M.Sc. Zoology syllabus

(With effect from Academic year 2018-19 for first semesters)

Structure of M.Sc. Zoology course

A two years M.Sc., programme is formulated for developing competent Zoology. The programme obliges students to read original publications and envisages significant inputs in Laboratory work, communication skills, creativity, planning, execution and critical evaluation of the scientific data. The course titles have been carefully chosen to represent the core courses and the specialization introduced in the two years course of Zoology are :- Invertebrate & Vertebrate , Gamete and Development biology, Endocrinology, Genetics & Evolution, Cell biology & Microbiology, Tools & Techniques, Metabolic regulations & cell functions, Animal Physiology, Biostatistics & Bioinformatics, Environmental Biology, Animal behaviour & Neurobiology, Enzymology, Toxicology & Pharmocalogy, Animal Biotechnology, Immunology and Molecular Biology inconsonance with the objectives of the University. The courses formulated have a Zoological slant than biological and are up to date. The course is fine tuned in order to enhance the job opportunities of the students.

M.Sc., Zoology

I Semester

S**. No**	Course	Marks		Total Marks
		Internal	External	
ZTH101	Structural anatomy of Invertebrate and vertebrate	25	75	100
ZTH102	Genetics & Evolution	25	75	100
ZTH103	Cell Biology & Microbiology	25	75	100
ZTH104	Tools and Techniques in Biology	25	75	100
ZTH105	Structural anatomy of Invertebrate and vertebrate & Genetics & Evolution (Practical-1)			100
ZTH106	Cell Biology & Microbiology & Tools and Techniques in Biology (Practical-2)			100

II Semester

S.**No**	Course	Marks		Total Marks
		Internal	External	
ZTH201	Metabolic Regulation & Cell Function	25	75	100
ZTH202	Developmental Biology	25	75	100
ZTH203	Animal Physiology	25	75	100
ZTH204	Biostatistics and Bioinformatics	25	75	100
ZTH205	Metabolic Regulation & Cell Function & Developmental Biology (Practical-1)			100
ZTH206	Animal Physiology & Biostatistics and Bioinformatics (Practical-2)			100

Non-core: ZTH 207: **Animal diversity and Economic Zoology**

III Semester

S.**No**	Course	Marks		Total Marks
		Internal	External	
ZTH301	Environmental Biology	25	75	100
ZTH302	Molecular Biology	25	75	100
ZTH303	Endocrinology	25	75	100
ZTH304	Enzymology	25	75	100
ZTH305	Environmental Biology & Molecular Biology (Practical-1)			100
ZTH301	Endocrinology & Enzymology (Practical-2)			100

Non-core: ZTH 307: Biodiversity and Wild Life Management: 100

IV Semester

S**. No**	Course	Marks		Total Marks
		Internal	External	
ZTH401	Animal Biotechnology	25	75	100
ZTH402	Toxicology And Pharmacology	25	75	100
ZTH403	Neurobiology And Animal Behaviour	25	75	100
ZTH404	Immunology	25	75	100
ZTH405	Animal Biotechnology & Toxicology And Pharmacology (Practical-1)			100
ZTH406	Neurobiology And Animal Behaviour & Immunology (Practicals-2)			100

EVALUATION

Evaluation is done by continuous assessment and semester- end examinations. Theory, practical (Lab work) will be carried out under the supervision of faculty.

I Semester

1. Four theory papers	4X100 =	400
2. Structural anatomy of Invertebrate and Vertebrate & Genetics & Evolution		100
3. Cell Biology & Microbiology & Tools and Techniques in Biology		100
	Total =	600

II Semester

1. Four theory papers	4X100 =	400
2. Metabolic Regulation & Cell Function & Developmental Biology		100
3. Animal Physiology & Biostatistics and Bioinformatics		100
	Total =	600
Non – Core: **ZTH 207**: Animal diversity and Economic Zoology		100

III Semester

1. Four theory papers	4X100 =	400
2. Environmental Biology & Molecular Biology		100
3. Endocrinology & Enzymology		100
	Total =	600
Non – Core: **ZTH 307**: Biodiversity and Wild Life Management		100

IV Semester

1. Four theory papers	4X100 =	400
2. Animal Biotechnology & Toxicology and Pharmacology		100
3. Neurobiology and Animal Behaviour & Immunology		100
	Total =	600

Grand total Marks = 600+600+600+600= **2400**

Non-core 200 Marks will not be counted for deciding percentage/grade

YOGI VEMANA UNIVERSITY :: KADAPA

M.Sc. Zoology

Revised Syllabus Effective from the Academic Year 2018-19

Semester- I

ZTH 101 : STRUCTURAL ANATOMY OF INVERTEBRATA & VERTEBRATA

UNIT -I

1.1 Species concept, International code of Zoological nomenclature, Taxonomical procedures, New trends in taxonomy
1.2 Acoelomata, Pseudocoelomata, Coelomata, Protostomia and Dueterostomia
1.3 Patterns of feeding and digestion in Porifera and Coelenterata
1.4 Feeding in Polychaeta, Mollusca and Echinodermata

UNIT-II

2.1 Structure of Gill, Lungs and Trachea
2.2 Circulatory system in Annelids, Arthropods and Mollusca
2.3 Advanced nervous system- Annelida, Arthropoda and Mollusca
2.4 Larval forms of Crustacea and Echinodermata

UNIT-III

3.1 Vertebrate integument and its derivatives: skin structure and functions, glands, scales, horns, claws, nails, hoofs, feathers and hairs
3.2 Evolution of heart
3.3 Evolution of aortic arches
3.4 Comparative account of respiratory organs

UNIT-IV

4.1 Evolution of Urinogenital system in vertebrate series
4.2 Organs of Olfaction, taste and lateral line system
4.3 Comparative anatomy of the brain in relation to its functions
4.4 Spinal cord and cranial nerves in mammals

List of Practicals

1. Museum study of all phylum wise representatives (Protozoa to Echinoderm)
2. Museum study of all class wise representatives (Cyclostomes & Mammals)
3. Virtual dissection of crab nervous system
4. Virtual dissection of *Poiceloceros* digestive, reproductive and nervous system
5. Virtual dissection of cockroach reproductive and nervous system
6. Virtual dissection of weberian ossicle and brain in *Labeo rohita*
7. Virtual dissection of cranial- Nerves of *Labeo rohita*
8. Virtual dissection of cranial Nerves of frog/ toad
9. Virtual dissection of circulatory (arterial & venous) system in *Calotes*
10. Virtual dissection of Urinogenital system in *Calotes*.

SUGGESTED READING MATERIAL

1. Hyman, L.H. The Invertebrates. Vol.1. Protozoa through Ctenophora, Mc Graw Hill Co., New York.
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York&London.
4. Hyman, L.H. The Invertebrates. Vol.8. Mc Graw Hall Co., New York and London.
5. Hyman, L.H. The Invertebrates. Vol.2 Mc Graw Hall Co., New York and London.
6. Barmes, R.D. Invertebrate Zoology, III edition. W.B. Saunders Co., Philadelphia.
7. Russel-Hunter, W.D. A biology of higher invertebrates, the Macmillan Co. Ltd., London.
8. Hyman, L.H. The Invertebrates smaller coelomate groups, Vol. V. Mc. Graw Hill, Co., New York
9. Read, C.P. Animal Parasitism. Prentice Hall Inc., New Jersey~! .
10. Sedwick, A. A student text book of Zoology, Vol.II and III. Central Book Depot, Allahabad.
11. Parker, T.J., Haswell, W.A. Text Book of Zoology, Macmillan Co., London.
12. Alexander, R.M. The Chordata. CambridgeUniversity Press, London
13. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinbourgh.
14. Bourne, G.H. The structure and functions of nervous tissue. Academic Press, New York.
15. Carter, G.S. Structure and habit in vertebrate evolution –Sedwick and Jackson, London.
16. Eecles, J.C. The understanding of the brain. McGraw Hill Co., New York and London.
17. Kingsley, J.S.Outlines of Comparative Autonomy of Vertebrates. Central Book Depot, Allahabad.

