NEW/ REVISED SYLLABUS FOR
M.Phil/ Ph.D. Course Work : ZOOLOGY
(Introduced from June 2011 onwords)

Paper - I

Total Marks - 100

Title of Paper - Research Methodology in Zoology

Specific Objectives, if any: To develop technical skill in Research students.

UNIT 1 – **No. of Lectures – 15**

An Insight into Research

What is Research?, Objectives of Research, Significance of Research, Research Techniques, Finding Research Materials, Scientific Writings, History of Scientific Writing, Writing a Review Paper and Thesis.

Biostatistics

Samples and Population, Statistics and Parameters, Random Sampling, Statistical Inference, Testing Hypothesis, Estimation, Measurement of Central Tendencies, Measures of Variations, Correlation, Regression, Testing Significance: Student 't' test, Chi Square test.

UNIT 2 – **No. of Lectures – 15**

Cell and Tissue Staining Techniques

a) Elements of microtomy- pre-microtomy processes, microtomy process, post microtomy process.
b) In situ and histological staining techniques- Whole mount (In situ) staining techniques, microbial staining techniques.
c) Histochemistry- General histochemistry, enzyme histochemistry, immunochemistry.
d) Microscopy- Light microscopy, electron microscopy, three dimensional microscopy, camera lucida.

Physiological and biochemical techniques

a) Hematological Techniques- Blood composition, hematological techniques.
b) Biochemical methods- Centrifugation, spectroscopy, chromatography, electrophoresis.
c) Detection of carbohydrates and lipids- Chemistry and classification, qualitative and quantitative detection.
d) Detection of enzymes- Chemistry and classification, qualitative and quantitative detection.

UNIT 3 – **No. of Lectures – 15**

Recent trends in biotechniques

a) Nucleic acid biotechniques- Salient features, laboratory biotechniques.
b) Immunological techniques- Elements of immunology, immune reaction, immunological techniques.
c) Radioimmunoassay of hormones- Principle of radioimmunoassay, chemistry and classification of hormones, radioimmunoassay (RIA) techniques for hormones.
d) Animal cell and tissue culture- Salient features, cell culture techniques, cell culture and immunocytochemistry.

UNIT 4 – **No. of Lectures – 15**

Computer applications

a) Applications of computer in Taxonomy and biodiversity study
b) Use of computer in biostatistics
c) Collection, preservation and maintence of animals for biodiversity study
d) Proteomics- proteomic analysis by mass spectrometry and genomics- genome wide analysis of gene structure and expression.

Recommended Reading:

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.

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Paper - II

Total Marks - 100

Title of Paper - Research Advances in Zoology

Specific Objectives, if any: i. To develop skill in Research students.

ii. To popularize and adopt newer and recent trends in research activities.

UNIT 1 – **No. of Lectures – 15**

The development of Animal form.

i) Ontogeny
ii) Morphology
iii) Evolution

Chemical signaling in the body.

i) Signaling molecules and their control.
ii) Target Cells.
iii) Response to signals.
iv) Extrinsic signal.

Molecular phylogeny genome mapping and Immune system in insects.

UNIT 2 – **No. of Lectures – 15**

Medical Zoology.

i) Brief introduction to pathogenic microbes.
a) Viruses, Rickettsiae, Spirochetes and bacteria.
ii) Pathogenic protozoans.
iii) Pathogenic helminths.
iv) Arthropods as a vector agents.
v) Biodiversity of vector mosquitoes.
vi) Trends in diagnosis of Malaria, JE and Dengue.
vii) Chikungunia treatment.
viii) Genomics of Dengue virus and virus- host interactions.
ix) Insect vector control strategies.

Enzymic protective Mechanisms in the body.

i) Blood clotting.

ii) Protection against ingested foreign chemicals.
iii) Protection of the body against its own proteases.
iv) Protection against reactive oxygen species.

UNIT 3 – **No. of Lectures – 15**

Biotechnology.

i) Enzymology of Genetic engineering.
ii) Cloning Vehicles.
iii) Analysis and expression of cloned genes in host cell.
iv) Gene libraries.
v) Changing genes.
vi) Application and impact of recomb - DNA technology.
vii) Ethical issues and biosafety regulation.
viii) Vermiwash production and applications.
ix) Production of transgenic insects and other animals.

