SOLAPUR UNIVERSITY, SOLAPUR

M.Sc. Part-I & II - ZOOLOGY

Syllabus New CBCS

w. e. f. June 2016
1) Title of the Course: M. Sc. ZOOLOGY

2) Introduction: This course provides a broad overview of Zoology and to produce expert hands that would have sufficient knowledge and expertise to solve basic needs and today’s urgent problems by using Zoology. The course structure is core-centric and advanced where students basically learn necessary basic subjects and the new technology are taught for that purpose. While preparing the subject due care has been taken by including the views and suggestions of all the stakeholders like employers, students, alumni, parents, industrialists etc. Care has also been taken while preparing the subject so that students will get the preparation of competitive examinations especially UGC-CSIR-NET and the state level SET examination.

3) Objectives of the course:
   The objectives of M. Sc. Zoology course are
   • To provide an intensive and in-depth learning to the students in field of Zoology.
   • Beyond simulating, learning, understanding the techniques, the course also addresses the underlying recurring problems of disciplines in today’s scientific and changing environment.
   • To develop awareness and subject knowledge through varied aspects and training methodology among the students.
   • To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy makers.

4) Advantages of the Course:
   • Zoology has tremendous job potential. The successful students will be able to establish their own entrepreneur business in the field of fisheries, Sericulture, Apiculture, agriculture, environment protection and also their own industry for Solid waste management, clinical pathology, genetic counseling, human karyotyping etc.
   • Medical, Animal & Scientific Research Organizations.
   • Universities in India & abroad.
5) Eligibility of Course:

**Eligibility:** A Candidate possessing Bachelor Degree with Zoology as a principal subject or having a Bachelor Degree of General graduation (with Zoology as one of the subject) certificate with UGC recognition and who have passed the entrance examination conducted by the Solapur University shall be held eligible for admission to M. Sc. Course in Zoology.

- **Admission:** Merit list based on average of B.Sc. aggregate and entrance exam conducted by University. For other university student merit list only on basis of entrance examination conducted by University.

6) Duration:

- The duration for this program is of 2 years with semester pattern (04 Semesters)

7) Medium of Instruction: English

8) Structure of the Course:

- Structure of M.Sc. course in faculty of Science has total of 4 semesters for 2 years.
- M. Sc. I comprise of total two semesters and M. Sc. II comprises of total two semesters.
- Semester I includes four theory papers (3 Hard Core and 1 Soft Core) and practical course as per theory papers.
- Semester II & III includes four theory papers (2 Hard Core, 1 Soft Core and 1 Open Elective) and practical course as per theory papers.
- Semester IV includes four theory papers (3 Hard Core and 1 Soft Core) and a Major project substituting the practical course.
- Each theory paper comprising of 5 units which are distributed in total 60 lecture hours having weightage of 4 credits.
- Practical papers are to be conducted at the end of their respective semester.
- Final year Major project work should begin in III semester and the completed thesis should be submitted at the end of the IV semester.
- Student would have to present his/her project work during the project report submission which would be evaluated by the internal as well as the external examiners.
- As per the credit system, the assessment of Theory paper of 100 marks weightage will be as: 70 marks theory assessment by University examination (UA) and 30 marks internal assessment by the college (CA). For internal assessment of candidate, periodical tests/seminars/viva/oral / quiz etc. may be suitably adopted.
- As per the credit system, the assessment of practical paper of 100 marks weightage will be as: 70 marks practical assessment by University examination (UA) and 30 marks internal assessment by the college (CA).
- In each semester students has to give compulsorily 16 tutorials (4 tutorials per theory paper) with weightage of 25 marks (1 credit).
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M.Sc.II-Zoology NEW C B C S w.e.f. 2017-18

### Semester III

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**Practicals**

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**Practicals**

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L = Lecture  T = Tutorials  P = Practical  UA=University Assessment
IA=Internal Assessment
4 Credits of Theory = 4 Hours of teaching per week
2 Credits of Practical = 4 hours per week
HCT = Hard core theory
SCT = Soft core theory
HCP = Hard core practical
SCP = Soft core practical
OET = Open elective theory
OEP = Open elective practical
MP = Major project
HCT1.1 Biosystematics

Maximum marks 100  
Teaching periods  60=4 credits

Unit 1.
1.0 Definition and basic concept of Biosystematics and Taxonomy.  
1.1 Historical resume of Systematics.  
1.2 Importance and applications of Biosystematics in Biology.  
1.3 International code of Zoological nomenclature.

Unit 2.
2.0 Trends in Biosystematics –concepts of different conventional and newer aspects.  
2.1 Chemotaxonomy.  
2.2 Cytotaxonomy.  
2.3 Molecular taxonomy.

Unit 3.
3.0 Dimensions of speciation and taxonomic characters.  
3.1 Mechanism of speciation in panmictic and apomictic species.  
3.2 Species concepts- category, different concepts, sub-species and other intraspecific categories.  
3.3 Theories of biological classification, hierarchy of categories.  
3.4 Taxonomic characters- different kinds, origin of reproductive isolation- biological mechanism genetic incompatibility.