ZTH 102: GENETICS & EVOLUTION

UNIT – I

1.1 Principles of Mendelian Inheritance- Identification of DNA as a genetic material, Gene as a unit of expression.

1.2 Interaction of genes: Multiple alleles, ABO groups & Rh factor, Epistasis; Incomplete dominance, codominance; Complementary genes, duplicate genes, lethal genes

1.3 Linkage, Recombination and gene mapping

1.4 Mutations: a) spontaneous and b) induced mutations; c) Molecular basis of mutations

UNIT – II

2.1 a) Numerical and Structural abnormalities of human chromosomes and syndromes
b) Human karyotype and human genome

2.2 Sex linked inheritance

2.3 Pedigree analysis

2.4 Eugenics: a) Positive eugenics, Artificial insemination, sperm banks
b) Negative eugenics, Amniocentesis, consanguinity, Genetic counseling

UNIT – III

3.1 Theories of organic evolution- Emphasis on Darwinism and Lamarckism

3.2 Neo-Darwinism

3.3 Role of isolating mechanisms

3.4 Models of speciation (Allopatric, sympatric and parapatric)

UNIT – IV

4.1 A detailed account on destabilizing forces (i) Natural selection (ii) Mutation (iii) Genetic drift

4.2 Phylogenetic gradualism & punctuated equilibrium

4.3 Micro & Macro evolution

4.4 Gene Evolution and Amino acid sequence and phylogeny

List of Practicals

1. Blood grouping
2. Rh factor demonstration
3. Mendelian ratios and its related Problems
4. Karyotyping
5. Syndrome charts – demonstration
6. Demonstration of Barr bodies
7. Problems on Hardy Weinberg's law

SUGGESTED READING MATERIAL

1. Genetics – Monrve W. Strickberger. 3rd Ed., May, 2000.
2. Genetics – K.B. Ahluwallia – 1985.
3. Principles of Genetics – E.J. Gardner. M.J. Simmons & D.P. Snustad.
4. Molecular Biology of genes – Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz &A.M.
5. Weiner. The Benjamin Cummings publishing company. Inc. Tokyo.
6. Basic Human Genetics – E.J. Mange, Arthur P. Mange. Indian Print, 1997.
7. Genetic disorders of Man by M.R. Goodman.
8. An introduction to modern genetics by Ch. Waddinsgton.
9. Dobzhansky, Th. Genetics and origin of species, Columbia University press.
10. Dobzhansky, Th., F.J. Ayala, G.L. Stebbins and J.M. Valentine EVOLUTION: Surjeet publications, New Delhi latest edition.
11. P.A. Moody Introduction to Evolution II ed/latest: Kalyani publishers, New Delhi.
12. Hartl, D.L. A primer of population genetics, Sinauer Associatesm Inc., Massachusetts.
13. Peter Volpe E. Understanding Evolution, University Book stall, New Delhi.
14. An introduction to genetic analysis. Griffiths, A.J.F., J.H. Miller, D.T. Suzuki, R.C. Lewontin & W.M. Gelbark, W.H. Freeman and Company, New York.

ZTH 103: CELL BIOLOGY & MICROBIOLOGY

UNIT – I

1.1 Cell organelles- Ultrastructure and functions: Cell Membrane, ER and Golgi complex,

1.2 Cell organelles- Ultrastructure and functions: Nucleus, Mitochondria, Ribosomes and Lysosomes

1.3 Cell Division and Regulation- Mitosis, Meiosis, Cell Cycle and its regulation

1.4 Cell death and proliferation – Apoptosis: definition, morphological and biochemical differences between apoptosis and necrosis, mechanism (internal and external signals) and significance. Brief account of biology of cancer.

UNIT – II

2.1 Cell signaling: Models of cell-cell signaling (steroid receptors, nitric oxide and carbon monoxide)

2.2 Functions of cell surface receptors (G-protein coupled receptors, Tyrosine kinases, cytokine receptors, receptors linked to other enzymatic activities), Pathways of intracellular signal transduction (cAmp pathways, cyclic cGMP, phospholipids and Ca^{2+}, Ras, Raf and MAP kinases)

UNIT-III

3.1 History and Scope of Microbiology

3.2 Microbial nutrition, growth and their control

3.3 Normal microbial flora of human body-skin, nose, respiratory tract, stomach, intestine, urinogenital tract.

3.4 Microbial diseases and their control

a) Bacterial diseases - Tuberculosis, Plague, Anthrax,

b) Viral diseases - AIDS, Rabies, Hepatitis

c) Fungal diseases - Cutaneous mycoses, Sub-cutaneous mycoses and Systemic mycoses, d) Protozoan diseases - Amoebiasis and Malaria

UNIT-IV

4.1Microbiology of fermented food (Diary Products, Meat and Fish, Microorganisms as sources of food

4.2 Industrial Microbiology (Types of fermentation process, Alcoholic beverages)

4.3 Industrial productions - Lactic acid and Glutamate

4.4 Therapeutic compounds – Antibiotics (Penicillin), Steroids and Industrial enzymes (Amylase and Protease).

List of Practicals

1. Mitosis – Onion root tips
2. Meiosis in flower buds/ Grasshopper testis
3. Giant chromosome in Chironomus Larva
4. Effect of colchicine on mitosis
5. Staining techniques–simple, Gram's staining
6. Isolation of microorganisms
7. Wet mount preparations
8. Antibiotic sensitivity tests

SUGGESTED READING MATERIAL

1. Cell Biology (Fundamentals and Applications) By Gupta / Jangir, 2001; Agrobios, India.
2. Cell and Molecular Biology by EDR De Robertis and EMR De Robertis Jr, Indian Edition, B.I. Publicaitons, Pvt. Ltd.
3. The Cell (A Molecular Approach) by Geoffrey M. Cooper, 2nd Edn. 2000, ISBN.
4. Text Book of Microbiology, by R. Aananthnarayan &C.K. Jayaram Panikar, 4th Edition, Orient Longmen, Hyderabad, 1990.
5. General Microbiology by C.B. Powar & H.F. Daginawala 1st Edition, Himalaya Publishing House, Bombay, 1982.
6. Elements of Microbiology, by M.J. Pelzar, Jr & E.C.S Chan International students Edition, 1981, MCGRAW-Hill international Book Company, New Delhi.
7. Microbiology C.M. Presscots, J.P. Harley & D.A Klein Mc Graw Hill. WCB

ZTH 104: TOOLS AND TECHNIQUES IN BIOLOGY

UNIT-I

1.1 Microscopy: Types of microscopes – Phase contrast microscope, Fluorescence microscope; Electron microscope – TEM and SEM

1.2 Centrifugation – basic principles, Types of rotors, high speed and ultracentrifuge

1.3 Principles of spectroscopy, Laws of Light absorption, applications of Colorimetry, Spectrophotometry

1.4 Measurement of pH and biological Buffers

UNIT-II

2.1 Chromotography – paper chromatography – thin layer chromatography

2.2 Ion exchange chromatography and affinity chromatography

2.3 Introduction to FPLC and HPLC

2.4 Radio isotope techniques – types of radio isotopes, detection and measurement of radiaoactivity, Applications of radio isotopes in biological sciences and safety measures

