.1 Orders: Siphonoptera, Diptera, Lepidoptera

3 Endopterygota-III
3.1 Order: Hymenoptera

NOTE: The information about the Orders of the insect Classification are excpected upto families with suitable examples.

Recommended Reading:

1. Ambrose, D.P., 2015. The Insects. Structure, Function and Biodiversity. Kalyani publishers, New Delhi. 626pp.
2. Gillot, C., 1980. Entomology. Plensum Press, New York. pp729.
3. Gullan, P. G. and Cranston, P. S., 2010. The insects. An outline of Entomology. Wiley Blackwell. pp. 565.
4. Imms, A.D., 1963. A general textbook of entomology. Ninth ed. revised by Richards O.W. and Davies R.G., Asia Publishing House, Mumbai. pp.886.
5. Mani, M.S., 1982. General Entomology. Third and Revised ed. Oxford and IBH Publishing Co., New Delhi. pp.912.
6. Snodgrass, R.E., 1935. Principles of insect morphology. McGraw-Hill Book Company, New York. 667pp.
7. embhare, D.B., 2010. Techniques in Life Sciences. Himalaya Publishing House, Mumbai. 463pp.
8. Triplehorn, C.A. and Johnson N.F., 2005. Borror and Delong'sIntroduction to the Study of Insects. 7th Ed. Brooks/Cole, a division of Thomson Learning, Inc. 864pp

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Title of Paper: Biology of Aging

Specific objective: To impart knowledge of phenomenon of aging form Organ level to molecular level.

UNIT I: Aging at whole animal level **15 hrs.**

a) Pathobiolgy- influence of age on life expectancy
b) Abnormal cell growth (Neoplasia) and aging
c) Nutrition and aging
d) Physiological stress of exercise, environmental stress and aging

UNIT II: Aging at tissue level and organ level **15 hrs.**

a) Neuronal and Autonomic aspects of aging
b) Aging in salivary glands
c) Aging of reproductive systems
d) Immunity and aging

UNIT III: Aging at Cellular level **15 hrs.**

a) Cell division and the cell cycle
b) Cell longevity: *In vivo*
c) The cellular basis for biological aging
d) Cellular transformation and *in vivo* aging

UNIT IV: Molecular basis of aging **15 hrs.**

a) Theories of aging
b) Causes of aging
c) Damage caused by free radical on protein, lipid and DNA
d) Lipid peroxidation and linlipfuschinogenesis
e) Strategies against aging – Enzymatic and non-enzymatic antioxidants

Recommended Readings:

• Handbook of: The Biology of Aging. Edited by C. E. Finch and L. Hayflick
• The Biology of Aging: Observations & Principles by Robert Arking
• Genes and Aging by M. S. Kanungo
• Senescence, Longevity, and the Genome by Caleb Finch
• Evolutionary Biology of Aging by Michael Rose
• Molecular Biology of Aging Edited By Leonard P. Guarente, Linda Partridge, Douglas C. Wallace
• Ageing Research Reviews
• Biogerontology

• Experimental Gerontology
• Journal of Gerontology
• Beckman, Kenneth B., and Bruce N. Ames. The Free Radical Theory of Aging Matures. *Physiol. Rev.* 78: 547–581, 1998.
• Brunk UT, Terman A. The mitochondrial-lysosomal axis theory of aging: accumulation of damaged mitochondria as a result of imperfect autophagocytosis. Eur J Biochem 2002; 269(8):1996-2002.
• Terman A, Brunk UT. Oxidative stress, accumulation of biological 'garbage', and aging. Antioxid Redox Signal. 2006 Jan-Feb;8(1-2):197- 204.
• Ward TH Trafficking through the early secretory pathway of mammalian cells. Methods Mol Biol. 2007;390:281-96.