Unit 4.
4.0 Procedure and keys in taxonomy.  
4.1 Taxonomic collection, preservation and curetting process of identification.  
4.2 Taxonomic keys- different kinds of taxonomic keys, their merits and demerits.  
4.3 Systematic publications- different kinds of publications.  
4.4 Process of typification of different Zoological types.

Unit 5.
5.0 Molecular phylogenetics.  
5.1 How to construct phylogenetic trees?  
5.2 Phylogenetic inference- Distance methods, parsimony methods, Maximum likelihood methods.  
5.3 Immunological techniques.  
5.4 Amino acid sequences and phylogeny.  
5.5 Nucleic acid phylogeny

Suggested Reading Material
2. J.C. Avise – Molecular markers. Natural History and Evolution, Champman & Hall , New York.  
5. E. Mayer- Elements of Taxonomy.  
M.Sc. SEMESTER - I
HCT 1.2   Tools and techniques in Biology

Maximum marks 100                                                                 Teaching periods 60 = 4 credits

Unit 1.
1.0 Principles and uses of analytical Instruments.                                      (12)
   1.1 Spectroscopy (Spectrophotometers, NMR, FTIR)
   1.2 Lasers in Biology.
   1.3 X-rays in Biology.
   1.4 Electron microscope (TEM, SEM)
   1.5 Proteomics

Unit 2.
2.0 Cell culture techniques.                                                               (12)
   2.1 Design and functioning of tissue culture laboratory.
   2.2 Culture media preparation.
   2.3 Types of culture- monolayer, suspension, capillary culture units, feeder layers,
       cell secretions and metabolic harvesting.
   2.4 Cell viability testing.
   2.5 Cell-characterization.
   2.6 Cell-transformation.

Unit 3.
3.0 Cell-based techniques.                                                                (12)
   a) Fusogens-somatic cell - fusion and its application.
   b) Fusion in different cell-cycle phases and its applications.
   c) Cell hybrids and its applications.

Unit 4.
4.0 Cryotechnique.                                                                          (10)
   4.1 Cryopreservation of cells, tissues, organs and organisms.
   4.2 Cryotomy.
   4.3 Freeze - drying and freeze fracturing techniques.

Unit 5.
5.0 Separation techniques and Radiolabelling techniques:                                     (14)
   5.1 Chromatography-TLC& Paper chromatography, electrophoresis and its types,
       column fractionation, .
   5.2 Ultracentrifugation and sub-cellular fractionation.Cell separation by - flowcytometry,
       centrifugation
   5.3 Radiolabel techniques in biology.
   5.4 Radioactivity counter Geigometry and Scintillation.
   5.5 Autoradiography.

Suggested Reading Material
   Biochemistry. ELBS Ed.
7. Cell Cooper, A molecular approach Second Edition
10. Cell Physiology
M.Sc. SEMESTER - I
HCT 1.3     Cell and Molecular Biology

Maximum marks 100

Unit 1.
1.0 Biomembranes. (14)
   1.1 Molecular composition, arrangement and functional consequences.
   1.2 Transport across the cell membrane - Passive and active transport, pumps, uniports, symports and antiports.
   1.3 Transport across epithelia
   1.4 Membrane potential
   1.5 Integrins.
   1.6 Collagens
   1.7 Cell junctions (tight, adhesion belts, focal contacts, septate, desmosomes, Hemidesmosomes, gap, chemical synapses, plasmodesmata).

Unit 2.
2.0 Structural organization and function of intracellular organelles: (12)
   nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum.

Unit 3.
3.0 Cytoskeleton. (10)
   3.1 Microfilaments and microtubules - structure and dynamics.
   3.2 Cilia, flagella - structure and dynamics.
   3.3 Microtubules and mitosis.
   3.4 Microtubular organizing centers - centriole, kinetochore, basal bodies.
   3.5 Intermediate filaments- Structure and function.
   3.6 Actin- binding proteins.
   3.7 Cell movement and cytoskeleton.

Unit 4.
4.0 Cell organelles and cell traffic. (14)
   4.1 Protein synthesis on free and bound polysomes.
   4.2 Uptake into ER.
   4.3 Membrane proteins and other proteins in ER.
   4.4 Post transcriptional modification and protein sorting in Golgi apparatus.
   4.5 Lysosomal assembly and functions.
   4.6 Biogenesis of mitochondria.

Unit 5.
5.0 Biology of cancer- cases of cancer, cancer cell morphology and properties. (10)

Suggested Reading Material
M.Sc. SEMESTER - I  
SCT 1.1  Population Genetics and Evolution

Maximum marks 100  
Teaching periods 60=4credits

Unit 1.
1.0 Concepts of evolution and theories of organic evolution.  (12)
   Emergence of evolutionary thoughts: Lamarck; Darwin–concepts of variation, adaptation, 
   struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary 
   synthesis.

Unit 2.
2.0 Neo Darwinism.  (12)
   2.1 Hardy - Weinberg Law of genetic equilibrium.
   2.2 A Detailed account of destabilizing forces a) Natural selection b) Mutation c) Genetic 
   drift d) Migration e) Meiotic drive

Unit 3.
3.0 Molecular population genetics.  (12)
   3.1 Patterns of change in nucleotide and amino acid sequences.
   3.2 Ecological significance of molecular variations.
   3.3 Emergence of Neo-Darwinism-neutral hypothesis.