UNIT-III

3.1Microtomy and staining procedures– types of microtomes, types of stains, staining procedures of biological materials

3.2 Electrophoresis: SDS-PAGE, Agarose gel electrophoresis

3.3 Blotting techniques

3.4 ELISA

UNIT-IV

4.1 Design and functioning of tissue culture laboratory methodology

4.2 Culture media preparation

4.3 Cell proliferation measurements

4.4 Cell viability testing and cell harvesting methods

List of Practicals

1. Separation of biological compounds by paper chromatography
2. Preparation of Buffers and Measurement of pH
3. Separation of biological compounds of by TLC
4. Absorption spectra of proteins and nucleotides
5. Separation of mitochondria and differential centrifugation
6. Separation of biomolecules using HPLC
7. Preparation of cell culture media
8. Separation of proteins by SDS-PAGE

SUGGESTED READING MATERIAL (ALL LATEST EDITIONS)

1. Animal Cell Culture – A practical approach, Ed.John. R.W.Masters, IRL Press.
2. Introduction TO Instrumental analysis, Ronert Braun. McGraw Hill International
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.W. Goulding, ELBS Edn.
4. Advanced Micripipette Techniques for cell physiology. K.T. Brown and D.G. Flamming IBRO,Hand Book Series.A Wiley Interscience publications,John Wiley and Sons,New York

5. Neuro anatomical Techniques, N.J. Stransfed and T.A. Miller Springer Verlag, New York Heidelberg, Berlin, 1980.
6. Principles of Neuropsychopharmacology by Robert S. Feldman, Jerrold S. Meyer and Unida quenzer. Sinancer Associates Inc. Publishers. Sunderland, Massachusetts, 1997.
7. General Zoological Microtechniques – F.M. Weesner.

PRACTICALS

ZPR 105: Practicals related to theory papers ZTH 101 and ZTH 102
ZPR 106: Practicals related to theory papers ZTH 103 and ZTH 104

Semester- II

ZTH 201: METABOLIC REGULATION & CELL FUNCTION

UNIT – I

1.1 Chemical bonds (Covalent, Hydrogen bonds, Ionic bonds, Vanderwall's interactions)
1.2 Thermodynamic principles in biology
1.3 Outline classification of organic compounds (carbohydrates, proteins and lipids)
1.4 Orders of protein structure (primary, secondary, tertiary and quaternary)

UNIT – II

2.1 Glycolysis, TCA cycle and their biological importance
2.2 Pentosephosphate pathway, gluconeogenesis
2.3 Regulation of carbohydrate metabolism (Glycolysis and TCA cycle)
2.4 Mitochondrial electron transport system, Oxidative phosphorylation

UNIT – III

3.1 Beta-oxidation of palmitic acid; Biosynthesis of long chain fatty acids (Palmitic acid)
3.2 Oxidative deaminaiton, decarboxylation and transamination of amino acids.
3.3 Biosynthesis of Urea and detoxification of ammonia
3.4 Biosynthesis of polyamines

UNIT – IV

4.1 Nucleotides and types
4.2 Biosynthesis of Nucleotides
4.3 Degradation of Nucleotides
4.4 Clinical disorders of purine metabolism

SUGGESTED READING MATERIAL

1. Robert K.Murrey, D.K. Granner, P.A. Mayes and V.W. Rodwell; Harper's Biochemistry McGraw Hill Publishers.
2. Biochemistry by A.L.Lehninger, Kalyani publishers, New Delhi.
3. D. Voet and J.G. Voet, Biochemistry, J. Wiley & Sons.
4. David L. Nelson and Michael M. Cox, Lehninger; Principles of Biochemistry, McMillan Worth Publications.

List of Practicals

1. Estimation of glucose
2. Estimation of soluble and structural proteins
3. Estimation of carbohydrates
4. Estimation of amino acids
5. Estimation transport of Glucose
6. Estimation of Blood glucose
7. Estimation of Lipids
8. Estimation of Triglycerides

ZTH 202: DEVELOPMENTAL BIOLOGY

UNIT I

1.1 Germ line determination: Germ plasm and the determination of the primordial germ cells.
1.2 Germ cell determination in Nematodes, Insects and Amphibians.
1.3 Germ cell migration in Drosophila
1.4 Germ cell migration in Amphibians, Reptiles, Birds and Mammals

UNIT II

2.1 Gametogenesis: Morphological basis in animals, semen composition, formation, sperm function, Spermatogenesis
2.2 Leydig cells: Morphology, Differentiation, function and its regulation.
2.3 Oogenesis and Vitellogenesis: Ovulation, super ovulation and ovum transport in mammals.
2.4 Fertilization: Biochemistry of fertilization and post fertilization events.

UNIT III

3.1 Creating Multi-cellularity: Cleavage types, comparative account of gastrulation, Neurulation
3.2 Germ layers: Ectoderm, Mesoderm and Endoderm
3.3 Tetrapod limb development
3.4 Metamorphosis in Insects and Amphibians

UNIT IV

4.1 Biology of sex determination: Testis determining genes, ovarian development, secondary sex determination in mammals, Environmental sex determination
4.2 Body axes: Establishment of body axes in mammals
4.3 Proximate tissue interaction
4.4 Genes and Morphogenesis

List of Practicals

1. Observation of developmental stages in frog and chick
2. Observation of different cleavage stages in the eggs of *Lymnea* (fresh water snail)
3. Role of shell during developmental of chick
4. Protein turnover during development of chick
5. Phosphorous metabolism in developing chick embryo
6. Calorific values during the development of chick

7. Ontogeny of excretory pattern in developing chick
8. Vitellogenesis in Crab
9. Fecundity index in Crab
10. Induced breeding in Frog
11. Spermatozoa observation in different vertebrates

Reference Books:

1. Austen, C.R. and Short, R.V. Reproduction in Animals
2. Schatten and Schatten. Molecular Biology of Fertilization
3. F.T. Longo, Fertilization, Chapman & Hall
4. R.G. Edwards, Human Reproduction
5. S.F. Gillbert, Development Biology, Sinauer Associates Inc., Massachusetts
6. Ethan Bier the Coiled Spring Harlsor Laboratory Press, New York.

ZTH 203: ANIMAL PHYSIOLOGY

UNIT – I

1.1 Feeding mechanisms and regulation
1.2 Comparative physiology of digestion of carbohydrates, protein and fats
1.3 Gastro-intestinal Hormones in regulation of digestion
1.4 Vitamins and their role in cellular metabolism

UNIT – II

2.1 Respiration- Types of Respiration, Respiratory organs, Mechanism of Respiration
2.2 Circulation of body fluids and types of hearts
2.3 Patters of nitrogen excretion among different animal groups and their evolutionary significance
2.4 Osmoregulation in different animal groups (aquatic and terrestrial)

UNIT – III

3.1 Principles of Thermoregulation
3.2 Homeothermic animals and Poikilothermic animals
3.3 Hibernation and Aestivation
3.4 Biological rhythms

UNIT – IV

4.1 Bioluminesence- Chemistry and functional significance
4.2 Chromatophores and regulation of their function
4.3 Structure and function of muscles, Theories of muscle contraction.
4.4 Physiology of receptors (Photo, Phono and chemo receptors)

List of Practicals

1. Assay of lipase
2. Assay of amylase
3. Assay of pepsin
4. Assay of ascorbic acid
5. Demonstration of cell fragility in different media (Iso, hypo and hyper)

6. Muscle contraction demonstration
7. Study of Myogenic and Neurogenic hearts
8. Demonstration of rate of oxygen consumption in crab/fish.