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Title of Paper: Secretary Cells

Specific objective: To impart knowledge regarding the phenomenon of cell secretion

UNIT I: **15 hrs.**

A. Overview of cell secretion and its activity
   i. Endocrine
   ii. Exocrine
   iii. Paracrine
   iv. Autocrine
B. Types of ligands and receptors
   i. Membrane receptors
   ii. Cytoplasmic receptors
   iii. Nuclear receptors
C. Molecular mechanism of ligand- receptor interaction.
D. Ligand turnover

UNIT II: Secretory pathways **15 hrs.**

A. Overview of Secretory pathway
B. Translocation of secretory proteins across ER membrane
C. Insertion of membrane proteins into the ER membrane
D. Past translational modification and quality control in the rough ER
E. Protein glycosylation in the ER and Golgi complex
F. Golgi and post Golgi protein sorting and proteolytic processing receptor mediated endocytosis and the sorting of of internalized protein
G. Molecular mechanisms of vesicular traffic

UNIT III: Histochemical and immunocytochemical approaches to study secretory product **15 hrs.**

A. Detection of glycoproteins
B. Detection of Mucopolysaccharides
C. Detection of secretory product by fluorescent tagged antibody
D. Detection of secretory product by enzyme tagged antibody

UNIT IV: Specialized secretory cells **15 hrs.**

A. Salivary gland cells light microscopic structure, Electron microscopic structure: salivary flow, major polypeptides secreted by salivary acini,

B. Neurosecretory cells

C. Neurons as unique and unusual cells: Vesicular transport of neurotransmitter, Release of neurotransmitter, Inactivation of neurotransmitter, Reuptake of neurotransmitter by presynaptic neuron.

D. Pancreatic cells, Plasma cells and Goblet cells:

i. Pancreatic cells: Light microscopic and electron microscopic structure of acinar cells and Endocrine cells- Alpha cells, Beta cells, Delta cells

ii. Plasma cells: Light microscopic and electron microscopic structure, secretion of antibodies

iii. Goblet cells: Light microscopic and electron microscopic structure, secretory activity and functions

Recommended Readings:

1. Molecular cell biology by Lodish, Baltimore et al.
2. The cell: A molecular approach- Cooper
3. Cell and molecular biology by Gerald Karp
4. The cell by Bruce Albert
5. Immunology by Kuby
6. Regulated Exocytosis in Mammalian Secretory Cells: Supplement 31: Handbook of Physiology Cell Physiology DolaSengupta, Jack A. Valentijn, James D. Jamieson
7. Presley JF. Imaging the secretory pathway: the past and future impact of live cell optical techniques. BiochimBiophysActa. 2005 Jul 10;1744(3):259-72.
8. *Lippincott-Schwartz J, Roberts TH, Hirschberg K.* Secretory protein trafficking and organelle dynamics in living cells. *Annu Rev Cell Dev Biol. 2000; 16:557-89.*
9. *Dahm T, White J, Grill S, Füllekrug J, Stelzer EH.* Quantitative ER <--> Golgi transport kinetics and protein separation upon Golgi exit revealed by vesicular integral membrane protein 36 dynamics in live cells. *MolBiol Cell. 2001 May; 12(5):1481-98.*
10. *Ben-Tekaya H, Miura K, Pepperkok R, Hauri HP.* Live imaging of bidirectional traffic from the ERGIC. [J Cell Sci. 2005]
11. *Füllekrug J, Scheiffele P, Simons K.*VIP36 localisation to the early secretory pathway. *J Cell Sci. 1999 Sep; 112 (Pt 17):2813-21.*
12. *Lippincott-Schwartz J, Cole N, Presley J.* Review Unravelling Golgi membrane traffic with green fluorescent protein chimeras. *Trends Cell Biol. 1998 Jan; 8(1):16-20.*
13. Archives of immunology Edited by British Society of Immunology

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Paper - III (Elective Paper)

Total Marks – 100 (80 Marks for theory exam and for 20 Marks for presentation of review of published papers in National/ Internationals Journals for Ph.D. course work and 10 + 10 marks seminar and review of papers respectively for M.Phil. Course)

Title of the paper: Cellular stress response

Specific objective:

ii) To understand stress responses at cellular and molecular level
iii) To understand molecular basis of inflammation
iv) To understand cellular and molecular alterations during cell death
v) To understand role of mild stressors' in strengthening the homeo-dynamic capacity of the cells