Unit 4.
4.0 Molecular evolution.  (12)
   4.1 Gene evolution.
   4.2 Evolution of gene families, Molecular drive in evolution.
   4.3 Assessment of molecular variation.
   4.4 Evolutionary links based on gene and protein families 
   and eukaryotic evolution based on different gene families

Unit 5.
5.0 Genetics of speciation.  (12)
   5.1 Phylogenetic and biological concept of speciation.
   5.2 Patterns and mechanisms of reproductive isolation.
   5.3 Models of speciation (Allopatric, Sympatric Parapatric).

Suggested Reading Material
   Education. Delhi
9. PBS Org. Website for Evolution concept
SCT 1.2 PROTOZOOLOGY

Marks 100  
Teaching periods 60= 4 Credits

Unit –1.  
i. Classification of Protozoa  
ii. Factors influencing the distribution of protozoa: Oxygen, Carbon dioxide, pH , Light, Food , Nutrition  
iii. Ecology of free living Protozoa

Unit –2  
Nutrition in Protozoa  
i. Methods of feeding  
a. Filter feeding  
b. Raptorial feeding  
c. Diffusion feeding  
ii. Digestion  
iii. Nutritional requirements

UNIT – 3  
1. General organization and morphology of the parasitic flagellates occurring in digestive tract of man.  
i. Retartomonas intestinalis  
ii. Chilomastix mesnili  
iii. Giardia lamblia  
iv. Trichomonas tenax

UNIT – 4  
1. General morphology, life cycle, transmission and pathology of parasitic Amoebae of man and domestic animals.  
i. Entamoeba histolytica  
ii. E. gingivalis

UNIT – 5  
2. Coccidia of poultry with special reference to the structure, treatment and control.  
3. Parasitism in ciliophora – structure, Life cycle, Pathogenesis and control of  
i. Ichthiotherius multifilis  
ii. Balantidium coli

Text Books:  
1. Aikawa and Sterling - Intracellular Parasitic Protozoa  
2. Baker - Prasitic Protozoa  
3. Chandler and Read - An introduction to Parasitology  
4. Chatterjee K. D. Parasitology (Protozoology and Helminthology)  
5. Thomas C. Cheng - General Parasitology  
6. Corliss - The ciliate Protozoa  
7. Dogiel - An Introduction to Protozoology  
8. Faust, Russel and Jung - Clinical Parasitology  
9. Hall - Protozoology  
10. Hoare - Trypanosomes of mammals  
11. Kudo - Protozoology  
12. Levine - An introduction to Protozoan parasites of domestic animals and of man
M.Sc. SEMESTER – I
PRACTICAL PAPER

HCP 1.1 BIOSYSTEMATICS

Marks 50

1. Calculation diversity indices to zooplankton populations from freshwater resources.
2. Classification of Invertebrates -40 Specimens.
3. Study of types of invertebrate larvae –Peculiarities and evolutionary significance.
5. Identification of poisonous and Non poisonous snakes.

HCP 1.2 TOOLS AND TECHNIQUES

Marks 50

1. Study of different laboratory equipments
2. Study of different microscopes
3. Cell separation by density gradient centrifugation
4. Separation of amino acids by paper chromatography.
5. Separation of Sugars by paper chromatography.
6. Isolation of active ingredients from natural resources by using column chromatography.
7. Sub cellular fractionation by using ultra centrifugation.
8. DNA Extraction and Isolation.
9. Analysis of DNA samples by gel electrophoresis.
10. Visit to ZSI, Seashore/ National Institutes /Wildlife Sanctuary/ National Parks/ Water reservoirs

HCP 1.3 Cell and Molecular Biology

Marks 50

1. Sub cellular fractionation of suitable material to show nucleus and mitochondria.
2. Estimation of marker enzyme – succinic dehydrogenase in mitochondrial fraction.
3. Demonstration of collagen in Liver section.
4. Metaphasic chromosome preparation of mitosis
5. Demonstration of meiosis in Onion bud.
SCP 1.1 Population genetics and evolution

1. Migration influenced examples identification with pictures.
2. Isolation influenced examples identification with pictures.
3. Evolution influenced examples identification with pictures.
5. Construction of Phylogenetic trees based on DNA, RNA and RFLP
6. Prezygotic Isolation in some Sp. of Drosophila.
7. Case studies related population genetics and evolution.

SCP 1.2 PROTOZOOLOGY (Practical)

1. Classification of parasitic protozoa by charts and models.
2. Planktonic protozoa
3. Study of ciliates in alimentary canal of vertebrates and invertebrates by charts and models
5. Preparation of blood smear, staining and identification of staining of Protozoans
6. Examination of fecal sample of vertebrate host for oocyst of coccidia.
7. Observation of oocysts for sporulation.
8. Study of different mosquito vectors of protozoan parasites.
9. Study of binary fission and conjugation in ciliates.
M.Sc. SEMISTER - II
HCT2.1 Developmental Biology

Marks=100
Teaching periods 60 =4credits

Unit 1
Evolution of sexual reproduction in Eukaryotes (10)

Unit 2
Study of egg, blastula, gastrula and three germ layers in Amphioxus, Frog, Chick and Mammals and Fertilization
Capacitation (16)

