

**SOLAPUR UNIVERSITY,  
SOLAPUR**

**M.Sc. Part-I&II- ZOOLOGY**

**Syllabus New CBCS**

**w. e. f. June 2016**

# **SOLAPUR UNIVERSITY, SOLAPUR**

## **M. SC. ZOOLOGY**

### **SYLLABUS: NEW CBCS PATTERN**

**(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).



**SOLAPUR UNIVERSITY, SOLAPUR**  
**Syllabus for M.Sc. Zoology Part - I**  
 (w. e. f. June, 2016)

**COURSE STRUCTURE**

<b>M.Sc.I- ZOOLOGY NEW C B C S w.e.f. 2016-17</b>									
<b>SEMESTER I</b>									
<b>Sem I</b>	<b>Code</b>	<b>Title of the Paper</b>	<b>Semester Exam.</b>			<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
			<b>UA</b>	<b>IA</b>	<b>Total</b>				
		<b>Hard Core</b>							
<b>ZOO</b>	HCT 1.1	Biosystematics	70	30	100	4	----	----	4
	HCT 1.2	Tools and Techniques in Biology.	70	30	100	4	----	----	4
	HCT 1.3	Cell and molecular Biology	70	30	100	4	----	----	4
<b>Soft Core (Any one)</b>									
	SCT 1.1	Population Genetics and Evolution	70	30	100	4	---	----	4
	SCT 1.2	Protozoology	70	30	100	4	---	----	
		Tutorial			25		1		1
<b>Practicals</b>									
	HCP 1.1	<b>Practical Course HCP 1.1</b>	35	15	50	----	---	2	6
	HCP 1.2	<b>Practical Course HCP 1.2</b>	35	15	50	----	---	2	
	HCP 1.3	<b>Practical Course HCP 1.3</b>	35	15	50	----	---	2	
<b>Soft Core (Any one)</b>									
	SCP 1.1	<b>Practical Course SCP 1.1</b>	35	15	50	----	---	2	2
	SCP 1.2	<b>Practical Course SCP 1.2</b>	35	15	50	----	---	2	
Total for First Semester			420	180	625	----	---		25

<b>Semester II</b>									
	<b>Code</b>	<b>Title of the Paper</b>	<b>Semester Exam.</b>			<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>ZOO</b>		<b>Hard Core</b>	UA	IA	Total				
	HCT 2.1	Developmental biology	70	30	100	4	---	---	4
	HCT 2.2	General and Comparative Endocrinology	70	30	100	4	---	---	4
<b>Soft Core (Any one)</b>									
	SCT 2.1	Environmental Physiology	70	30	100	4	---	---	4
	SCT 2.2	Helminthology	70	30	100	4	---	---	
<b>Open Elective (Anyone)</b>									
	OET 2.1	Computational Biology	70	30	100	4	---	---	4
	OET 2.2	Research Methodology and Intellectual Property Right	70	30	100	4	---	---	
		Tutorial			25	---	1	---	1
<b>Practicals</b>									
	HCP 2.1	<b>Practical Course HCP 2.1</b>	35	15	50	---	---	2	4
	HCP 2.2	<b>Practical Course HCP 2.2</b>	35	15	50	---	---	2	
<b>Soft Core (Any one)</b>									
	SCP 2.1	<b>Practical Course SCP 2.1</b>	35	15	50	---	---	2	2
	SCP 2.2	<b>Practical Course SCP 2.2</b>	35	15	50	---	---	2	
<b>Open Elective (Anyone)</b>									
	OEP 2.1	<b>Practical Course OEP 2.1</b>	35	15	50	---	---	2	2
	OEP 2.2	<b>Practical Course OEP 2.2</b>	35	15	50	---	---	2	
<b>Total for Second Semester</b>			<b>420</b>	<b>180</b>	<b>625</b>	<b>---</b>	<b>---</b>	<b>---</b>	<b>25</b>

**M.Sc.II-Zoology NEW C B C S w.e.f. 2017-18**

**Semester III**

	Code	Title of the Paper	Semester Exam.			L	T	P	Credits
<b>ZOO</b>		<b>Hard Core</b>	UA	IA	Tot				
	HCT 3.1	Molecular Cytogenetics	70	30	100	4	---	---	4
	HCT 3.2	Biochemistry	70	30	100	4	---	---	4
		<b>Soft Core(Any one)</b>					---	---	
	SCT 3.1	Comparative Animal Physiology	70	30	100	4	---	---	4
	SCT 3.2	Economic Entomology	70	30	100	4	---	---	
		<b>Open Elective (Any one)</b>							
	OET 3.1	Wild life and Conservation Biology	70	30	100	4	---	---	4
	OET 3.2	Ecology and Ethology	70	30	100	4	---	---	
		Tutorial			25		1		1