UNIT I: Cell stress **15 hrs.**

1. ER stress
2. Unfolded protein response
3. Ubiquitin mediated proteolysis
4. Role of autophagy in cell stress
5. Role of mitochondria in cell stress
6. Hormesis

UNIT II: Inflammation and repair **15 hrs.**

1. Acute inflammation: cellular events
2. Chronic inflammation: cellular events
3. Wound Healing: Factors affecting wound healing and mechanism of wound healing
4. Repair: scar formation, Fibrosis

UNIT III: Cell degeneration and death **15 hrs.**

1. Atrophy
2. Aplasia
3. Hypoplasia
4. Necrosis: causes, ultrastructural changes during degeneration and necrosis
5. Apoptosis: Cellular alterations and significance
6. Intrinsic apoptotic pathway
7. Extrinsic apoptotic pathway

UNIT IV: Hyperplasia, neoplasia and cancer **15 hrs.**

1. Hyperplasia
2. Neoplasia
3. Molecular regulation of cell cycle, cell cycle check points
4. Loss of function mutations in cancer
5. Gain of function mutations in cancer
6. Hyperplasia: causes and consequences
7. Mechanism of tumor Angiogenesis

Reference books:

1. Molecular Cell Biology by Lodish H. F. *et al.*
2. Molecular biology of the cell by Bruce Alberts
3. Muir's Textbook of Pathology Levison DA.
4. Immunology by Kuby
5. The biology of cancer by Weinberg RA

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Title of Paper: Advances in Fisheries and Aquaculture

Specific Objectives: To provide knowledge on enhaced nutrition to human population
To develop international marketing strategies for fisheries and aquaculture

UNIT I: **15 hrs.**

1) Freshwater Resources and their Conservation.
   i) Proper use of freshwater resources.
   ii) Restoration of freshwater ecosystem.
   iii) Large man-made lakes: Present controversy in India.
   iv) Management of ponds & Village tanks.
2) Lakes and Reservoirs
   i)Important physico-chemical processes.
   ii) Evolution of ecosystem.

UNIT II: **15 hrs.**

1) Eutrophication of aquatic systems.
   i) Causes, consequences and control.
   ii) Important parameters & indicators.
   iii) Eutrophication of flowing waters.
   vi) Potential of fishing and fish production in the freshwaters.
   v) Role of fish in human nutrition.
2) Freshwater fisheries:
   i) Riverine fisheries of India.
   ii) Reservoir fisheries and its potential in India.
   iii) Craft and gears used in inland fisheries.
   iv) Extension program and Fishermens co-operative societies.

UNIT III: **15 hrs.**

   i) Riverine fisheries and pollution problems.
   ii) Biological monitoring of pollutants in aquatic ecosystems.
   iii) Fisheries resources of large lakes and reservoirs.
   iv) Management and conservation.
   v) Fish Byproducts and Marketing.

UNIT IV: **15 hrs.**

1) Aquaculture:
   i) Recent advances in Inland Fisheries developments in India.
   ii) Polyculture of Indian and Exotic carps.
   iii) Culture techniques for freshwater prawns.

iv) Culture of brackishwater finfish and shellfish and their economics.
v) Aquaculture: Marketing and Economics in India.

2) Major capture fisheries & their potential in India.
i) Coastal fishery.
ii) Off shore fishery.
iii) Crustacean fishery.
iv) Molluscan fishery.

Recommended readings :

1. Prasad B. (1962) The wealth of India- Fish and Fisheries . CSIR, New Delhi
2. Lanham (1962) The Fishes. Columbia Uni. Press. New York.
3. Central Marine Fisheries Institute, Bulletin 32& 33, Cochin, India, 1982.