Unit 3
Introduction to Organogenesis (08)

Unit 4
Development of limbs in fishes, amphibians, birds, and mammals.
Regulation of limb development in chordates. (12)

Unit 5
Development of anteriority to posteriority in Drosophila and Chordates.
Regulation of development in Drosophila. programmed cell death .
Cell apoptosis , its role in development of human limbs. (14)

Suggested Reading Material

1. Turner, C.D. and Bangara J.T. General Endocrinology
M.Sc. SEMESTER - II
HCT 2.2 General and Comparative endocrinology
Marks=100
Teaching periods 60 =4credits

Unit 1
1.0 Endocrinology: General consideration. (16)
   1.1 Discovery of hormones.
   1.2 Classification and chemical nature of hormones.
   1.3 Experimental methods of hormone study.
   1.4 Hormones of gastrointestinal tract

Unit 2
2.0 Neuroendocrine system of vertebrates and neurosecretion of invertebrates. (10)

Unit 3.
3.0 Biosynthesis and mechanism of hormone secretion. (10)
   3.1 Biosynthesis of amino acid derivative peptide and steroid hormones.
   3.2 Hormones: Secretion, transport and degradation.
   3.3 Hormones and homeostasis.
   3.4 Hormone receptors and mechanism of hormone action.
   3.5 Hormonal regulation of metabolism.

Unit 4.
4.0 Hormone action in different facets of life. (10)
   4.1 Growth
   4.2 Migration and color change.
   4.3 Behavior.

Unit 5
5.0 Hormones and reproduction in vertebrates. (14)
   Reproductive System: Development and differentiation of
gonads, genital ducts, external genitalia,
mechanism of sex differentiation.
Outline and histological of male reproductive system and female reproductive system .
Hormonal control of implantation;
Hormonal regulation of gestation, pregnancy diagnosis,
Mechanism of parturition and its hormonal regulation;
Lactation and its regulation

Suggested Reading Material
2. Turner, C.D. General Endocrinology,
5. Turner, C.D. and Bangara J.T. General Endocrinology
8 Burch, Warner M.; Burch; Endocrinology, Lippincott Williams & Wilkins.
9 Felig; Endocrinology And Metabolism .McGraw-Hill ISE.
M.Sc. SEMESTER - II
SCT2.1 Environmental Physiology

Marks 100
Teaching periods: 60=4 credits

Unit 1.
1.0 Homeostasis and physiological regulations. (06)
   1.1 Concept of homeostasis
   1.2 Acclimatization-acclimatization and adaptation

Unit 2.
2.0 Physiology of stress. (14)
   2.1 Fundamental concept of stress
   2.2 Causes and effects of stress.
   2.3 Stress, strain and fatigue.
   2.4 Environmental stresses (temperature, light, humidity, vibration, noise and toxins.
   2.5 Physiological responses to stresses.
   2.6 Stress management.
   2.7 Man under stress.

Unit 3.
3.0 Environment and Health. (10)
   3.1 Environmental health hazards.
   3.2 Industrial health hazards.
   3.3 Occupational diseases.
   3.4 Man-machine and environment system.

Unit 4.
4.0 Space physiology (10)

Unit 5.
5.0 Blood and circulation (20)
   Blood corpuscles, haemopoiesis and formed elements,
   Comparative anatomy of heart structure, myogenic heart, specialized tissue,
   ECG – its principle and significance, cardiac cycle,
   heart as a pump, blood pressure,
   neural and chemical regulation of all above.

Suggested Reading Material

3. Pummer L. Practical Biochemistry , Tata McGrow– Hill.
SCT 2.2 HELMINTHOLOGY

Marks=100  Teaching periods 60=4redits

Unit I Introduction, history and scope of Helminthology  (12)
1. General organization and Classification of Platyhelminthes.
2. General organization and Classification of Nemathelminths
3. Cestodes (Cestodarians and Eucestodes).
4. Trematodes (Monogenea, Aspidobothria and Digenea)
5. Host – parasite Interaction

Unit- II  (12)
Geographical distribution, habitat, morphology (Structure), life cycle, pathogenicity, diagnosis, treatment and prevention of the following type.

*Trematode:*
1) *Fasciola hepatica*
2) *Fasciolopsis buski*
3) *Schistosoma haematobium*
4) *Paragonimus westermani*

Unit- III  (12)
Geographical distribution, habitat, morphology (Structure), life cycle, pathogenicity, diagnosis, treatment and prevention of the following type.

*Cestode:*
1) *Taenia saginata*
2) *Dipylidium caninum*
3) *Hymenolepis nana*
4) *Echinococcus granulosus*

Unit- IV  (12)
Geographical distribution, habitat, morphology (Structure), life cycle, pathogenicity, diagnosis, treatment and prevention of the following type.