Insect Biotechnological Approaches

i) Mulberry Silkworm rearing : Chowki rearing, Late age, Shoot feeding and Branch feeding
ii) Wild Silk Technology: Silkworm diversity and Silk Production.
iii) Bee Keeping: Pollination and Crop yield.
iv) Production technique for Microbial Control agents.

UNIT 4 – **No. of Lectures – 15**

Aquaculture.

i) Philosophy and history of aquaculture.
ii) Different aquaculture practices in the world.
iii) Aquaculture in India, its potential and future.
iv) Economics of aquaculture in India.
v) Problems of aquaculture.

Applied Limnology – Measurement.

i) Case studies of take Washington, Lake Tahose, Shagawa Lake.
ii) Case studies of Thames River, Nile River, Ganga river.
iii) Nutrient diversion, weed control.
iv) Management of water bodies.
v) Pisces and Biological control of mosquitoes.

Recommended Reading:

1. Sathe, Sathe and Mahendra (2011)- Mosquito Borne Diseases. Mang. Pub., Delhi. pp 1-342.
2. Julian, Crampton and Paul (1991)- Insect molecular Science. Academic press, London.
3. Kawane and Sathe (2011)- Wild Silk Technology. DPH, New Delhi. pp 1-224.
4. Beament et al., (1964)- Advances in insect physiology vol.-2. Academic Press, London.

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Paper - III (Elective Paper) **Total Marks – 100**

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Title of Paper – ADVANCES IN PEST MANAGEMENT

Specific Objectives, if any: To control pest insects.

To develop new control measures for insects.

UNIT 1 – **No. of Lectures – 15**

1. Natural determinants of growth and metamorphosis
2. Insect behavior and physiological interpretations:
    a. Mating
    b. Oviposition
    c. Parental care
3. Genetic control of insect pests and recent advances
4. Pheromonal and hormonal pest control of insect pests

UNIT 2 – **No. of Lectures – 15**

1. Ecological Pest Management
2. Components of Biological control
    a. Biodiversity of biocontrol agents: Parasitoids, Predators and microbial agents
    b. Biology and habitat of BCA
    c. Mass production of BCA
    d. Utilization of BCA in Biological Pest Control
3. Advances in Integrated Pest Management.

UNIT 3 – **No. of Lectures – 15**

1. Crop resistance to pest insects: Pest suppression by harmonious, coordinated and fortuitous biological means
2. Insecticides: Organic insecticides, mode of action of insecticides, metabolism of insecticides
3. Haemolymph proteins of insects and sex specific proteins of insects
4. Industrial Entomology:
    a. Sericulture: Commercial Silk Production, Recent Trends, Marketing.

b. Apiculture: Modern methods of bee keeping, Role in pollination and crop yield.
c. Lac culture: New Trends in lac culture, Marketing.
d. Insect as a human food: Insect Diversity, preparation of food, marketing.

UNIT 4 – No. of Lectures – 15

1. Insect hormones and pheromones: Chemistry and functions of hormones and pheromones.
2. Bioluminescence in insects: Light producing organs and biochemistry of light production.
3. Insect development: Embryonic and post embryonic development: Morphological, biochemical and physiological basis.
4. Insect parasitism, Insect host parasite relation and crop pest biocontrol agents interactions.

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 By Patil 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, NewDelhi.
18. Insects Pest Management Ecological Approach by T.V.Sathe and Jyoti Oulkar. 2010. DPH,NewDelhi

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Title of Paper – BIOLOGICAL INSECT PEST CONTROL

Specific Objectives, if any: To control insect pests ecofriendly.

UNIT 1 – No. of Lectures – 15

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 other insect orders.
b. Predators: Insects (Coleoptera, Neuroptera, Hemiptera, Odonata, Lepidoptera, Thysanoptera), Invertibrates and Vertibrates.

UNIT 2 – No. of Lectures – 15

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, Copidosoma koehleri, 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.

