



**SOLAPUR UNIVERSITY, SOLAPUR**

**M.Sc. (Zoology) Part II Syllabus W.E.F. June 2014**

**Syllabus to be implemented from June 2014 onwards  
SEMESTER- III & IV**

<b>Paper Code No.</b>	<b>Paper No.</b>	<b>Title of paper</b>	<b>Total Marks</b>	<b>Credits</b>
<b>SEMESTER III</b>				
<b>301</b>	<b>IX</b>	<b>Molecular cytogenetics</b>	<b>100</b>	<b>04</b>
<b>302</b>	<b>X</b>	<b>Wild life and Conservation Biology</b>	<b>100</b>	<b>04</b>
<b>303</b>	<b>XI</b>	<b>Comparative Animal Physiology</b>	<b>100</b>	<b>04</b>
<b>304</b>	<b>XII</b>	<b>Biochemistry</b>	<b>100</b>	<b>04</b>
<b>305</b>	<b>V</b>	<b>Practical based on Paper IX and X</b>	<b>100</b>	<b>04</b>
<b>306</b>	<b>VI</b>	<b>Practical based on Paper XI and XII</b>	<b>100</b>	<b>04</b>
<b>SEMINAR</b>			<b>25</b>	<b>01</b>
<b>TOTAL -625</b>				
<b>SEMESTER IV</b>				
<b>401</b>	<b>XIII</b>	<b>Animal Biotechnology</b>	<b>100</b>	<b>04</b>
<b>402</b>	<b>XIV</b>	<b>Applied Zoology</b>	<b>100</b>	<b>04</b>
<b>403</b>	<b>XV</b>	<b>Environmental biology and toxicology</b>	<b>100</b>	<b>04</b>
<b>404</b>	<b>XVI</b>	<b>Zoo keeping and Animal house management</b>	<b>100</b>	<b>04</b>
<b>405</b>	<b>VII</b>	<b>Practical based on Paper XIII and XIV</b>	<b>100</b>	<b>04</b>
<b>406</b>	<b>VIII</b>	<b>Practical based on Paper XV and XVI</b>	<b>100</b>	<b>04</b>
<b>SEMINAR</b>			<b>25</b>	<b>01</b>
<b>TOTAL -625</b>				

**Note:**

1. As a part of practical 406 a research or project on the topics related is to be submitted in the form of Two hard copies and in CD format. The project shall carry 50 marks. Both external and internal examiners shall assess the project in the form of ten point scale. The details of assessment system shall be provided by the Chairman to the examiners.

2. As per the credit system, the assessment of Theory paper of 100 marks weightage will be as: 70 marks theory assessment by University examination and 30 marks internal assessment by the Department. For internal assessment of candidate, periodical tests/seminars/ viva/oral / quiz etc. may be suitably adopted.

## Semester III

**Paper IX Molecular cytogenetics** [Teaching periods-45]

**Unit No. I(A) Fine Structure of Gene:**

Prokaryotic and Eukaryotic genome organization  
Metaphase chromosome. Structure of chromatin, centromere, Telomere and its maintenance.  
Heterochromatin and euchromatin.  
Coding and noncoding sequences, Satellite DNA, Amplification and rearrangement.

**(B) Dosage compensation of sex determination in *Caenorhabditis elegans*, *Drosophila* and human**

**(C) Imprinting of genes , chromosomes and genomes.**

**Unit No. II Genome analysis:**

C value paradox, detailed account of various models of prokaryotic genomes, viral genomes, Eukaryotic genomes, organization of genes in organelle genomes.  
Molecular analysis of genomic DNA in yeast.  
Transposable elements in genetic regulation.  
Genome analysis – humans Yeast, microbial genomes.

**Unit No. III Microbial genetics :**

Bacterial chromosomes, Bacteriophages- types, structure and morphology of T<sub>4</sub> phage.  
Morphogenesis, Lysogeny and Lytic cycle in Bacteriophages, Host cell restriction, Complementation, molecular recombination, DNA ligases, topoisomerases, Gyrase, Methylases, Nucleases, restriction endonucleases, Plasmids and bacteriophage based vectors for cDNA and genomic libraries.