*Nematode:*
1) *Ascaris lumbricoides*
2) *Ancylostoma duodenale*
3) *Wuchereria bancrofti*
4) *Enterobius vermicularis*

Unit-V: Clinical Helminthology  (12)
1) Chemicals and reagents used in preservation of parasitic materials
2) Collection, processing and identification of parasites,
3) Recovery of parasite eggs and larvae from faecal specimens
4) Antihelminthic drugs
Reference Books

1. Medical Parasitology by Markell, Voge and John, 8thed. W.B. Saunders Co.
5. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh - Smyth J.D (1977)
11. The Zoology of Tapeworm. - Wardle and Mcleod (1952)
12. The advances in the Zoology of tapeworm from Wardle and Mcleod (1952)
14. The Physiology of Cestodes. - J.D Smyth
15. Vertebrate Nematodes - York and Mapelston
M.Sc. SEMESTER – II
OET 2.1 Computational Biology

Maximum marks 100  Teaching periods 60=4credits

Unit 1
1.0 Measures of Central Tendency and measures of dispersion: (12)
   1.1 Arithmetic mean, median and mode
   1.2 Absolute and relative measures of dispersion:
       Range and its coefficient,
       Mean deviation and its coefficient,
       Quartile deviation and its coefficient,
       Standard deviation and its coefficient,
       Coefficient of variation.

Unit 2.
2.0 Correlation and regression (ungrouped data): (12)
   Concept of correlation and regression,
   Methods of studying correlation
   a) Scatter diagram
   b) Karl Pearson’s coefficient of correlation and
   c) Rank correlation

Unit 3.
3.0 Probability (10)
   3.1 Elements of Probability, classical definition of probability

Unit 4.
4.0 Probability distributions (12)
   4.1 Introduction to probability distribution
   4.2 Definition and properties of binomial distribution and normal distribution.

Unit 5.
5.0 Tests of simple hypothesis (14)
   5.1 Based on normal distribution
   5.2 Student’s ‘t’ test (paired, unpaired)
   5.3 Chi-square tests for goodness of fit and for independence of attributes.
   5.4 One way Analysis of variance

Suggested Reading Material
OET2.2 Research Methodology and Intellectual Property Right

Marks=100                                                                                     Teaching periods 60 =4credits

Unit I
Collection of literature- Books - Journals. Digital library and search of articles - Key words and search - Internet – Google Scholar – Pub med – Inflibnet – Medline – Agricola – Science direct - Open access Journals - other sources. Short communications –review articles.Funding agencies UGC, DBT, DST. (10)

Unit II
Collection of samples / data – Data analysis – Microsoft Excel – Construction of tables – headings - footer - hypothesis testing – Test of Significance – Tabulation – Presentation of results - Use of SPSS. (10)

Unit III

Unit IV
Thesis structure –Components - Writing Introduction – review of literature – Materials & Methods – Presentation of results – Discussion of Results based on literature – Arriving conclusions – Briefing of Summary – Arrangement and how to quote reference in thesis - Appendix. (05)

Unit V

Reference Books
M.Sc. SEMESTER – II
PRACTICAL

HCP 2.1 Developmental Biology

1. Sperm motility test and analysis.
2. Study of Different Phases of Oestrus Cycle in Rat.
3. To demonstrate acrosomal development in Rat testis by PAS method.
4. Procedure to understand embryological stages of chick up to 72hrs’ by non invasive method’ using CD/Model/Chart

HCP 2.2 General and Comparative endocrinology

1. Study of testicular cells- Sertoli cells, Interstitial cells and sperm cells in the sections of testis.
2. Demonstration of pituitary cell types,
3. Demonstration of neurosecretory cells.
4. Bioassay of estrogen by vaginal smear technique by photos / pictures
5. Effect of Adrenalin and Atropine Sulphates.
6. Study of different endocrine glands of vertebrates and invertebrates.

SCP 2.1 Environmental Physiology

1. Heart perfusion and recording of cardiogram of frog by CD/Model/Virtual demonstration.
2. Estimation of rate of O2 consumption by the freshwater fish.
3. Effect of Temperature on pulse rate/heart rate.
4. Mounting of spiracle and trachea – CD/Slide/Model
5. Effect of aphytotoxins, or CCl4 induced in rat liver
6. Estimation of Blood lactic Acid in frog
7. To study digestive enzyme(Amylase, Protease and lipase), by standard methods
8. To study effects of various Physical and chemical factors on enzyme activity and to demonstrate the protein nature of enzyme.

SCP 2.2 Helminthology

1) Identification of trematodes from various hosts.
2) Identification of cestodes from various hosts.
3) Identification of nematodes from various hosts.
4) Procedure for Preservation, staining and identification of trematodes.
5) Procedure for Preservation, staining and identification of cestodes.
6) Procedure for Preservation, staining and identification of parasitic nematodes.
7) Identification of helminth eggs and larval stages.
8) Study and use of antihelminthic drugs
OEP 2.1 Computational Biology
1. Measures of central tendency.
3. Coefficient of variation.
4. Correlation coefficient and regression coefficient (Ungrouped data)
5. Problems based on classical definition of probability.
6. Example based on Chi-square test.
7. Example based on Student’s t test.
8. ANOVA.