**Practicals**

	HCP 3.1	<b>Practical Course HCP 3.1</b>	35	15	50	---	---	2	2
	HCP 3.2	<b>Practical Course HCP 3.2</b>	35	15	50	---	---	2	2
	SCP 3.1	<b>Practical Course SCP 3.1</b>	35	15	50	---	---	2	2
	SCP 3.2	<b>Practical Course SCP 3.2</b>	35	15	50	---	---	2	2
	OEP 3.1	<b>Practical Course OEP 3.1</b>	35	15	50	---	---	2	2
	OEP 3.2	<b>Practical Course OEP 3.2</b>	35	15	50	---	---	2	
		<b>Total for Third Semester</b>	<b>420</b>	<b>180</b>	<b>625</b>	---	---		<b>25</b>

**Semester IV**

	Code	Title of the Paper	Semester Exam.			L	T	P	Credits
<b>ZOO</b>		<b>Hard Core</b>	UA	IA	Total				
	HCT 4.1	Animal Biotechnology	70	30	100	4	---	---	4
	HCT 4.2	Applied Zoology	70	30	100	4	---	---	4
	HCT 4.3	Environmental Biology and Toxicology	70	30	100	4	---	---	4
		<b>Soft Core(Any one)</b>					---	---	
	SCT 4.1	Zookeeping and Animal House Management	70	30	100	4	---	---	4
	SCT 4.2	Fishery Science	70	30	100	4	---	---	
		Tutorial			25		1		1

**Practicals**

	MP 4.1	Major Project	140	60	200	---	---		8
			<b>420</b>	<b>180</b>	<b>625</b>	---	---		<b>25</b>
									<b>100</b>

L = Lecture T = Tutorials P = Practical IA=Internal Assessment

UA= University 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

# SOLAPUR UNIVERSITY, SOLAPUR

## M.Sc. ZOOLOGY Part I Syllabus

(Choice Based Credit System)

To be implemented from year 2016-2017

### HCT1.1 Biosystematics

Maximum marks 100

Teaching periods 60=4 credits

#### Unit 1.

1.0 Definition and basic concept of Biosystematics and Taxonomy. (12)

- 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. (12)

- 2.1 Chemotaxonomy.
- 2.2 Cytotaxonomy.
- 2.3 Molecular taxonomy.

#### Unit 3.

3.0 Dimensions of speciation and taxonomic characters. (12)

- 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. (12)

- 4.1 Taxonomic collection, preservation and curation 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. (12)

- 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

1. M.Kato- The Biology of Diversity.
2. J.C. Avise – Molecular markers. Natural History and Evolution, Chapman & Hall , New York.
3. E.O. Wilson- Biodiversity, Academic Press, Washington.
4. G.G. Simpson –Principle of Animal Taxonomy, Oxford IBH Publishing Company.
5. E. Mayer- Elements of Taxonomy.
6. E.O. Wilson- The Diversity of Life. W.W. Northern and Company.
7. B.K. Tikedar- Threatened Animals of India, ZSI Publication, Calcutta.
8. E. Mayer- Principles of Systematic Zoology, M. Hill Publication.

**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**

1. John R.W. Masters. Animal Cell Culture. IRL Press.
  2. Robert Braun. Introduction of Instrumental Analysis. McGraw Hill International Editions.
  3. K. Wilson and K.H. Goulding. A Biologist Guide to Principles and Techniques of Practical Biochemistry. ELBS Ed.
  4. Pattabhi, V. Biophysics. Narosa Publishing House.
  5. Bisen, P.S.; Mathur. Tools and Techniques in Life Sciences. CBS Publishers and Distributors.
  6. Keith Wilson&John Walker. Practical Biochemistry. Cambridge low price.
  7. Cell Cooper , A molecular approach Second Edition
  8. Cell : Alberts, 2002
  9. Rediscovering Biology: Annenberg E Edition
  10. Cell Physiology
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**M.Sc. SEMESTER - I**  
**HCT 1.3 Cell and Molecular Biology**

**Maximum marks 100**

**Teaching periods 60=4credits**

**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).  
Cell matrix and cell matrix adhesion

**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**

1. B. Alberts et al. The Molecular Biology of Cell Garland Publishing Inc. New York and London.
2. De. Robertis et al. Cell and Molecular Biology. Saunders College Publishing, Philadelphia.
3. W. H. Elliot and D.C. Elliot. Biochemistry and Molecular Biology. Oxford University Press. Oxford, New York.
4. Giese A.C. Cell Physiology. Saunders College Publishing, Philadelphia.
5. P.S. Verma & V.K. Agrawal . Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Company, New Delhi-55
6. Sandhya Mitra. Genetic Engineering, Macmillan.
7. R.C. Dubey .A text Book of Biotechnology. S. Chand and Company, New Delhi-55.
8. Mohan Arora. Genetic Engineering. Himalaya Publishing House.
9. Becker, Klein smith. The World of the Cell. Pearson Education.
10. Geoffrey M. Cooper. Cell. A Molecular Approach. ASM Press . Washington.
11. Gerald Karp. Cell and Molecular Biology. Willey International Edition.
12. Watson et al... Molecular Biology of the Gene. Pearson Education.