**Unit No. IV Human cytogenetics:**

Techniques in human chromosome analysis. Molecular cytogenetic Approach.  
Human karyotype, banding, nomenclature.  
Chromosome based heritable diseases in human. For example Sickle Cell Anemia, PKU, thalassemia and glaucoma

**Unit No.V(A)**Cytogenetic implications and consequence of structural and numerical alterations of chromosome.

Cytogenetic effects of ionizing and non-ionizing radiation

**(B)** Genetics of cell cycle:

Genetic regulation of cell division in yeast and eukaryotes.

Molecular basis of cellular check points.

**(C)** Molecular cytogenetic techniques

Automated karyotyping

Chromosome painting, DNA Sequencing. Application of RFLP in forensic Science, disease prognosis, genetic counselling and pedigree analysis.

### **Books Recommended**

1. Molecular Biology of the Gene, J.D. Watson , N.H. Hopkins, J.W. Roberts et al The Benjamin/Cummings Pub. Co. Inc., California
2. Molecular Cell Biology, J. Darnell, H Lodish and D. Baltimore Scientific American Books, Inc, USA.
3. Molecular Biology of the Cell B. Alberts, D. Bray. J. Lewis & J.D. Watson. Garland Publishing Inc. New York
4. Molecular Biology and Biotechnology. A comprehensive desk reference . R.A. Meyers (Ed) VCH Publishers, Inc New York
5. Genes VI/VII Benjamin Lewin Oxford University Press UK
6. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Ltd., New York
7. Cell Physiology Molecular Dynamics, Henry Tedeschi (2003) .Running Text Book available on Web link only
8. Essentials of Human Genetics (1990) Orient Longmans Ltd. Bombay

**Paper X Wild life and Conservation Biology [Teaching periods-45]**

**Unit No. I(A) Ecosystem and community :**

Definition and characteristics of community, classification of communities, composition of community, structure/stratification of community, community metabolism and stability, habitat and Niche

**(B) Ecological succession:**

Ecotypes, ecotone, age effect and ecological indicators

**Unit No. II Factors affecting ecosystem and community structure:**

a. Natural factors:

Earthquakes, Tsunamis, volcanoes, landslides and cyclones.

b. Intracommunity factor- competition, antagonism, predation and disease.

c. Anthropogenic factors:

Introduction of exotic species, urbanization, industrialization, sports and tourism.

Habitat loss and its effect on wild life. Patch formation, discontinuous distribution. Breaking of food chain

**Unit No. III(A) Quantifying community diversity:**

Indices of diversity, species rare fraction curves, estimating the total number of species, species area curve, species abundance distributions

**(B) Conservation of nature and natural resources:**

**(C) Traditional conservation practices, agricultural practices, fishing methods etc.**

**Unit No. IV.** Modern conservation practices, Reserve forests, sanctuaries, national parks, biosphere reserves, Biodiversity hotspots etc. Captive breeding of endangered species

**Unit No. V.** Indian Forest Acts, Indian wild life act, red data book and TRAFIC, Earth Summit and agenda, environment impact assessment (EIA)

### Reference Books

1. Ecological Methods with particular reference to the study of insect Populations; Sothwood T.R.E.
2. The Oxford Anthology of Indian Wild life Vol I Hunting and Shooting
3. The Oxford Anthology of Indian Wild life Vol II Watching and Conserving
4. Nair S.M. Endangered Animals in India and Their Conservation
5. English M.A. Animal Kingdoms : Wild Sanctuaries of the World
6. Sanctuary Asia : Bimonthly Journal
7. Biodiversity: E.O. Wilson (1988) National Academies Press

### Paper XI Comparative Animal Physiology [Teaching periods-45]

**Unit No. I** Feeding mechanism and its regulation. Food and diet specificity. Comparative physiology of digestion and nutrition.

**Unit No. II(A)** Physiology of respiratory pigments in different phylogenetic groups. Circulation of body fluids and its regulation. pH regulation of body fluids.

**(B)** Patterns of nitrogen excretion among different animal groups. Osmoregulation in freshwater and marine fishes. Desert adaptations of osmoregulation.