OEP 2.2 Research Methodology and Intellectual Property Right
1. Preparation of project proposal for Funding agencies (UGC)
2. To suggest a title to the given abstract/paper.
3. Assigning legends to given graphs, figures and captions to given tables.
4. Study of proof correction symbols; proof- reading the given text and correcting the proofs.
5. Designing of tables and graphs from the given data.
6. How to write materials and methods, observation section of a research paper.
7. Write discussion section for the given discussion less research paper.
8. Citations/ References: how to find and cite references from journals, books and databases.
9. Oral presentation: Rhythm, style, control, mock presentation for 10 minutes
11. Writing of Indian patent.
SOLAPUR UNIVERSITY, SOLAPUR
M.Sc. ZOOLOGY Part II Syllabus
(Choice Based Credit System)
To be implemented from year 2017-2018

SEMESTER- III

HCT 3.1 Molecular cytogenetics

Marks=100 Teaching periods 60 = 4 credits

Unit 1.

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

(C) Imprinting of genes, chromosomes and genomes. (14)

Unit 2.
Genome analysis:

Unit 3.
Microbial genetics:
Bacterial chromosomes, Bacteriophages- types, structure and morphology of T4 phage. Morphogenesis, Lysogeny and Lytic cycle in Bacteriophages, Host cell restriction, Complementation, molecular recombination, DNA ligases, topoisomerases, Gyrases, Methylases, Nucleases, restriction endonucleases, Plasmids and bacteriophage based vectors for cDNA and genomic libraries. (10)

Unit 4.
Human cytogenetics:
Unit 5.

(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
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
HCT 3.2  Biochemistry

Marks=100                                                                                     Teaching periods60 =4credits

Unit 1.
Structure and role of carbohydrates, lipids, proteins, nucleic acids (A-, B-, Z-, DNA, tRNA),
Micro RNA

Unit 2.
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 3.
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.

Unit 4.
Biosynthesis of fatty acids, triglycerides, phospholipids and steroids. β- Oxidation of lipids.
Metabolic regulation during hypoxia.

Unit 5.
(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.
4. Biochemistry Mathews C.K. , Holde K.E. Pearson Education
5. Nature of Enzymology R.L. Foster
6. Enzyme Biotechnology Tripathi G.
Ballou O.P. Fitzgerald Science Press Bethesda
Unit 1.
Feeding mechanism and its regulation. Food and diet specificity. Comparative physiology of digestion and nutrition. (10)

Unit 2.
(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. (14)

Unit 3.
(A) Chromatophores and its regulation. Role of chromatophores.
(B) Physiology of light reception and visual perception. (10)

Unit 4.
(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. (14)

Unit 5.
(A) Physiology of nervous system with reference to neurohormone regulation in mammals.
(B) Neurotransmitters: Major sense organs and receptors, Homeostasis (Neural and hormonal), Bioluminescence, Circadian rhythms (12)

Reference Books
2. General and comparative physiology W.S. Hoar,
4. Chemical Zoology Academic Press Edited by Florkin and Sheer 7 Volume series
5. Physiology of Mammals and other vertebrates Marshall and Hughes
8. Comparative Physiology : B.T. Sheer
SCT 3.2 Economic Entomology

Unit 1.
Industrial Entomology
1.1: Sericulture- Types of silk worm. Life cycle and rearing of mulberry silkworm (Bombyx mori) and its economic importance.
1.2: Life cycle and rearing of non mulberry silkworm (Tassar, Anthera mylitta): brief idea of cocoon processing for silk fabric-cocoon boiling, reeling, rereeling, winding, doubling, twisting, and weaving.
1.3: Apiculture: Types of honey bees. Life cycle, beehive, bee product and its economic importance.
1.4: Lac culture: Lac insect Laccifer lacca-life cycle, lac processing, lac product and its economic importance.

Unit 2
Study of Insect pest
2.1: Agricultural pest- Grasshopper, Red cotton Bug, cotton spotted ball worm, cotton pink ball worm, gram pod borer
2.2: Medical pest: Housefly, mosquito, Pediculus humanus (head louse)
Bed bug (Cimex)
2.3: House hold pest: Cockroach, termite.
2.4: Veterinary pest: Ticks, mites, Bird lice
2.5: Vegetable pest: The red pumkin beetle, Pieris brassicae, brinjal fruit borer, The Hadda beetle

Unit 3
Methods of pest control
3.1: Natural control, Applied control, Integrated pest management (IPM)
3.2: Chemical control: Insecticides, Pyrethroids, carbamates mode of action merits and demerits.
3.3: Biological control: Biological agents-predators and parasites; merits and demerits

Unit 4.
Disease caused insect vectors
4.1: Malaria, Fialaria, Dengue
4.2: Sleeping sickness, Leishmaniasis (Kala azar) Biology of Parasites

Unit 5.
Animal association (12)
5.1: Types of Parasites, Types of Hosts, Interrelationship between host and parasite
5.2: Responses and hosts to parasitic infection, Mode of transmission of parasite,
5.3: Host specificity and parasitic adaptation
**Suggested Readings**

2. Elements of Entomology - Rajendra Singh.
11. Lac culture in India farm information unit, DEMOFA, New Delhi S.Krishnaswami.
17. Economic Zoology – Shukla Upadhaya. Saras Publication
18. Invertebrate Zoology - R.L Kotpal
OPEN ELECTIVE (Any one)
OET 3.1  Wild life and Conservation Biology

Marks=100  Teaching periods 60 =4credits

Unit 1.
(A) Ecosystem and community: Definition and characteristics of community, classification of communities, composition of community, structure/stratification of community, habitat and Niche.
(B) Ecological succession: Ecotypes, ecotone

Unit 2.
Factors affecting ecosystem and community structure:
b. Intracommunity factor- competition, antagonism.
c. Anthropogenic factors: Introduction of exotic species, urbanization, industrialization, Patch formation, Breaking of food chain

Unit 3.
(A) Quantifying community diversity: Indices of diversity, species abundance distributions
(B) Conservation of nature and natural resources:
(C) Traditional conservation practices, agricultural practices, fishing methods etc.