**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**

1. Hart, D.L. A primer of Population Genetics. Suinuaer associates, Inc. Massachusetts.
  2. King. M. Species Evolution. The Cambridge University Press, Cambridge.
  3. Smith J.M. Evolutionary Genetics. Oxford University Press. Oxford, New York.
  4. Merrel D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc.
  5. Jha A.P. Genes and Evolution. John Publication, New Delhi.
  6. Boylan. Genetic Engineering: Science and Ethics on the New Frontier. Pearson Education. Delhi
  7. Human Biology : G.A. Harrison , G.M. Tanner, D.R. Pilbeam , P.T. Baker ; Oxford Science Publication. 1988.
  8. Evolution The triumph of an Idea : Carl Zimmer Harper Collins Publishers 2001
  9. PBS Org. Website for Evolution concept
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## SCT 1.2 PROTOZOLOGY

Marks 100

Teaching periods 60= 4 Credits

### Unit –1. (10)

- 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 (10)

Nutrition in Protozoa

- i. Methods of feeding
  - a. Filter feeding
  - b. Raptorial feeding
  - c. Diffusion feeding
- ii. Digestion
- iii. Nutritional requirements

### UNIT – 3 (14)

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 (12)

1. General morphology, life cycle, transmission and pathology of parasitic Amoebae of man and domestic animals.

- i. *Entamoeba histolytica*
- ii. *E. gingivalis*

### UNIT – 5 (14)

1. Structure and life cycle pattern of acephaline and cephaline Gregarines.
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. *Ichthiophtherius multifilis*
- ii. *Balantidium coli*

#### Text Books:

1. Aikawa and Sterling - Intracellular Parasitic Protzoa
2. Baker - Prasic 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 Protzoan 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.
4. Classification of Vertebrates -40 Specimens.
5. Identification of poisonous and Non poisonous snakes.
6. Study of temporal vacuities in skulls of reptiles.

**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
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**M.Sc. SEMESTER – I**

**PRACTICAL PAPER**

**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.
6. Preparation of Drosophila Culture.
7. Polytene chromosomes from slide/photo of salivary glands of Chironomus/ Drosophila larva.

**SCP 1.1 Population genetics and evolution****Marks 50**

1. Migration influenced examples identification with pictures.
  2. Isolation influenced examples identification with pictures.
  3. Evolution influenced examples identification with pictures.
  4. Estimation of genes & genotypic frequencies in light of Hardy Weinberg law.
  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.
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**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
  4. Demonstration by video: Impregnation of ciliates with dry silver nitrate for study of kinetic structure.
  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.
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**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
  2. R.G. Edwards. Human Reproduction.
  3. Austen C.R. and Short R.V. Reproduction in Animals.
  4. F.T. Longo. Fertilization, Chapman & Hall.
  5. Mathur, Ramesh. Embryology, Anmol Publications .
  6. Morgan, T. H. .Embryology And Genetics. Agrobios India
  7. Balanski. Introduction to Embryology.
  8. Developmental Biology ;Scott F Gilbert Sixth Edition, Sinaur Publications
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**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**

1. E.J.W. Barrington. General and Comparative Endocrinology. Oxford , Clarendon Press.
  2. Turner. C.D. General Endocrinology,
  3. A. Gorbman et al. Comparative Endocrinology. John Wiley & Sons.
  4. R.H. Williams. Text Book of Endocrinology. Press. Oxford, New York.
  5. Turner, C.D. and Bangara J.T. General Endocrinology
  - 7 .Mac E. Hadley. Endocrinology. Pearson Education.
  - 8 Burch, Warner M.; Burch; Endocrinology, Lippincott Williams & Wilkins.
  - 9 Felig; Endocrinology And Metabolism .McGraw-Hill ISE.
  - 10 Prosser Brown . Comparative Animal Physiology. Saunders Publication.
  11. Endocrinology : An integrated approach S.S. Nussey and S.A. Whitehead (NCBI ) 1999
-