SUGGESTED READING MATERIAL

1. C.L. Prosser. Comparative Animal Physiology. W.B. Saunders & Company
2. R. Eckert. Animal Physiology. Mechanisms and Adaptation. W. H. Freeman & Company
3. W.S. Hoar. General and Comparative Animal Physiology
4. Schiemdt-Nielsen. Animal Physiology. Adaptation and Environment. Cambridge
5. C.L. Prosser. Environment and Metabolic Physiology Wiley-Liss, New York.

ZTH 204: BIOSTATISTICS AND BIOINFORMATICS

UNIT – I

1.1 Definition - scope of biostatistics
1.2 Measures of central tendency – arithmetic mean, median and mode
1.3 Measures of dispersion -range, mean deviation, standard deviation, Standard error
1.4 Co-efficient of variation, types of correlation, linear regression analysis

UNIT –II

2.1 Concepts of probability, laws; Normal probability distribution and its application
2.2 Tests of significance: Students t-Test (simple, paired), F- test
2.3 Application of $\chi 2$ (chi-square) test in biology and testing the goodness of fit.
2.4 Analysis of Variance (ANOVA), SPSS

UNIT – III

3.1 History of Computers, classification of computers, computer generations
3.2 Input, output processing and storage devices –, hard disk, CD – ROM, DVD etc.
3.3 Operating system – Introduction – types of operating systems
3.4 MS – Office (ACCESS, EXCEL, WORD, POWER POINT), applications of computers in biology

UNIT –IV

4.1 Internet basics; WWW, HTML and HTTP
4.2 Scope, importance and status of Bioinformatics
4.3 Biological databases (Gene bank and Protein sequence database)
4.4 Sequence analysis: Pair wise and multiple sequence alignment; human genome project

List of Practicals:

1. Problems related to Mean, mode and median
2. Problems related to test of significance
3. Analysis of variance (ANOVA)
4. Probit analysis
5. Regression curves
6. Generation of graphs using MS-Excel
7. Power point presentations
8. Data analysis using SPSS
9. Sequence data retrieval in Fasta format from NCBI database
10. Searching with Blast

11. Secondary structure Prediction
12. Viewing of PDB files using Rosmol
13. Aligning sequence using ClustalX

SUGGESTED READING MATERIAL

1. Computers to-day by Suresh K. Basandra (1999), Published by Galagotia Publications, Pvt. Ltd., New Delhi
2. Microsoft Office, by Setultz, 1997.
3. Database processing by D.M. Kroenke, Galgotia Publications, 1990.
4. Introduction to Biostatistics – By Sokal – Rohlf (2^{nd} Edn) freeman International Editor, 1971.
5. Bio – Statistics – An introductory text – Goldstein, A The Macmillan Co., New York,1971.
6. Bio – Statistics - By Lewis Alvin E. Affiliated East – West press (P)Ltd., 1971.
7. Statistical analysis in Biology by Mather, K Chapman and Hall, London, 1972.
8. Probit analysis by finney, D.J.S. Chand & Co., Ltd,. New Delhi
9. Biostatistics by Lewis Alvin (1971) Affiliates East West Press Pvt., Ltd., New Delhi.
10. Statistical methods in Biology by Bailey Norman T.J. (1965) The English Language Book Society & the English university Press Ltd.
11. Bioinformatics. Murthy, C.S.V. Himalaya Publishing House, Hyderabad
12. Bioinformatics by Andreas D. Baxevanis and B.F. Francis Ouellette, 2^{nd} Ed., 2002.
13. Basic Bioinformatics by S. Ignaeimuthi, S.J. Narosa publications, 2005
14. Introduction to Bioinformatics, S. Sundara Rajan and R. Balaji, Himalaya Publishing House, 2003.

PRACTICALS

ZPR 205: Practicals related to theory papers ZTH 201 and ZTH 202
ZPR 206: Practicals related to theory papers ZTH 203 and ZTH 204

Semester- III

ZTH 301: ENVIRONMENTAL BIOLOGY

UNIT – I

1.1 A general account on Biomes and their environments
1.2 Fresh water: Classification and Characteristics, eutrophication, seasonal changes
1.3 Marine: Classification and Characteristics
1.4 Terrestrial: Characterization of Forests- Grass lands – Tundra –Desert

UNIT – II

2.1 Dynamic view of ecosystem and Energy Flow patterns in different ecosystems
2.2 Estimation of Energy Budget, Biomass and Productivity
2.3 Biogeochemical cycles- hydrological (water), oxygen, nitrogen, phosphorus and sulphur cycles.
2.4 Natural calamities and Disaster management in India

UNIT – III

3.1 Air Pollution: Criteria and Standards in India, Health hazards and Toxicology – Green House gases and Green House effect

3.2 Water Pollution: Criteria and Standards in India, Health hazards and Toxicology

3.3 Environmental epidemiological studies- Community environmental epidemiology and Occupational environmental epidemiology. Environmental health hazards- epidemiological episodes in India and abroad.

3.4 Environmental Laws: Environmental Laws in India- Legislation and Execution

UNIT-IV

4.1Biomonitoring; Scope and biological monitoring programmes; Mussel Watch Program

4.2 Bio-indicators and environmental monitoring, Environmental impact assessment

4.3 Bioremediation; Need and scope of bioremediation.

4.4 Environmental applications of bioremediation

List of Practicals:

1. Estimation of dissolved oxygen content in different water samples
2. Effect of Photoperiodism on CO_2 levels in different water samples
3. Estimation of Organic matter in water and soil samples
4. Estimation of BOD in different water samples
5. Calculation of energy budget of an ecosystem
6. Analysis of OP compounds in water samples through TLC
7. Estimation of inorganic phosphate levels and biomass in surface and sediment waters
8. Determination of Calcium in a sedimentary bed and surface waters of freshwater pond

SUGGESTED READING MATERIAL

1. Practical methods in Ecology & Environmental Science, R.K. Trivedy, Goel, Trisal, 1997.
2. Environmental Physiology of desert organism. Ed.by N.F. Hadley – Dowden Huchinson and Ross, Inc.Penn.USA.
3. The Ecology of waste water treatment – H.A. Hawkes pergoman press, 1963.
4. Biochemical ecology and water pollution – P.R. Dugan, plenum press, London, 1972.
5. Pesticides in the environment – R. White Stevenns, Marcel-Dekker Inc. New York, 1971.
6. Environmental Science Research Volumes:
   Vol.1. Indicators of environmental quality – W.A. Thomas, 1972.
   Vol.3. Environmental pollution by pesticides – C.A. Edwards, 1974.
   Vol.5 Environmental dynamics of pesticides – R. Hague and V.H. Preed, 1975.
7. Ecology & Environment – P.D. Sharma, 1991.
8. Field Biology & Ecology – Allen H Benton & E. Werner, JR, 1980.
9. Encyclopedia of environmental pollution and control, enviromedia, Karad, Vol.1&2, R.K Trivedi.
10. Ecotechnology for pollution control and environmental management, enviromedia, Karad, R.K. Trivedi.
11. Health hazards and human environment, World Health Organization (WHO)1972.
12. Current pollution researches in India – R.K. Trivedy and P.K. Goel. Karad.
13. Chemical and biological methods for water pollution studies – R.K. Trivedy and P.K. Goel, 1984.