Unit 4.
Modern conservation practices,
Reserve forests, sanctuaries, national parks,
Biodiversity hotspots etc.
Captive breeding of endangered species

Unit 5.
Indian Forest Acts, Indian wild life act,
red data book ,
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
Unit 1. Ecosystem: (12)
1.1. Structure and function;
1.2. Energy flow and energy pyramids.
1.3. Mineral cycling (Carbon, Nitrogen, Phosphorus);
1.4. Primary production and decomposition;
1.5. Structure and function of some Indian ecosystems:
Terrestrial (forest) and Aquatic (fresh water)

Unit 2. Habitat and niche: (12)
2.1. Concept of habitat and niche;
2.2. Niche width and overlap;
2.3. Fundamental and realized niche;

Unit 3. Species interactions: (12)
3.1. Types of interactions-Interspecific: Commensalism, Mutualism, Parasitism, Symbiosis, Competition Intraspecific Interactions
3.2. Community ecology: Nature of communities; Community structure and attributes; Edges and ecotones.

Unit 4. Population ecology & Ethology: (12)
4.1. Characteristics of a population;
4.2. Population growth curves;
4.3. Population regulation;
4.4. Stereotyped and acquired behaviour Social behaviour, altruistic behaviour, orientation and echolocation; Biological rhythms

Unit 5. Applied ecology: (12)
1. Environmental pollution;
2. Global environmental change;
3. Biodiversity
b. Patterns of Biodiversity;
PRACTICAL

HCP 3.1 Molecular cytogenetics
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. study following techniques through photographs
   a) Southern Blotting
   b) Northern Blotting
   c) Western Blotting
   d) DNA Sequencing (Sanger's Method)
   e) PCR
   f) DNA fingerprinting

HCP 3.2 Biochemistry
1. Estimation of blood urea.
2. Colorimetric estimation of glucose.
3. Colorimetric estimation of Protein.
4. Isozyme LDH separation by Electrophoresis.
5. Estimation of fat / water soluble vitamins
7. Preparation of Casein.
8. Electrophoresis of proteins.
9. Excursion Tour (Local/ Sanctuary/ Science centre/ Aquatic or terrestrial ecosystem/ research centre).

SCP3.1 Comparative animal physiology
1. Study the oxygen consumption of aquatic animals under stress.
2. Respiratory pigments their analysis and oxygen carrying capacity.
3. Ammonia estimation in body fluids (suitable invertebrate –crab/earthworm)
5. Peritoneal and membrane dialysis. (Experiment may be designed with egg membrane).
6. Comparison of RBCs and WBCs in different groups of vertebrates under different environmental conditions.
7. Enzyme separation by MgCl₂ gradient methods.
8. Any other practical set by Department

SCP3.2 Economic Entomology
1. Pests of stored gains.
2. Household pests.
3. Pests of medical importance.
4. Pests of veterinary importance.
5. Forest pests.
6. Types of silk moths.
7. Rearing appliances of mulberry silk worm and demonstration.
8. Study of forensic insects
10. Life cycle and types of honey bees.
11. Lac insect economic importance.
OEP 3.1 Wild Life and Conservation Biology

1. Community sampling, quadrat sampling for plants - relative abundance distribution,  
2. Community sampling for animals - relative abundance distribution  
3. Plaster cast methods for pug mark identification  
4. Identification and survey methods of wild life.  
5. Hair, antlers, teeth, skin, hide, skull, bones, ivory identification of wild life.  
7. Any other practical set by Department.

OEP 3.2 Ecology & Ethology

1. Study of ecosystem biodiversity of local area.  
2. Estimation of DO/ BOD  
4. Estimation of Salinity /Nitrates and phosphates from a given water sample.  
5. Biomass analysis in a given ecosystem.  
6. Productivity estimation in given ecosystem (Primary and Secondary)  
7. Study of efficiency of sampling method.  
8. Study of air quality and aerobiology in given area.  
9. Estimation of various physical parameters of water (SSP, Turbidity, TDS etc).  
10. Visit to any biodiversity center /National park/Sanctuary and submission of report.
HCT4.1 Animal Biotechnology

Marks=100                                                                                     Teaching periods 60 =4credits

Unit 1.
(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 (10)

Unit 2.
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 (20)

Unit 3.
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. (20)

Unit 4.
A) Organization of transcriptional units: Mechanism of transcrioption of prokaryotic and 
eukaryotic cells. RNA processing (Capping, polyadenyalation, splicing, introns andexons).
Ribonucleoprotiens. Structure of mRNA, genetic code and protein synthesis.
(B) Cell diversification in early embryo, stem cell and stem cell therapy. Totipotency and 
pleuripotency, embryonic stem cells, renewal of stem cells- epidermis, hemopoitic stem cells,
stemcells disorder, blood cell formation, bone marrow transplant/ placental(cord) blood protocol. (10)