**(C)** Thermoregulation in Poikilotherms, Homeotherms .  
Hibernation

**(D)** Communication in Bees.

**Unit No. III(A)** Chromatophores and its regulation. Role of chromatophores.

**(B)** Physiology of light reception and visual perception.

**Unit No. IV(A)** Physiology of contractile elements – actin, actomyosin, myofilaments, microtubules, myosin, voluntary and involuntary

muscles, Cardiac muscle physiology. Role of isoenzymes (LDH) in cardiac physiology.

(B) Physiology of sleep and anaesthesia.

(C) Control of reproductive mechanism in amniotes( reptiles, birds and mammals) and their Reproductive cycles.

**Unit No. V(A)** Physiology of nervous system with reference to neurohormone regulation in mammals.

(B) Neurotransmitters: Major sense organs and receptors, Homeostatis(Neural and hormonal), Bioluminescence, Circadian rhythms

### **Reference Books**

1. Comparative Animal Physiology. C.L. Prosser. W.B. Saunders and Company
2. General and comparative physiology W.S. Hoar,
3. Animal Physiology: Adaptations and Environment. Schmidt-Nielsen Cambridge
4. Chemical Zoology Academic Press Edited by Florkin and Sheer 7 Volume series
5. Physiology of Mammals and other vertebrates Marshall and Hughes
6. Chemical Zoology Ed. Florkin and Sheer B.T. Academic Press Vol. 1-10.
7. Text Book of Medical Physiology: Guyton , Prism Publishers Bangalore 2004 Ed
8. Comparative Physiology : B.T. Sheer



**Paper XII Biochemistry****[Teaching periods-45]**

**Unit No. I** Structure and role of carbohydrates, lipids, proteins, nucleic acids(A-, B-, Z-, DNA, tRNA), Micro RNA

**Unit No. II** Oxidative phosphorylation, energy conservation and release. cyclic AMP-its structure and role. Bioenergetics, biological energy transducers, Concept of free energy, Redox potential, Thermodynamic principles of biology. Hydrogen bonding, energy rich bonds.

**Unit No. III** Glycolysis, TCA cycle, glycogen breakdown and synthesis, inter conversion of hexoses and pentoses. Amino acid metabolism. coordinated control of metabolism Biosynthesis of purines and pyrimidines, oxidation of lipids.

**Unit No. IV** Biosynthesis of fatty acids, triglycerides, phospholipids and steroids.  $\beta$ - Oxidation of lipids. Metabolic regulation during hypoxia.

**Unit No. V(A)** Classification and nomenclature of enzymes.

Co-enzymes, isoenzymes, allosteric enzymes, ribozyme, abenzymes, enzyme activators, inhibitors, Mechanism of enzyme Catalysis.

**(B)** Enzyme kinetics: Michaelis – Menten equation. Regulation of enzyme activity by non genetic mechanisms. Negative and positive co-operativity.

**(C)** Metabolic engineering, site directed mutagenesis and enzyme engineering.

**(D)** Immobilised enzymes and their applications.

**Reference Books**

1. Biochemistry of Plants and Animals Mallette M.E.
2. Cell Physiology and Biochemistry Mcelroy W.D.
3. Biochemistry, D. Voet and J.G. Voet, J. Wiley and Sons (Now Pearson Education)

4. Biochemistry Mathews C.K. , Holde K.E. Pearson Education
5. Nature of Enzymology R.L. Foster
6. Enzyme Biotechnology Tripathi G.
7. Basic Separation Techniques in Biochemistry (1998) Okotore R.O. New Age Internationals New Delhi.
8. Fundamental Lab Techniques in Biochemistry and Biotechnology (1998) Ninfa A.J. and Ballou O.P. Fitzgeralf Science Press Bethesba
9. Leningers principles of Biochemistry Nelson and Cocks (2001) Mac Millan and Co.
10. Modern Experimental Biochemistry Boyer and Rodney (2001) Benjamin Cunnings NY.
11. Biochemistry Methods Vote D. and Vote J.G. John Wiley USA (2004)

### **Practical: (V)**

1. Human karyotype analysis from photographs, Types of chromosomes,
2. FISH technique
3. Barr body identification and staining
4. Examples of Mendelian inheritance of human genetical diseases
5. Pedigree analysis of human population.
6. Community sampling, quadrat sampling for plants- relative abundance distribution,
7. Community sampling for animals- relative abundance distribution
8. Plaster cast methods for pug mark identification
9. Identification and survey methods of wild life.
10. Hair, antlers, teeth, skin, hide, skull, bones, ivory identification of wild life.
11. Case studies of habitat loss and wild life protection act. Data collection in practical hand book expected.
12. Excursion Tour.
13. Any other practical set by Department.