14. "Prime Minister Narendra Modi releases country's first-ever National Disaster Management Plan", The Times of India, 1 June 2016
15. Parliament of India (23 December 2005), "Disaster Management Act, 2005, [23rd December, 2005.] NO. 53 OF 2005" (PDF), Ministry of Home Affairs (India)
16. Natural Hazard and Disaster Management Hardcover – May 2008 by B. C. Jat
17. Disaster Management Hardcover – 6 Jul 2013 by Vinod K. Sharma
18. Disaster Management: Global Challenges and local solutions by Rajib Shaw / R. R. Krishnamurthy.
19. Disaster Management and Strategies Concept & Methods, Risk Reduction & Insurance, Experiences & Case Studies by Ashu Pasricha / Kiyanoush Ghalavand / Jai Narain Sharma
20. Disaster Management (3 Vols.) Man-made Disasters by K. K. Singh / Lotfi Aleya / Vinod Singh.
21. Industrial Pollution – V.P. Kudesia, 1990.
22. Animal Physiology – Adaptation & Environment. 4th Edition – Knut Schmidt – Nielsen – CambridgeUniversity Press.
23. Environmental Biology and Toxicology-P.D. Sharma, Rastogi Publications, Meerut (India), 1998.
24. Biodegradation & Bioremediation – 2nd editon, Martein Alexander – Academic Press, 1999 USA.
25. Water Treatment and purification technology – W.J. Ryan, Agrobios (India), Jodhpur, 2002.
26. Methods in Environmental Analysis – Water soil and air by P.K. Gupta – Agrobios (India), Jodhpur, 2001.

ZTH 302: MOLECULAR BIOLOGY

UNIT-I

1.1 Central dogma of Molecular biology; Chromosomal Organization
1.2 Nuclear and mitochondrial genome
1.3 Structure of gene (Cistron, Muton, Recon)
1.4 Watson and Crick Model; Types of DNA; Properties of DNA

UNIT-II

2.1 Replication in Prokaryotes and Eukaryotes; General principles, enzymology, various modes (conservative, semi conservative and dispersive) and models of replication (rolling circle, θ-mode replication - uni and bidirectional),
2.2 DNA synthesis by reverse transcription
2.3 Post replicational modifications and Inhibitors of replication
2.4 DNA damage and repair mechanisms: Photo reactivation, excision repair, recombination & SOS repair

UNIT III

3.1 Transcription: Types of RNA, enzymes and molecular mechanisms involved in Transcription (RNA Polymerases, promoters, initiation, elongation and termination of RNA synthesis)
3.2 Post transcriptional modification (Cap, Poly A formation and splicing), Ribozymes
3.3 Translation: General features (Genetic code, codon, degeneracy and universality) molecular mechanism of translation

3.4 Post translational modification; Role of antibiotics in protein synthesis

UNIT IV

4.1 General principles of gene regulation with reference to Lac and trp
4.2 Tryptophan Operon, Britten and Davidson model for Eukaryotic regulation
4.3 DNA sequencing, DNA finger printing, Polymerase chain reaction
4.4 Polymerase chain reaction (PCR)

List of Practicals:

1. Estimation of DNA by diphenylamine method
2. Determination of purity and quantity of DNA
3. Determination of melting temperature (Tm) of DNA
4. Estimation of RNA by orcinol method
5. PAGE electrophoresis of proteins
6. Problems related to molecular biology
7. Southern and Western blotting
8. Electro-elution of DNA
9. Polymerase chain reaction

SUGGESTED READING MATERIAL

1. Molecular Biology by David Freifelder, 1993
2. Molecular Biology of Gene-by J.D.Watson, 1988
3. Harper's review of Biochemistry by D.W. Martin et al 1990
4. Biochemistry by A.L. Lehninger
5. Cell and Molecular Biology-E.D.P. De Robertis and E.M.F. De Robertis
6. Concepts in Molecular Biology-S.C. Rastogi, V.N. Sharma and AnandaTandon (1993)
7. Genes VII by Benjamin Lewin
8. Genes VIII and IX by Benjamin Lewin.

ZTH 303: ENDOCRINOLOGY

UNIT-I

1.1 Introduction to Endocrinology- Historical back ground, characteristic features of hormones
1.2 Classification and chemical nature of hormones
1.3 Mechanism of hormone action (Peptide and Steroid hormones)
1.4 General account of Pheromones

UNIT-II

2.1 Structure and functions of hormones of Pineal, Pituitary, thyroid and Parathyroid
2.2 Structure and functions of hormones of Adrenals, Pancreas and Gastrointestinal tract
2.3 Hormones in female sexual cycle, Pregnancy and lactation
2.4 Hormones of Testis and regulation of spermatogenesis

UNIT-III

3.1 Biosynthesis and secretion of hormones corticosterioid hormones-peptide hormones-catecholamines
3.2 Hormone receptors; receptor structure and signal transduction mechanism-G-protein family
3.3 Hormones in crustaceans - growth, development and reproduction.
3.4 Hormones in insects - growth, development and reproduction.

UNIT-IV

4.1 Growth hormones and growth factors
4.2 Hormones and homeostasis (Calcium, glucose, Phosphate, water)
4.3 Hormonal regulation of carbohydrate, nitrogen and lipid metabolism
4.4 Hormones as pharmaceuticals

List of Practicals:

1. Observation of the histological section of the pituitary, adrenals, pancreas and gonads
2. Isolation and extraction of pituitary gland from fish
3. Estimation of glucose levels in the blood of frog/rat exposed to adrenaline and insulin
4. Estimation proteins in the reproductive tissues of a fish injected with pituitary extract
5. Estimation of SDH activity in the heamolymph of eyestalk ablated crab
6. Estimation of oxygen consumption in eyestalk ablated crab
7. Demonstration on the effect of ligature on the development of larvae of insects
8. Estimation of glucose in alloxon-induced diabetes
9. Effect of adrenalectomy on total proteins in the liver of albino rats

SUGGESTED READING MATERIAL

1. Barrington. E.J.W. General and comparative Endocrinology Cambridge Press, Oxford.
2. Bentley, P.J. Comparative Vertebrate Endocrinology, Cambridge Press, Oxford
3. Williams, R.H. Text Book of Endocrinology, W.B. Saunders Co., Philadelphia.
4. Martin, C.R. Endocrine Physiology. OxfordUniv. Press, Oxford.
5. Prakash S. Lohar. Endocrionology-Hormones and human health-2005. MJP Publishers-Chennai

ZTH 304: ENZYMOLOGY

UNIT – I

1.1 Classification of enzymes and nomenclature
1.2 Enzyme specificity (optical specificity, group specificity)
1.3 Quantitative measurement of enzyme activity
1.4 Isolation of enzymes, Intracellular distribution of enzymes

UNIT – II

2.1 Bioenergetics- Kinetic theory and collision theory
2.2 Mechanism of enzyme action (Lock and key; Induced fit model), catalytic site, Role of metal ions.
2.3. Effect of reactant concentration (Rate constant, First order, Second order and Zero Order reactions)
2.4 Effect of enzyme concentration, pH and temperature

UNIT – III

3.1 Effect of substrate concentration, Determination of kinetic constants (K_m and V_{max})

3.2. Inhibition of enzyme activity (competitive, non-competitive, uncompetitive, mixed inhibition and inhibitor constant K_i)

3.3 Kinetics of Allosteric enzymes

3.4 Regulation of enzyme activity (Metabolic regulation), Catalytic efficiency of enzymes (Feedback inhibition, covalent modification)

UNIT – IV

4.1 Enzymes in clinical diagnosis

4.2 Immobilized enzymes and their applications

4.3 Isozymes

4.4 Enzyme engineering

List of Practicals:

1. Effect of pH on SDH activity and determination of ionizable groups
2. Effect of temperature on SDH activity and determination of activation energy using Arrhenius equation
3. Determination of kinetic constants such as Km and Vmax
4. Inhibitor sensitivity (determination of IC_{50})
1. Effect of inhibitors on SDH activity and determination of inhibitors constant
2. Estimation of GOT and GPT in the serum samples
3. Isolation and purification of arginase
4. Isolation of LDH isozymes using electrophoresis
5. Determination of Ks (substrate constant) for any allosteric enzyme using Hill equation
6. Characterization of any selected enzyme using bioinformatic tools (sequence determination, homology search, structure, genomic sequence, cDNA sequence, dendrogram, metabolic function.