UNIT 3 – **No. of Lectures – 15**

6. Use of parasitoids and predators in classical biological insect pest cotrol 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 4 – **No. of Lectures – 15**

9. Crop pest biocontrol agents interactions.
10. Recent advances in biological pest control programmes

Recommonded 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, NewDelhi.
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, NewDelhi

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Title of Paper – INSECT PARASITOIDS

Specific Objectives, if any: To control insect pests ecofriendly.

UNIT 1 – **No. of Lectures – 15**

1. Defination 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.
6. Case studies of pest suppression utilizing parasitoids in India and abroad.

UNIT 2 – **No. of Lectures – 15**

7. 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. Intrensic rate of increase in parasitoids.

UNIT 3 – **No. of Lectures – 15**

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

UNIT 4 – **No. of Lectures – 15**

10. Insect Nematode Parasites:
    i. Taxonomic relationships
    ii. Biological relationships
    iii. Examples of insect pests supressions
    iv. Utilizing Nematodes

11. Insect protozon parasites
    i. Taxonomic relationships
    ii. Biological relationships
    iii. Examples of insect pests supressions
    iv. Utilizing Nematodes

Recommonded 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, NewDelhi.
13. Insects Pest Management Ecological Approach by T.V.Sathe and Jyoti Oulkar. 2010. DPH,NewDelhi
14. Vermiculture and Organic farming by T.V.Sathe. 2004. DPH, NewDelhi. pp 1-122.

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Title of Paper – Biopesticides

Specific Objectives, if any: Sustainable and Eco- friendly insect pest Management.

Unit -I **15 hrs**
Pests, Pesticides and Biopesticides

Pest problems in agriculture, Pesticides paradox: Insecticides resistance, Insect resurgence, Pesticide poisoning, Contamination of food commodities, Effect on non – target organisms.

Unit-II **15 hrs**
Predators and Parasitoids

Introduction, Historical perspective, Biological control agents : predators and parasitoids, Biological control approaches, Augmentation, conservation, integrated Biological control.

Unit- III **15 hrs**
Microbial control

Introduction, Historical perspective, Bacterial pathogens: *Bacillus thuringiensis, Bacillus spaericus,* Viral pathogens: Baculovisus, Fungal pathogens and protozoan pathogens.

Unit-IV **15 hrs**
Botanical pesticides

Introduction, Historical perspective, promising plant, Major botanical pesticides, insecticidal phytochemicals, Behavior and physiology affecting phytochemicals, Hormonal mimics and antagonists, pest resistance to

phytochemicals. Biological origin of IPM concept, IPM: A Paradigm shift, Biotechnological approaches Sustainable pest management.

Recommended reading:

1. Ware, G. W. (2000) Pesticides: Theory and application. Freeman and Company, New York
2. Dhaliwal, G.S. and Koul, O. (2008) Biopesticides and pest management.
3. Dhaiwal, G.S. and Arora, R (2006) Integrated pest management: concepts and approaches. Kalyani Publishers, New- Delhi.
4. Dhiwal, G.S. and Arora. R. (2006) Role of Phytochemicals in integrated pest management. Harwood Academy Publishers, Netherlands.
5. Vincent, C. (2002) Biopesticides the origin of vegetables. Lavoisier Publishers, New York.

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Title of Paper – BIODIVERSITY

Specific Objectives, if any: Sustainable and eco-friendly use of Biodiversity.

UNIT I **15 hrs**

BIODIVERSITY SCIENCE **:**Concept & definition, scope and constraints of biodiversity science. Evolution of biodiversity, factors promoting high diversity, global biodiversity.

MEASURES OF BIODIVERSITY-Diversity indices, information statistic indices, biodiversity values.

UNIT II **15 hrs**

SPECIES DIVERSITY**:** Species inventory, history and origin, species richness, future of species diversity studies, threats to species diversity.

Taxonomical, Biological, Ethological, Biochemical and Molecular Approches

GENETIC DIVERSITY: Nature and origin of genetic variation, methods based on DNA chromosomes and determinants of genetic diversity.

ECOSYSTEM DIVERSITY **:**Classification, Measuring ecosystem diversity, megabiodiversity centers, hot spots.

UNIT III **15 hrs**

THREATS TO BIODIVERSITY**:** Issues relating to threats to biodiversity, approaches to combat threats to biodiversity, values and uses of biodiversity, loss of biodiversity

carbon dating

Biodiversity and adaptation : Morphological, Physiological, Molecular.