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Title of Paper: Fish Physiology

Specific Objective: To provide detailed understanding of body organization and its physiology in fishes

UNIT I: Digestive system **15 hrs.**

1 Food and Feeding
2 Gastromatic index
3 Physiology of digestion
4 Adaptive modifications in digestive tract of fishes

UNIT II: Excretion and Osmoregulation **15 hrs.**

1 Fish kidney
2 Physiology of excretion
3 Osmoregulation and ionic balance
4 Endocrine control of excretion and osmoregulation

UNIT III: Reproductive system **15 hrs.**

1 Male and female reproductive organs
2 Seasonal changes in testicular and ovarian cycles
3 Hormonal regulation of fish reproduction
4 Environmental influence on fish reproductive cycle

UNIT IV: Specialized organs in fishes **15 hrs.**

1 Light producing organs
2 Electric organs in fishes
3 Electric organs in fishes
4 Poison glands in fishes

Recommended readings:

1 Fish Physiology by Hoar and Randal (Vol I to XII)
2 Encyclopedia of Aquaculture by RR Stickney
3 An introduction to fishes by SS Khanna
4 Fish and Fisheries by K Pandey and JP Shukla
5 Aquaculture research needs for 2000 AD by JK Wang and PV Dehadrai
6 General and Applied Ichthyology by S. K. Gupta and P. C. Gupta

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Title of Paper: Environmental Biology

Specific Objective:

i. To provide detailed understanding of system ecology.
ii. To develop sustainable strategies for ecosystem protection and conservation

UNIT I: **15 hrs.**

1) Population Ecology:
   i) Properties of Population – Density, Natality, Mortality.
   ii) Population age distribution.
   iii) Population growth.
   iv) Cyclic Oscillations in Population.
   v) Carrying Capacity of Population.
   vi) Environmental resistance.
2) Wildlife:
   i) Causes of threatening the wildlife.
   ii) Wildlife distribution in India.
   iii) Endangered fauna from India.
   iv) Protected areas – National Parks, Sanctuaries & Biosphere reserves.
   v) Wildlife protection Act 1972.
   vi) Wildlife management techniques.
   vi) Special wildlife conservation projects- Project tiger, Crocodile breeding project, Musk deer breeding project & Gier lion sanctuary project.

UNIT II: **15 hrs.**

3) Natural Resources:
   i) Classification of resources.
   ii) Need of conservation of natural resources.
   iii) Renewable natural resources – Water, Fishery, Wildlife, Forest & Grass lands.
   iv) Non-renewable natural resources – Top Soil, Land, Mineral resources.
   v) Conservation of water resources.
4) Human Ecology:
   i) Man and his environment.
   ii) Humans impact on nature.
   iii) Degradation of environment due to – Mining, Industries, Agriculture & Urbanization.
   iv) Environmental problems – Global warming, Eutrophication.
   v) Socio-economic aspects of environmental problems.
5) Limnology:
   i) Types of aquatic ecosystems – Fresh water & Marine water.

ii) Zonation in marine ecosystem – Littoral, Limnetic & Profendal zones.
iii) Physico-chemical parameters of aquatic ecosystem – pH, Temperature,Dissolved Oxygen, Dissolved Carbondioxide, Nitrates, Phosphates & Hardness.
iv) Planktons forms – Freshwater & marine water.
v) Conservation of aquatic ecosystems.

UNIT III: **15 hrs.**

6) Biodiversity:
i) Introduction – Species diversity, Genetic diversity & Ecosystemic diversity.
ii) Economic importance of biodiversity.
iii) Priorities of biodiversity conservation.
iv) Need of biodiversity conservation.
v) Conservation of biodiversity.
vi) Biodiversity hot spot from India.
vii) Conventions on biodiversity.

7) Toxicology:
i) Toxicity evaluation methods.
ii) Bioaccumulation and biomagnification of pollutants in aquatic ecosystem.
iii) Resistance development in organisms to pollutants.

UNIT IV: **15 hrs.**

8) Limiting Factors:
i) Lebigs law of minimum.
ii) Shelfords law of tolerance.
iii) Combined concept of limiting factors.
iv) Limiting factors – Radiation, Water, Temperature, Gases, Soil biogenic salts.Fire, Anthropogenic factors.

9) Environmental Education & Sustainable Development:
i) Formal education system.
ii) Non-formal education systems.
iii) Importance of environmental education in solving environmental problems.
iv) Role of NGO in minimising environmental crises.
v) Concept of sustainable development.
vi) Resource conservation & sustainability.
vii) Sustainable use of natural resources.