SUGGESTED READING MATERIAL

1. Harper's Biochemistry by Robert K. Murray, Peter A. Mayer, D.K. Granner, V.W. Rodwell, Lange Medical Book.
2. Enzyme kinetics by D.V. Roberts, Cambridge University Press.
3. Enzyme Kinetics by I.W. Segel.
4. Biochemical calculations by I.H. Segel 2nd Ed. John Wiley & Sons.
5. Biochemistry by D. Voet and J.G. Voet, J.Wiley & Sons.

PRACTICALS

ZPR 305: Practicals related to theory papers ZTH 301 and ZTH 302

ZPR 306: Practicals related to theory papers ZTH 303 and ZTH 304

Semester -IV

ZTH 401: ANIMAL BIOTECHNOLOGY

UNIT-I

1.1 General Introduction and Achievements of Biotechnology

1.2 Enzymes used in gene cloning - Restriction endonucleases, DNA ligases, Kinase, Phosphatase, Nucleases, Polymerases, Reverse transciptase

1.3 Cloning vectors (Plasmids, Phages, cosmids, yeasts Shuttle vectors), viral vectors (SV40, Adenovirus and Baculovirus) used in Gene cloning.

1.4 Cloning and selection strategies of recombinants (antibiotic selection, blue white screening, colony hybridization, Fluorescence in-Situ Hybridization (FISH) and immunological test.

UNIT-II

2.1 Preparation of cell lines, types of cell lines. Types of Stem Cells, Stem Cell Therapy

2.2 Applications of cell culture in Veterinary– Disease diagnosis, virus vaccines, hormones

2.3 Application of Biotechnology in Medicine- Production of monoclonal antibodies (Hybridoma technology), Production of vaccines and Production of Growth Hormone

2.4 Gene therapy: Introduction, principle of gene transfer and examples (Adenosine deaminase deficiency disease, Duchenne Muscular dystrophy disease and Cystic fibrosis)

UNIT-III

3.1 Livestock improvement: Manipulation of reproduction in animals (Artificial insemination, multiple ovulations, *in vitro* fertilization, Embryo transfer technology)

3.2 Methods of gene transfer – Microinjection, electroporation, lipofection and viral mediated gene transfer techniques

3.3 Generation of chimeric, transgenic and knockout mice and other animals and their characterization. Gene editing- Gene silencing-CRISPR-associated protein-9 nuclease (Cas9) technology

3.4 Potential application of transgenic animals: models for various diseases/disorders, production of peptides and proteins of biopharmaceutical interest (molecular farming)

UNIT-IV

4.1 Growth hormone transgenics and stem cell technology for betterment of aquaculture. Sex reversal in fishes and their applications, Production of monosex populations. Aquaculture and fish seed production: Hypophysiation, hCG injections

4.2. Marine bio/fish resources and its applications in pharmaceutical and Nutraceutical Industries

4.3. Fresh water and marine (oyster) pearl culture technology, pearl culture in India, uses of pearl culture

4.4. Intellectual Property Rights: Introduction; Types of IP; Patents and its types, Trademarks, Copyright & Related Rights, Protection of GMOs; ethical and legal issues in Biotechnology.

List of Practicals:

1. Instrumentation in animal biotechnology laboratory
2. Preparation of different types of culture media
3. Isolation of genomic DNA
4. Bacterial Plasmid DNA Isolation
5. Restriction digestion and ligation of vector and insert gene
6. Bacterial transformation using plasmid
7. Cell counting using hemocytometer
8. Staining and viability testing of animal cells
9. Media preparation and membrane filtration
10. Preparation of single cell suspensions from spleen and thymus
11. Sterilization techniques (Physical and chemical)

SUGGESTED READING MATERIAL

1. Animal Biotechnology-M.M. Ranga, Agrobios (India)-2000
2. Biotechnology-Fundamentals & Applications-S.S.Purohit & S.K. Mathur, Agro Botonics-1999
3. A text book on Biotechnology-(II Ed.) H.D. Kumar. EWP-Private Ltd., New Delhi-1998
4. A text book of Biotechnology-R.C. Dubey.S.Chand & Company Ltd., New Delhi-1996 Biotechnology-V. Kumaresan. Saras Publication-1994
5. Animal Biotechnology – Recent concepts and developments. P. Ramadass, MJP Publications, Chennai, 2009
6. Venkitaraman: Economic Zoology (Sudarsana Publishers, 1983)
7. Srivastava: A text book of Applied Entomology, Vol. II and III (Kalyani Publishers, 1988, 1991)
8. Shukla & Upadhyaya: Economic Zoology (Rastogi Publishers, 1999-2000)
9. Dunham R.A. Aquaculture and Fisheries Biotechnology and Genetic Approaches.CABI Publishing,UK.
10. Animal Transgenisis and Cloning. Edited by L. M. Houdebine, Wiley, USA.

ZTH 402: TOXICOLOGY AND PHARMACOLOGY

UNIT-I

1.1 Origin and scope of Toxicology and Principles of Toxicology
1.2 Distribution, Excretion and Absorption of toxicants
1.3 Bio accumulation, bio-magnifications and Biotransformation of Toxicants
1.4 Teratogens and their effects on mammalian development

UNIT-II

2.1 Classification of pesticides, mechanisms of pesticide toxicity and detoxification mechanisms.
2.2 Toxicity Evaluation (LC50 & LD50) and factors affecting the Toxicity
2.3 Toxic effects of metals (Cadmium, Lead and Mercury)
2.4 Sources of radiation, types of radiation and physiological hazards of radiation.

UNIT-III

3.1 Scope and Importance of Pharmacology – dosage forms and routes of drug administration.
3.2 Pharmacokinetics – absorption, distribution, metabolism and excretion.

3.3 Pharmacodynamics – mechanisms of drug action, combined effect of drugs and factors modifying drug action.
3.4 Response of cells to drugs

UNIT- IV

4.1 Response of central nervous system to depressants: alcohols and Opium
4.2 General anaesthetics – Properties of anaesthetics (Ether and Barbiturates)
4.3 Effects of analgesics and antipyretics
4.4 Pharmacologic agents in allergic diseases- Histamines and antihistamines

List of Practicals:

1. Determination of LC_{50} and LD_{50} of selected toxicants in different animals.
2. Effect of temperature on the ciliary activity in the normal and pesticide/ metal exposed fresh water muscles
3. SDH activity in activity in different tissues of frog/fish with reference to malathion/mercury/cadmium
4. Effects of toxicants on the rate of oxygen consumption of aquatic animals
5. Effects of toxicants on total proteins of fish/ frog
6. Teratogenic effects of pesticides on mice
7. Pesticidal effect on morphology of tissue
8. Routes of drug administration
9. Assay of paracetamol and ibuprofen by using UV-Vis spectroscopy by linear curve method.
10. Detection of calcium levels in *calcical-300* by atomic absorption spectroscopy
11. Simultaneous determination of *ibuprofen* and *paracetamol* by UV spectrophotometry
12. Qualitative and quantitative determination of vitamin c in *citrus limon* by high performance liquid chromatography
13. Identification of drugs using TLC.