UNIT IV **15 hrs**

BIODIVERSITY CONSERVATION**:**Goals, In –situ and Ex-Situ conservation, role of universities and colleges in conservation, biodiversity awareness programmes, biodiversity education resources, media and sustainable development.

Recent Trends in insect biodiversity conservation, protection and utilization

Recommended readings:

1. An advanced Textbook on Biodiversity by K.V.Krishnamurti.
2. Biodiversity and biotechnology by Ray and Ray.
3. Biodiversity by Mandal and Nandi
4. Advancement in insect biodiversity by Rajiv K.Gupta.2004.
5. Biotechnological approaches in Entomology by T.V. Sathe 2008.
6. Molecular Entomology by J.H. Law 1987.

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Paper – III (Optional paper) Total Marks -100

Comparative Animal Physiology

(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 – EXERCISE AND OCCUPPATIONAL PHYSIOLOGY

Unit-I Nutrition for human Performance. 15 hrs

i) Carbohydrates, Fat and Proteins – Biochemical reaction and molecular interpretations
ii) Vitamin, mineral and water.
iii) Energy value, Energy transfer, Energy expenditure.
iv) Energy expenditure during Hot and Physical activity.
v) System of Energy delivery and Utilization.
vi) Food and Nutrition relating to work exercise and Environmental Stress.
vii) Diet Therapy

Unit-II Applied and Exercise Physiology 15hrs

i) Energy for Exercise
ii) Enhancement of Energy capacity- Aerobic and Anaerobic power.
iii) Obesity
iv) Muscular strength
v) Fundamentals of Physical exercise
vi) Responses of body to exercise
vii) Recovery from exercise
viii) Special aids to performance and conditioning.
ix) Weight control through Exercise and Diet- Physiological and Molecular Approach.

x) Physical fitness and Risk Factors.
xi) Effect of Exercise on Health and Fitness.
xii) Sport and Recreation
xiii) Doping- Biochemical and Molecular Interpretation.

Unit-III Work performance and Environmental stress.

i) Exercise at medium to high altitude.
ii) Exercise and physico-chemical stress.
iii) Exercise and Biological stress.
iv) Environmental factors: Biotic and Abiotic (with Biochemical and Molecular interpretation.

Effect of physical Training

i) Physiological profiles, training and adoption.
ii) Physiological and Biochemical changes.

Unit-IV Ergonomics and Occupational Physiology.

i) Man- Machine and Environment.
ii) Man at work.
iii) Women at work.
iv) Aging Occupational stress.
(Fundamental, Physiological, Biochemical and Molecular Approaches of above i-iv).

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 (Optional paper) Total Marks -100

Comparative Animal Physiology

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Title of Paper- PHYSIOLOGY OF REPRODUCTION

Unit- I Reproductive System. 15hrs

i) Male reproductive system.
ii) Role of apididymis in Male fertility.
iii) Female reproductive System.
iv) Capicitation of aparmatozoa in the Female.
v) Birth control- Natural, Artificial and Environmental components.
vi) Aging and reproductive system.

Unit-II Development and Inheritance. 15hrs

i) Development during pregnancy.
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. 15hrs

i) Artificial insemination, semen analysis sperm preparation for ICSI.
ii) Invitrofertilization. (IVF)
iii) 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 sex hormones.
iv) Female sex hormones.
Physiological, Biochemical and Molecular Approches in above (i-iv).
v) Pregnancy and Neonatal 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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Title of Paper – Toxicology

Unit –I Scope of Toxicology. 15 hrs

i) History, Definition, Disciplines of toxicology.
ii) General concept of toxicology.
iii) Toxicants and their classification.
iv) Cardio toxicants, Immunotoxicants : Types, Biochemical and Molecular mechanisms.

Unit –II Environmental pollution and public healt 15 hrs

i) Principal consequences of Environmental pollution.
ii) Impact of Air, Water and Soil Pollution on Human Health : Physiological, Biochemical and Molecular components.
iii) Air, water and soil pollution.
iii) Radioactive and noise pollution : Physiological and Molecular interpritation.
iv) Bioaccumulation and Biomagnification.