### **Practical (VI)**

1. Study the oxygen consumption of aquatic animals under stress.
2. Respiratory pigments their analysis and oxygen carrying capacity.
3. Estimation of blood urea.
4. Ammonia estimation in body fluids (suitable invertebrate – crab/earthworm)

5. Colorimetric estimation of glucose.
6. Colorimetric estimation of Protein.
7. Enzyme separation by  $MgCl_2$  gradient methods.
8. Isozyme LDH separation by Electrophoresis.
9. Demonstration of Blood gas analysis.
10. Peritoneal and membrane dialysis. (Experiment may be designed with egg membrane).
11. Estimation of fat / water soluble vitamins
12. Colorimetric estimation of Lactose in Milk.
13. Preparation of Casein.
14. Electrophoresis of proteins.
15. Comparison of RBCs and WBCs in different groups of vertebrates under different environmental conditions.
16. Any other practical set by Department

**Paper XIII Animal Biotechnology [Teaching periods-45]**

**Unit No. I(A)** Cell and tissue culture. Primary cultures, cell line, cell clones, somaclonal variations, micropropagation, somatic embryogenesis, Haploidy, protoplast fusion, and somatic hybridization, Cybrids, Gene transfer methods. Transgenic biology, Allelopathy.

**(B)** Genetically engineered animals and hybridoma technology.

**Unit No. II** Principles and techniques of nucleic acid hybridization and cot curves. Sequencing of proteins and nucleic acids. Computerized models to study Southern, Northern and Western blotting techniques. Polymerase chain reaction. Methods for measuring nucleic acid and protein interactions. FISH and GISH

**Unit No. III** Regulation of gene expression in pro and eukaryotes. Attenuations and operon concept. DNA methylation, Heterochromatization, transposition, regulatory sequences, transecting factors, Environmental regulation of gene expression.

**Unit No. IV(A)** Organization of transcriptional units: Mechanism of transcription of prokaryotic and eukaryotic cells. RNA

processing (Capping, polyadenylation, splicing, introns and exons). Ribonucleoproteins. Structure of mRNA, genetic code and protein synthesis

**(B)** Cell diversification in early embryo, stem cell and stem cell therapy. Totipotency and pluripotency, embryonic stem cells, renewal of stem cells- epidermis, hemopoietic stem cells, stem cells disorder, blood cell formation, bone marrow transplant/placental(cord) blood protocol.

**Unit No.V(A)** Principles and methods of genetic engineering and gene targeting, application in agriculture, health, medicine and industry.

**(B)** Ethical issues in human cloning and biotechnology. Biosafety regulations

### **Reference Books**

1. Guidelines for Human Embryonic Stem Cell Research National Academies Press (2005)
2. Stem Cells and Future Regenerative Medicine (2002) National Academies Press
3. Animal Cell Culture A Practical Approach Ed, John R.W. Masters IRL Press
4. Cell Culture Handbook "Sigma". ( Available with the help of Internet Search Sigma Website)
5. Concepts of Genetics Klug W.S. Cummings M.R. ( 2005) Pearson Education , Delhi
6. Campbell A.M. and Heyer L.J. Discovering Genomics, Proteomics and Bioinformatics Pearson Education (2004)
7. Selvin J. and Others : Biotechnology Emerging trends, Biotech Books Delhi (2003)
8. Cellular Interaction and Immunology (1994) Open University Netherlands University of Greenwich, UK.

**Paper XIV Applied Zoology [Teaching periods-45]**

**Unit No. I** Reproductive technology- Collection and cryopreservation of gametes. Semen analysis, Ovulation induction, Fertility control, amniocentesis, IVF sterility and its treatment. Gamete intrafallopian transfer, Surrogate pregnancy and gestational carrier. Fertility control in male and female. Modern trends in contraception. Hormonal assay. Cancer and reproductive tract infections.