Recommended readings:

1 Usher –Biological management and conservation
2 Hanson- Animal Diversity
3 Saharaia- Wildlife in India
4 Duffy- Grassland Ecology and Wildlife management
5 Odum- Fundamentals of Ecology

NEW/ REVISED SYLLABUS FOR
M.Phil. / Ph.D. Course Work: ZOOLOGY
(Introduced from June, 2020 onwards)

Paper - III (Elective Paper)

Total Marks – 100 (80 Marks for theory exam and for 20 Marks for presentation of review of published papers in National/ Internationals Journals for Ph.D. course work and 10 + 10 marks seminar and review of papers respectively for M.Phil. Course)

Title of Paper: Trends in sericulture

Specific Objectives: i) To provide advanced rearing techniques of domestic & Vanya silkworms for improving productivity

ii) To inculcate knowledge on byproducts of Sericulture

UNIT I: **15 hrs.**

1. Eri Silk Industry:
   a. Present status and scope in India
   b. Caster cultivation
   c. Pests and diseases of caster
   d. Seed production technology of *Philasomia ricini*
   e. Rearing Technology for *Philasomia ricini*
   f. Pests and diseases of *P. ricini*

UNIT II: **15 hrs.**

1. Tasar Silk Industry:
   a. Present status and scope in India
   b. *Antheraea mylitta* food plants
   c. Pests and diseases of *A.mylitta*
   d. Eco-races and diversity of *A.mylitta*
   e. Seed Technology of silkworms and pests & diseases of *A. mylitta*
2. Muga Silk Industry:
   a. Present status and scope in India
   b. Food plants of *Antheraea assama* and their cultivation
   c. Pests and diseases of *A. assama* food plants
   d. Seed Technology
   e. Rearing Technology, pests and diseases of *A. assama*

UNIT III: **15 hrs.**

1. New Trends in mulberry *Bombyx mori* silk production:
   a. Present status and scope in India
   b. Seed Technology
   c. Rearing Technology
   d. Silk Technology:

i. Reeling and weaving of mulberry silk
ii. Reeling and weaving of non- mulberry silk

2. i. Structure and development of silk gland
ii. Silk bio- synthesis

UNIT IV: **15 hrs.**

1. Newer Trends in Sericulture:
   a. Mulberry and silkworm hybrids: Scope and Status
   b. Silkworm as a tool for Lab Technology
   c. Use of RELF Technology in Sericulture
   d. Medicines, cosmetics and handicrafts out of mulberry and silkworm
   e. Quality cocoon and silk production Technology
   f. Various eco- friendly technologies in sericulture for crop productivity
   g. Sericulture and epidemiology
   h. Health hazards in sericulture

Reference Books:

1. FAO Manuals on Sericulture, Central silk board
2. Sathe, T. V. (1998): Sericultural Crop Protection
3. Sathe, T. V. and Jadhav, A. D. (2001): Sericulture and Pest Management
4. Sathe, T. V. and Thite, S. H. (2004): Shoot Feeding and Sericultural Trends
5. Mohanti, P. K.: Tropical Cocoon Production
6. M. S. Jolly: BivoltineGrainage for tropics
7. M. S. Jolly: Economics of Sericulture under irrigated conditions
8. CSR & TI, Mysore: Tips for successful silkworm cocoon crops
9. Sarkar, D. C. (1988): Ericulture in India (CSB, Bangalore)
10. Jolly, M. S., Sen, S. K. and Ahsan, M. M. (1974): Tassar Culture, CSTRI, Ranchi
11. Annual Report of Central Muga Research Institute, Assam
12. Ullal, S. R. (1968): Sericulture in USSR A study report, CSB, Bangalore
13. Boyer, H. W. and Nicosia, S. (1979): Genetic Engineering, NHBP, Amsterdam, New York
14. Ganga, G. and Chetty, S. J. (1997): An Introduction to Sericulture. (2nd Edition) O & IBH Publication Company Ltd. New Delhi
15. Sinha, H. The Development of India Silk Oxford and IBH Publication Company Ltd. New Delhi
16. Mohan Rao M. M. (1988): A Text Book of Sericulture BSP Publication, Sultan Bazard, Hyderabad.