Unit –III Toxicological testing methods and Pesticide Metabolism 15hrs

i) Toxic metals – Principal of metal toxicity, important toxic metals, effect on human kand animals.
ii) Toxicity tests – Based on number and condition, Based on exposure period, Acute toxicity test, Chronic toxicity test, toxic effects.
iii) Toxicological testing methods – Behavioral, respiratory, Kidney, Liver, Skin fuction tests.

iv) Metabolism of Pesticides of following group : Chrorinated Hydrocarbons, O.P., Carbamates, Dinitrophenols, Synthetic pyrathroids and Biopesticides.

Unit – IV Dose-response relationship 15 hrs

i) Selection of doses, Types of dose-response relationship, cumulative response, threshold limt.
ii) Mode of action of toxicants – Protein, Lipid and Carbohydrates at cellular level.
iii) Modifying factors of toxicity of xenobiotic chemical.
iv) Biotransformation of toxicants – oxidation, reduction, hydrolysis, conjugation reaction.

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,ICUS-SCOPE, 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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Title of Paper: Biology of Aging

Specific objectives if any: To impart knowledge of phenomenon of aging form organ to molecular level.

Unit-I Aging at whole animal level

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

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

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 Aging at molecular level

a) Damage by free radicals to macromolecules
b) Macromolecular metabolism during aging

c) Metabolic changes and their significance in aging

d) Lipid peroxidation and 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.

New/ Revised Syllabus for
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Paper III (Elective Paper) Total Marks: 100

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Title of Paper: Secretory Cells

Specific objectives if any: To impart the knowledge regarding the phenomenon of cell secretion

Unit- I

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

A. Translocation of secretory proteins across ER membrane
B. Molecular mechanisms of vesicular traffic
C. Techniques for studying the secretory pathway
D. Secretory pathways in polarized cells

Unit- III Histochemical and immunocytochemical approaches to study secretory product

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

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:

- Molecular cell biology by Lodish, Baltimore *et al.*
- The cell: A molecular approach- Cooper
- Cell and molecular biology by Gerald Karp
- The cell by Bruce Albert
- Immunology by Kuby
- Regulated Exocytosis in Mammalian Secretory Cells: Supplement 31: Handbook of Physiology Cell Physiology Dola Sengupta, Jack A. Valentijn, James D. Jamieson

- Presley JF. Imaging the secretory pathway: the past and future impact of live cell optical techniques. Biochim Biophys Acta. 2005 Jul 10;1744(3):259-72.
- *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.*
- *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. *Mol Biol Cell. 2001 May; 12(5):1481-98.*
- *Ben-Tekaya H, Miura K, Pepperkok R, Hauri HP*. Live imaging of bidirectional traffic from the ERGIC. [J Cell Sci. 2005]
- *Füllekrug J, Scheiffele P, Simons K.*VIP36 localisation to the early secretory pathway. *J Cell Sci. 1999 Sep; 112 (Pt 17):2813-21.*
- *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.*
- Archives of immunology Edited by British Society of Immunology

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Title of Paper: Cell Biology

Specific objectives if any: To impart the knowledge of various cell processes at molecular level

Unit I

1) Compartmental diversity within the cell and its maintenance.
    i) Molecular mechanisms of vesicular transport.
    ii) Maintenance of compartment identity.
2) Bioenergetics:
    i) Cellular metabolisms.
    ii) Energy transformations.
3) Molecular Motors.
    i) P - loop N TPase super family
    ii) Myosins.
    iii) Kinesin & Dynein.
    iv) A rotary motor (in bacteria).

Unit II

1) Signal transduction pathways in cell.
    i) G-proteins
    ii) Cyclic AMP.
    iii) Ca+2 as messenger.
    iv) Protein kinases.

2) Ionic basis of membrane excitability.
    i) Ionic channels.
    ii) Electrical properties of membrane.

3) Control of gene expression.
    i) Organization of gene.
    ii) Role of gene regulatory proteins.

iii) Role of DNA-binding proteins.
iv) Chromatin structure & control of gene expression.