SUGGESTED READING MATERIAL

1 Toxic interactions-R.S.Goldstein, W.R. Hewitt and J.B.Hook. Academic Press-1990
2 Pesticides and human Welfare-D.L.Gunn and J.G.R. Stevens. OxfordUniversity Press-1978
3 Pesticides action and Metabolism-O' Brien
4 Environmental toxicology of Pesticides-F. Mastimura, G.M.Boush and T. Misato
5 The Encyclopedia of Americana-Vol.15
6 Introduction to Biochemical Toxicology-E. Hodgson & F.E. Gutherie
7 Casarett & Doul's –Toxicology-The basic science of poisons-C.D.Klassen, Mary, O.A & John Doull
8 Pharmacologic principles of Medical practice John C. Krantz Jr C. Jellaff carr.
9 An introduction to pharmacology and therapeutics James Andrew Gunn
10 Crash course: Pharmacology Darson
11 Pharmacology, Brenner stevans
12 Text book of Pharmacology- Laurence Bennett
13 Pharmacology-H.P. Rang, M.M Dale,J.M. Relter, P. Moore, Cherchill Livingston
14 Text book of Pharmacology- Satoskar
15 The Pharmacological basis of therapeutics Good man & Grisons

ZTH 403: NEUROBIOLOGY AND ANIMAL BEHAVIOUR

UNIT-I

1.1 Micro anatomy of neurons and types of nerve cells.
1.2 Autonomic nervous system – Sympathetic Division, Parasympathetic Division.
1.3 Bioelectrical properties of neurons (Resting membrane potential- Nearnst equation; Sodium and potassium pump; Propagation of nerve impulse.
1.4 Synapses: Structure and Integration (Types of synapses; Ultra structure of synapse Chemical transmission; Electrical transmission)

UNIT-II

2.1 Chemical composition of the nervous system-cerebrospinal fluid-CNS barriers
2.2 Synthesis –storage-release and inactivation mechanisms and functions of the following neurotransmitters; Acetylcholine & Catecholamines (Norepinephrine, Epinephrine, Dopamine)
2.3. Amino acid Neurotransmitters-Glutamate and GABA
2.4 Neuropeptides (Oxytocin and Vasopressin)

UNIT – III

3.1 General introduction: An over view of concept of Animal behaviour
3.2 Visual Perception, Auditory perceptionand Olfactory Perception
3.3 Animal aggression and Homing territoriality
3.4 Social organization, Advantages, Social organization in insects, primates

UNIT-IV

4.1 Conditioning Learning (Classical and Operant conditioning and, Multiple-response learning)
4.2 Cognitive Learning (Insight Learning, Sign Learning, Latent Learning)
4.3 Kinds of remembering (Redintegrative memory –Recall – Recognition-Relearning-Retrieval process-Theories of Memory).
4.4 The nature of forgetting (Decay through disuse- Interference effects, motivated forgetting, improving memory)

Practicals in Neurobiology

1. Heteropolar and multipolar neuron
2. Sensory neurons
3. Coelentarata nerve net
4. Pyramidal cell from cortex
5. Motor neuron from spinal cord
6. C.S. of spinal cord
7. Bipolar cell from olfactory bulb
8. Neuromuscular junction
9. Stretch receptors in cray fish
10. Organization of sepia central nervous system
11. Synapse enlarge
12. Stellate ganglion in sepia
13. Isolation and identification of different regions of mice brain
14. Spinal reflexes in decerebrated frog

Practicals in Animal Behavior

1. Habituation learning in snails
2. Spacial learning in albino rats
3. Locomotor activity in albino rats
4. Spotters
5. Insight learning in chimpanzee
6. Insight learning in raccoon
7. A chimpanzee using a stick to obtain an apple
8. Thorndike puzzle box

9. Instrumental conditioning
10. Imprinting
11. Feeding behaviour
12. Bee language
13. Courtship behaviour
14. Classical conditioning
15. Social behaviour
16. Pheromones in ants
17. Round and waggle dance of scout honey bee
18. Spatial leaning in bee wolf
19. Symbiosis adaptation
20. Aggressive mimicry

SUGGESTED READING MATERIAL

1. Neurobiology. Shepherd, G.M.OxfordUniversity press, London.
2. Basic Neurochemistry-G.J. Siegal, R.W. Albers, B.W. Agranoff, R. Katzman (1981) Little, Brown and company. Boston.
3. Introduction to Nervous system-T.H. Bullock, R. Cork, A. Granner (1977); W.H Free-man&Co.
4. Principles of Neural Science –E.R. Kandel and J.H. Schwertz. (1981); Elsevier/North Holland. NY. Oxford.
5. Mechanism of Drug Action on the Nervous System- M.A.B. Brazil, R.W. Ryall. (1979); cambridge University Press. Cambridge, London and New York.
6. The Bio Chemical basis of Neuropharmacology-J.R. Cooper, F.E. Bloom, &R.H. Roth. (1982); Oxford University Press, NY and London.
7. Principles of Neuro Phychopharmacology- Robert S. Feldman, Jerrold S. Meyer and Lind F. Quenzer. Sinauer Associates, Inc. Publishers. Sunderland. Massachusetts.
8. Alcock, J. Animal behaviour: An evolutionary approach. Sinauer Assoc., Sunderland, Mass.USA.
9. Bradbury, J.W. and S.L.Vehrencamp. Principles of animal communication. Sinauer Assoc. Sunderland, Mass. USA.
10. Clutton-Brock, T.H. the evolution of parental care. PrincetonUniv. Press, Princeton, NJ, USA.
11. Eibl-Eibesfeldt, I. Ethology. The biology of behaviour. Holt, Rinehart and Winston, New York.
12. Gould, J.L. The mechanisms and evolution of behaviour.

ZTH 404: IMMUNOLOGY

UNIT – I

1.1 Immunity – Types of Immunity, Innate and Acquired Immunity

1.2 Cells of the immune system: Lymphoid cells, Mononuclear cells, granulocytic cells, Mast cells

1.3 Organs of the immune system – primary and secondary lymphoid organs, lymphatic system

1.4 Antigens: Antigenic determinants or epitopes, immunogenicity, Haptens

UNIT – II

2.1 Innate (Non-specific immunity): Anatomical barriers, phagocytosis, NK cells, Interferons

2.2 Humoral immunity: Immunoglobulins (fine structure of immunoglobulins and immunoglobulin classes); the complement system- Classical and alternate pathway. Inflammation

2.3 Cell mediated immunity: Mechanism of cell mediated immunity

2.4 Brief account on Antigen presentation, Major histocompatability complex

UNIT – III

3.1 Antigen – Antibody interactions: Affinity, Avidity, Cross – reactivity, precipitation reactions, and Agglutination reactions.
3.2 Hypersensitivity – Coombs classification, types of hypersensitivity
3.3 Tolerance
3.4 Transplantation