**Unit No. II(A)** Immunology-History, Overview, and scope.

**(B)** Antigen antigenicity, cells and tissue immune system. Innate immunity, Humoral immunity, B lymphocytes, Immunoglobulins, organization and expression of Ig genes.

**(C)** Cell mediated immunity, T lymphocytes, Major Histocompatibility complex. Class I and II molecules. HLA system in human.

**Unit No. III** Development of polyclonal sera, monoclonal antibody production and characterization, Vaccines against communicable and infectious diseases. Conventional and genetically engineered vaccines. DNA vaccines, Immunological tolerance.

**Unit No. IV(A)** Blood bank protocols : Blood matching, separation blood cells, plasma and serum. Blood cell Routine tests of blood for hepatitis and ELISA.

**(B)** Biological warfare and its control. Common methods of biological warfare. Resistance mechanism against biological warfare.

**Unit No. V(A)** Vermitechnology- Importance of vermiculture. Vermiwash, Vermicompost Earthworms as protein source.

**(B)** Important human and veterinary parasites (Protozoa and helminthes) Molecular basis of host parasitic interaction.

### Reference Books

1. Animal Health at Cross Roads : Preventing Detecting and Diagnosing Animal Diseases ( 2005)
2. IVF Protocol (Wikipedia) The Free Web Encyclopaedia
3. Biotechnology Research in Age of Terrorism: National Research Council (2004) National Academies Press
4. Earthworms-Their Ecology and Relationship with Soils and Land Use; Lee K.E.
5. Modern Immunology : Dasgupta
6. Biology of Earthworms ;Edwards C.A. and Lofty J.R
7. Vaccines
8. Blood Transfusion Merck manual (Available on Internet)
9. Immunology; Roitt I.M. / Brostoff J.

### Paper XV Environmental biology and toxicology [Teaching periods-45]

**Unit No. I(A)** Concept and dynamics of ecosystem, components, food chain and energy flow, productivity and biogeochemical cycles, types of ecosystem. Population ecology and biological control, lotic and letic.

**(B)** Limnology- Ecology of lakes ponds and water dams. Agricultural land ecosystem problems .

**Unit No. II** Kinds of aquatic habitats(freshwater and marine), distribution of and impact of environmental factors on the aquatic biota, productivity, mineral cycle and biodegradation in different aquatic ecosystems, biology and ecology of reservoirs. Management of green house and poly house. Induced Pisciculture.

**Unit No. III(A)** Environment pollution in terms of air, water, soil, noise Legislation and Indian standards of pollution levels. Causes and effects of pollution. Radiation and thermal pollution. (Case studies : Chernobyl and three mile island. Minamata disease , Methyl Isocyanates poisoning in Bhopal) Remedial measures.

(B) Case studies of urban trash management. Carbon credits. Solid waste management. Litter and plastic waste management. Biological indicators of pollution

(C) Industrial pollution their control with reference to textile, sugar and dairy industries.

**Unit No. IV** Conservation of natural resources. Rain water harvesting system. Water recycling. Waste water management

**Unit No. V** Toxicology- Classification of toxicants, toxic agents, mode of action. Pesticides, metals, Toxic agents in house hold use. Soil toxicants. Carcinogens used in industries. Food additives in the form of food colours and preservatives. Indian standards.

### **Reference Books**

1. Singh H.R. Introduction to Animal Ecology and Environmental Biology
2. Lee K.E. Earthworms Their Ecology and Relationships with soil and Land use (1985) Academic Press , New York
3. Matsumura Fumio Toxicology of Insecticides (1985) Plenum Press New York
4. Jakob T. Food Adulteration (1977) Macmillan Comp Delhi
5. Jacob T. Foods, Drugs and Cosmetics (1977) Macmillan Comp Delhi
6. Text Book of Environmental Science Purohit/Shammi/ Agrawal (2005 reprint) Student Edition Jodhpur
7. Environmental Biology : Eric Bharucha UGC Press Hyderabad 2005
8. Environmental Toxicology Satake M, Mido Y and others (2001) Discovery Publishers Delhi.
9. Mineral Resources Economic and Environmental Kesler S.E. (1994) Mac-Millan College Publishers London
10. Environmental Medicine Andrew Pope and David Rall (1995) National Academies Press
11. Environmental Challenges in Chemistry in 21st Century Report on Workshop on Environment (2003) National Academies Press
12. Forging a Poison Control System Committee on Poison Control System US (2004)