Unit III

1) Garbage disposal unit inside the cell.
    i) Lysosomes.
    ii) Peroxisomes.
2) Cell and Defense.
    i) Cellular basis of immunity.
    ii) SER and Biotransformation.(Biotics & xenobiotics)
3) Cell renewal:
    i) By simple duplication.
    ii) By stem cells.
    iii) By pluripotent stem cells.
4) Cell death.
    i) Apoptosis Type I
    ii) Apoptosis Type II

Unit IV

1) Evolution of cellular organization of life.
    i) First form of life.
    ii) RNA world.
    iii) DNA world.
    iv) Prokaryotic & Eukaryotic cellular evolution.
2) Genomics and Evolution.
    i) Principles of genome annotation.
    ii) Evolution of macromolecular sequences.
    iii) Building phylogenetic trees.
    iv) Phylogenetic, cladistics and ontology.
3) Proteomics and Drug designing.
    i) Conceptual models of protein structure.
    ii) Three dimensional structure classification and protein function.
    iii) Structural alignment.
    iv) Pharmainformatics & drug designing.

Recommended Readings:

- Molecular cell biology by Lodish, Baltimore *et al.*
- The cell: A molecular approach- Cooper
- Cell and molecular biology by Gerald Karp
- The cell by Bruce Albert

NEW/REVISED SYLLABUS FOR

M.Phil/Ph.D. Course Work: Zoology

(Introduced from June 2011 onwards)

Paper III (Optional Paper) **Total Marks – 100**

Aquaculture and Fisheries

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

Title of Paper: Advances in Fisheries and Aquaculture

Specific Objectives, if any: To provide nutrition to human population

To develop international marketing to fishers 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 Reservoirsi)
   Important physico-chemical processes.
   ii) Evolution of ecosystem.

Unit –II **15hrs**

Eutrophication of aquatic systems.
i) Causes, consequences and control.
ii) Important parameters & indicators.
iii) Eutrophication of flowing waters.

i) Potential of fishing and fish production in the freshwaters.
ii) Role of fish in human nutrition.

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

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

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.

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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Aquaculture and Fisheries

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

Title of Paper: Fish Physiology

Specific Objectives, if any: To provide understanding of fish physiology

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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Aquaculture and Fisheries

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Title of Paper: Environmental Biology

Specific Objectives, if any: To Protect Environment

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

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SERICULTURE

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

Title of Paper: Trends in sericulture

Specific Objectives, if any: To encourage Sericulture Industries

Unit –I **15 hrs**

1. Eri Silk Production:

a. Historical account
b. Caster cultivation
c. Pests and diseases of caster
d. Seed technology of *Philasomia ricini*
e. Rearing Technology for *Philasomia ricini*
f. Pests and diseases of *P. ricini*

Unit- II **15 hrs**

2. Tropical Tasar Sericulture:

a. Historical account
b. Tasar silkworm food plants
c. Pests and diseases of tasar silkworm
d. Eco-races and diversity of tasar silkworms
e. Seed Technology of worms and pests and disease of *Antharaea mylitta*

3. Muga Sericulture:

a. Historical account
b. Food plants of *Antharaea assama* and their cultivation
c. Pests and diseases of *A. assama* food plants
d. Seed Technology
e. Rearing Technology of worms and pests and diseases of worms

Unit- III **15 hrs**

4. New Trends in Bivoltine mulberry silkworm:

a. Scope
b. Seed Technology
c. Rearing Technology

5. (i) Structure and development of silk gland
(ii) Silk synthesis and factors controlling silk synthesis
(iii) Silk Technology: Reeling and weaving of mulberry silk
(iv) Reeling and weaving of non mulberry silk

Unit – IV **15 hrs**

6. Newer Trends in Sericulture:

a. Mulberry silkworm hybrids: Scope and Status
b. Use of DNA recombinant Technology
c. Use of RELF Technology in Sericulture
d. Use of PCR Technology in Sericulture
e. Geomagnetism and silk production
f. Vermiwash use in sericulture for crop productivity
g. Sericulture and epidemiology
    i. Usthama/Bronchitis
    ii. AIDS
    iii. Allergy etc

Reference Books:

1. FAO Manual on Sericulture
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: Bivoltine Grainage 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.