UNIT – IV

4.1 Autoimmune disorders: Single organ autoimmune disease (Thyroiditis, Pernicious Anaemia), Systemic autoimmune diseases (Rheumatiod arthritis, Systemic Lupus Erythematosus (SLE).
4.2 Primary immune disorders (SCID, Digeorge's syndrome)
4.3 Immunodeficiency diseases (AIDS), HIV's mechanism of Immunosupression
4.4 Immunization (Active and passive immunity), types of vaccines

List of Practicals:

1. Preparation of differential cell types (Macrophages, live cells, astrocytes)
2. Double diffusion technique
3. Radio immunodiffusion
4. ELISA Test Demonstration (Tridot)
5. Agglutination test
6. Rocket immuno electrophoresis
7. Immuno electrophoresis demonstration

Reference books:

1. Kuby, J. (1998) Immunology, W.H. Freeman and Company, New York.
2. Roitt, I.,Brostoff, J. Male, D. (1999/2000) Immunology, 4th Edition. Harcourt Brace and Company Asia, Pte. Ltd., Singapore.
3. Harpers Review of Biochemistry, Murray, Granier, Mayes and Rodwell, Lange Medical Publicaitons,25th Ed.
4.. Human Physiology by Stuart Era Fox, W.M.C. Brown Publishers, USA 1984 or Recent Edition.
5. An introduction to Immunology by C.V. Rao, Narosa publishing house, 2002.
6. Immunology introductory textbook by Nandini Shetty, Wiley Eastern Ltd.

PRACTICALS

ZPR 405: Practicals related to theory papers ZTH 401 and ZTH 402
ZPR 406: Practicals related to theory papers ZTH 403 and ZTH 404

For 2nd Semester (Non-core) (CBCS) with effect from 2018-19
ZTH 205: **Animal diversity and Economic Zoology**

Unit I: Characterisation of Invertebrate phyla from Protozoa to Echinodermata

Unit II: Characterisation of Vertebrate phyla from Fishes to Mammals

Unit III: Beneficial animals: Corals - Earthworm - Vermiculture - Beneficial Insects (Apiculture, Lac culture). Aquaculture – Prawns - Lobsters - Crabs - Pearl oysters – Fishes)

Unit IV: Harmful animals: Disease causing organisms - Vectors – Poisonous organisms – Fouling organisms - Pests.

Books:

1. Hyman, L.H. The Invertebrates. Vol.8. Mc Graw Hall Co., New York and London
2. Hyman, L.H. The Invertebrates. Vol.2 Mc Graw Hall Co., New York and London
3. Kingsley, J.S.Outlines of Comparative Autonomy of Vertebrates. Central Book Depot, Allahabad
4. Economic Zoology, Dr. G. S. Sukla and Dr.V.B. Upadhyay, Rastogi Publications, 5th Edition, 2013
5. Economic Zoology by Venkitaraman PR, Publication: Kottayam V. Publishers 1989
6. Text Book Of Economic Zoology by Venkitaraman,P R, 1983

For 3rd semester (Non-core)
ZTH 305: Biodiversity and Wild Life Management

Unit: I

1. Introduction: Definition, History of Biodiversity
2. Importance of Biodiversity
3. Biodiversity resources of India

Unit: II

1. Biodiversity documentation and Nomenclature
2. Biodiversity laws
3. Biodiversity hotspots in India

Unit: III

1. Importance of wild life management and wild life sanctuaries in India
2. Management of rare and endangered species
3. Deforestation and effects on wild life

Unit: IV

1. Special management programme of wild animals in India
2. Wild life trade: assessment and documentation: preventive measures
3. Wild life legislation

Reference Books:

1. IUCN (1994), Guidelines for protected area management categories. Cambridge, UK and Gland, Switzerland: IUCN
2. IUCN-UNEP-WWF (1980), World conservation strategy, living Resources, conservation for sustainable development, international union for conservation of nature and natural resources.
3. Sharma, B.D. (1994), high altitude wild life of India, Oxford and IBH publication, New Delhi, 289.
4. Red data list of threaten animals, list part 1. Vertebrates, Govt. of India, Z. S. I. publ.
5. Gaston, K.J. and spicer, J.I.(1988),Biodiversity: An introduction, Blackwell science, Oxford.
6. Ghosh, A.K. (1986), India and world conservation strategy,Z.S.I.,Govt.of India,Kolkata.
7. Ghosh, A.K. (2008), Biodiversity conservation: Issues on concern,In:Zool.Res.in Human welfare, Ramkrishna and chatterjee(Eds.),Z.S.I.,Govt.of India,Kolkata,19-22
8. Jeffries, M.J. (2006), Biodiversity and conservation, 2nd ed., Rouledge, London and New York.

Department of Zoology
Model Question Paper
Pre-PhD Examinations
Paper – I, Research Methodology

Time: 3 hours Maximum Marks: 100

Answer all questions
Each question carries 20 marks

Unit -I

1. What is review of literature? Write the different methods used for the collection of research data **(OR)**

   Discuss the scope of Biostatistics in biological research

Unit -II

2. Describe the principle, procedure and applications of Fluorescence Microscope.

   (OR)

   Describe the principle, and applications of Spectrophotometer

Unit -III

3. Discuss the different types of Chromatography used in separation of biological molecules

   (OR)

   What is the density gradient centrifugation? Write the principle and applications

Unit - IV

4. Discuss different types of Blotting techniques used in molecular biology

   (OR)

   Write the principle and procedure for ELISA? Discuss its role in Diagnosis of a disease.

Unit -V

5. Write the details of Design and functioning of cell/tissue culture laboratory

   (OR)

   Applications of radio isotopes in biological sciences

Department of Zoology
Pre-Ph.D Examination Syllabus
Paper-I (Research Methodology)

(Common to all the research scholars of the department)

UNIT-I

1. **Review of literature:** Methods of data collection, Note making, Interpretation and report writing.
2. **Analysis of data:** Introduction to biostatistics, Arithmetic mean, median and mode, standard deviation and co-efficient of variation, Test of significance: students t- test, F-test and $\chi 2$ –test.

UNIT-II

1. **Microscopy:** Microscopy: Types of microscopes – Phase contrast microscope, Fluorescence microscope; Electron microscope
2. **Spectroscopy:** Laws of Light absorption, applications of Colorimetry, Spectrophotometry and spectrofluorimetry

UNIT-III

1. **Chromatography:** Paper chromatography – thin layer chromatography, Ion exchange chromatography and affinity chromatography
2. **Centrifugation:** Types of centrifuges, Preparative ultra centrifugation – differential gradient centrifugation – density gradient centrifugation

UNIT-IV

1. **Molecular biology:** DNA sequencing, Polymerase chain reaction, cDNA library, blotting techniques (Southern/Northern/Western)
2. **Immunology:** Radio immuno assays (RIA) and ELISA

UNIT-IV

1. Design and functioning of cell/tissue culture laboratory methodology
2. **Radio isotope techniques** – types of radio isotopes, detection and measurement of radiaoactivity – GM counter, Scintillation counter, auto radiography, applications of radio isotopes in biological sciences

Reference Books:

1. A Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.W. Goulding, ELBS Edn.
2. Molecular Biology by David Freifelder, 1993
3. Introduction to Biostatistics – By Sokal – Rohlf (2^{nd} Edn) freeman International Editor, 1971.
4. Bio – Statistics – An introductory text – Goldstein, A The Macmillan Co., New York,1971.
5. Research Methodology: Methods and Techniques 9second revised edition) by C. R Kothari, New age international Publications