**Paper XVI Zoo keeping and Animal house management**  
**[Teaching periods-45]**

**Unit No. I(A)** Introduction, Scope, policy of Zoo keeping.

**(B)**Management – Animal behaviour in captivity. Ethical issues  
 - Zoo architecture, Natural habitats, Exhibit design.

**(C)**Housing , feeding, breeding, behaviour in crocodile, lizards ,  
 snakes and tortoises.Snake identification, venom and antivenin.

**Unit No. II** Housing, feeding, behaviour, in water and land  
 birds. Enclosure design. Diurnal and nocturnal birds.  
 Management of grain eater and birds of prey. Flightless birds.

**Unit No. III(A)** Housing , feeding, behaviour in common zoo  
 mammals like monkeys, racoons, rabbits, wild cats, ungulates,  
 grazing mammals . Elephant and camel management.  
**(B)**Veterinary services in zoo. Common disease in zoo reptiles,  
 birds and mammals. Diseases and prevention of zoo diseases.  
**(C)**Public awareness programmes in a zoo. Zoo as conservation  
 recreation , research and educational institute. Permanent  
 displays in zoo.

**Unit No.IV** Documentation permissions, visitor rules regulations and  
 surveillance in a zoo. Accidents, fire fighting, first aid to the  
 zoo animals and visitors.

**Unit No. V** Animal house management- rodent management growth,  
 maintenance, housing, feeding, disinfection procedures in  
 animal house. Taxidermy and applications.

**Reference Books**

1. Animal Care and Management at the National Zoo Review  
 Smithsonian Institute's National Zoological Park (2005) National  
 Academies Press
2. An Introduction to Animal Behaviour , (1997)Cambridge . New York
3. Rodents Laboratory Animal Management : National Academies Press  
 1996



4. Animal care and Management at the National Zoo : Smithsonian Institute's National Zoological Park Interim Report (2004)
5. PJC Zoo Animal Technology On line (Free website)
6. Taxidermy .net
7. Animal Health at the cross roads Preventing Detecting and Diagnosing Animal Diseases (2005) National academies Press

### **Practical (VII)**

1. Preparation of cell culture media for animal cell culture
2. Culture methods of microbiology
3. Isolation of pure cultures
4. Media preparation.
5. Microbial analysis of vermicompost.
6. DNA estimation in cells
7. Experiments in induction of fish / frog oocytes.
8. Hormone assay
9. Separation of serum antibodies
10. Estimation of serum antibodies
11. Ovulation protocols
12. One week actual lab work in IVF clinic and in reputed blood bank is expected.
13. Any other practical se by the department

### **Practical (VIII)**

1. Estimation of residual pesticides in water, soil and vegetables.
2. Residual pesticides in fodder and milk.
3. Water analysis for hardness, detergents, toxicants, colouring agents , nitrates and chlorates.
4. Effect of toxicants on aquatic animals.
5. Record of pollutants of the city.
6. Air sampling methods for dust and fibres.
7. Design of cattle and poultry food for zoo mammals and birds.
8. Construction of animal house.
9. Common zoo diseases and their remedies. Identification and diagnosis
10. To prepare ethogram of various zoo animals.
11. Any other practical se by the department
12. Visit of sea shore/grass land /pond for hydrobiological/ food chain study in a grass land. Visits of polyhouse, apiculture, sericulture and water reservoir.

**Project:** A project as apart of practical examination of 406 is expected. The project is worth 50 marks. Two hard copies and a power point

presentation and a CD of the project is to be submitted during practical examination. A project may be selected at the beginning of the year to get sufficient time for visits data Collection and Presentation.

**Equivalence of Syllabus:**

There is no equivalence for theory and practical of old and new course. The student should appear for theory and practical based on new course only.