Unit 5.
(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 (10)

Reference Books
4. Cell Culture Handbook “Sigma”. ( Available with the help of Internet Search Sigma Website)
6. Campbell A.M. and Heyer L.J. Discovering Genomics, Proteomics and Bioinformatics 
Netherlands University of Greenwich, UK.
HCT4.2 Applied Zoology

Marks=100

Teaching periods 60 = 4 credits

Unit 1

Unit 2
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. (20)

Unit 3
Development of polyclonal sera, monoclonal antibody production and characterization, Vaccines against communicable and infectious diseases. Conventional and genetically engineered vaccines. DNA vaccines, Immunological tolerance. (10)

Unit 4

Unit 5
(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. (10)

Reference Books
2. IVF Protocol (Wikipedia) The Free Web Encyclopaedia
4. Earthworms-Their Ecology and Relationship with Soils and Land Use; Lee K.E.
5. Modern Immunology: Dasgupta
7. Vaccines
9. Immunology; Roitt I.M. / Brostoff J.
HCT4.3 Environmental biology and toxicology

Marks=100 Teaching periods 60 =4credits

Unit 1.
(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 lentic.
(B) Limnology- Ecology of lakes ponds and water dams. Agricultural land ecosystem problems

Unit 2.
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 3.
(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. (Casestudies : 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 wastemanagement. Biological indicators of pollution
(C) Industrial pollution their control with reference to textile, sugar and dairy industries.

Unit 4.
Conservation of natural resources. Rain water harvesting system. Water recycling. Waste water management

Unit 5.

Reference Books
1. Singh H.R. Introduction to Animal Ecology and Environmental Biology
5. Jacob T. Foods, Drugs and Cosmetics (1977) Macmillan Comp Delhi
SCT4.1 Zoo keeping and Animal house management

Marks=100

Teaching periods 60 =4credits

Unit 1.
(A) Introduction, Scope, policy of Zoo keeping.
(B) Management – Animal behaviour in captivity. Ethical issues - Zoo architecture
(C) Housing, feeding, breeding, behaviour in crocodile, snakes and tortoises.
Snake identification,

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Unit 2.
Housing, feeding, behaviour, in water and land birds. Enclosure design.
Diurnal and nocturnal birds.
Management of grain eater and birds of prey.

10

Unit 3.
(A) Housing , feeding, behaviour in common zoo mammals like monkeys, rabbits, wild cats, ungulates, grazing mammals.
Elephant and camel management.
(B) Veterinary services in zoo. Common disease in zoo reptiles, mammals.
Diseases and prevention of zoo diseases.
(C) Public awareness programmes in a zoo.

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Unit 4.
Documentation permissions, visitor rules regulations and surveillance in a zoo. Accidents, fire fighting, first aid to the zoo animals and visitors.

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Unit 5.
Animal house management- rodent management growth, maintenance, housing, feeding, disinfection procedures in animal house.
Taxidermy and applications.

10

Reference Books
5. PJC Zoo Animal Technology On line (Free website)
6. Taxidermy.net
**Unit -1**
General characters and classification of fresh and marine water fishes.
Identification of larval stages of major carps.
Identification of fishes up to species level,

**Unit -2**
Aquatic ecosystems: Fresh, brackish and marine water ecosystems.
Identification of plankton, nekton and benthos.
Role of plankton in fish culture.

**Unit -3**
Culture techniques of major carps.
Breeding techniques, Induced breeding, breeding in happa,
Types of fish culture -Cage culture, Monoculture, Poly culture.
Types of hatcheries, hatching happa, Chinese hatchery.

**Unit – 4**
Conventional and non-conventional fishing methods.
Fishing crafts and gears.
Fish products and by-products.
Fish preservation techniques.

**Unit -5**
Coloration in fishes, physiology of coloration,
Types of migration,
Bioluminescence and physiology of light production in fishes.
Venom and venomous glands, electric organ in fishes.

**Books**
1. Prosser & Brown- Comparative Physiology
2. Leninger- Principles of Biochemistry
3. Harper-. Physiological Chemistry
15. Day, F. -The fishes of India.
MP 4. **Project:** The project is worth 200 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.

**Note:**
As per the guidelines of **UGC notification number F.14-6/2014(CPP-II) dated 1st August, 2014** it is now essential to make necessary modifications to stop dissection and promote and orient students towards the knowledge component rather than skill development. However, ITC based virtual dissections are promoted. Now, the responsibility to discontinue dissections and use of animals in experiments totally rests on concerned authorities of respective colleges/Institutes. As per the notification it is important to encourage the field trips and observations without disturbing the biodiversity. For laboratory observations existing permanent slides and specimens should be shown. As per the guidelines of UGC, all the Zoology departments should be empowered with infrastructure to adopt Information communication technology (ICT) required for the purpose of virtual dissections for which virtual class room / laboratory to be enriched with few computers (according to the strength of students), internet facility, printer etc.

Note: The excursion tour may be arranged by abiding the rules of Government of Maharashtra/Solapur university/Parent Institute.