**M.Sc. SEMESTER - II**  
**SCT2.1 Environmental Physiology**

**Marks 100**

**Teaching periods: 60=4credits**

**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**

1. Echert R. Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
  2. Hoar W.S. General and comparative Animal Physiology, Prentice Hall of India.
  3. Pummer L. Practical Biochemistry , Tata McGrow –Hill.
  4. Wilson K. and Walker J. Practical Biochemistry.
  5. Strand F.L. Physiology : A Regulatory System Approach. Macmillan Publishing Co. New York.
  6. Wilma P.G. et al. Environmental Physiology, Blackwell Sci. Oxford, UK.
  7. Frederic Martini. Fundamentals of Anatomy and Physiology. Prentice Hall.
  8. Tortora. Principles of Anatomy and Physiology. Wiley Publications.
  9. Ezeilo, Gabriel C. .Textbook of Physiology. Oxford University Press.
-

## SCT 2.2 HELMINTHOLOGY

Marks=100

Teaching periods 60=4credits

### Unit I Introduction, history and scope of Helminthology (12)

1. General organization and Classification of Platyhelminthes.
2. General organization and Classification of Nematelminths
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) *Fasciolopsisbuski*
- 3) *Schistosomahaematobium*
- 4) *Paragonimuswestermani*

### Unit- III (12)

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

#### **Cestode:-**

- 1) *Taeniasaginata*
- 2) *Dipylidiumcaninum*
- 3) *Hymenolepis nana*
- 4) *Echinococcusgranulosus*

### Unit- IV (12)

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

#### **Nematode:-**

- 1) *Ascarislumbricoides*
- 2) *Ancylostomaduodenale*
- 3) *Wuchereriabancrofti*
- 4) *Enterobiusvermicularis*

### 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) Antihelminthicdrugs

## Reference Books

1. Medical Parasitology by Markell, Voge and John, 8th ed. W.B. Saunders Co.
2. The Biology of animal parasites, Cheng T.C. (1964)-Saunders International Student Edition.
3. The Invertebrates Vol II, McGraw Hill, New York.- Dawes B. (1946).
4. Text book Medical Parasitology Jaypee Brothers, - Medical Publishers, New York. - Panikar C.K.J (1988)
5. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh - Smyth J.D (1977)
6. Parasitology (Protozoology and Helminthology) -SoodPamnik (1993) CBS Publication and Distribution, Delhi.
7. Human helminthology Manual for Clinical, Sanitarians Medical Zoologists – Faust, EmerestCaroll.
8. SystemaHelminthum Vol. IV Monogenea and Aspidobothria - Yamaguti S. (1963) Inter- Science Publishers, London.
9. Synopsis of Digenetic Trematodes of Vertebrates - Yamaguti S. (1971) Vol. I & II Keigaku Publishing Co., Tokyo, Japan.
10. Parasitology (Protozoology and Helminthology) -Chatterjee K. D. (1969)
11. The Zoology of Tapeworm. - Wardle and Mcleod (1952)
12. The advances in the Zoology of tapeworm from Wardle and Mcleod (1952)
13. SystemaHelminthum Vol. II Cestoda. - SatyuYamaguti (1959)
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**

1. Sokal R.R. and F.J. Rohit. Biometry, Freeman, San Fransisco.
2. Gupta- Fundamentals of Statistics.
3. Snedecor, G.W. and W.G. Cochran, Statistical Methods, East-West Press, New Delhi.
4. Green, R.H. sampling design and statistical methods for environmental biologist. John Wiley & sons, New York.
5. Pranab Kumar Banerjee. Introduction to Biostatistics. S. Chand and Company, New Delhi-55.
6. Zar. Biostatistician Analysis. Pearson Education. Delhi.
7. Deshpande A.V. Introduction to Probablity and Statistics. Vipul Prakashan.
8. Arora P.N. and Malhan P.K. Biostatistics. Himalaya Publishing House.

## 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 – Inflight – 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

Publishing of Articles in National and International Journals - Selection of Journals – ISSN Number – Peer reviewed Journals – Science citation index – impact factor and its importance. Manuscripts preparation for Journals – components – Submission and Publication – reprints and pdf formats. Paper presentation in Conferences. (10)

### 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

Intellectual property rights -Introduction- Protection of intellectual property, copyright, trademark, geographical indications, trade secrets, Layout design of integrated circuits. Patent-Criteria and procedure of patenting, patenting biological material.Patent procedure inIndia.Revocation of Turmeric and Neem patent.Patenting of biological material with example and case studies. (10)

### Reference Books

1. Anderson, Durston&Polle 1970: Thesis and assignment, writing Wiley Eastern Limited
2. G. Vijayalakshmi and C. Sivapragasam. (2008) Research Methods –Tip & Techniques, MJP Publishers, Chennai. WWW.mjppublishers.com
3. Malter K, 1972: Statistical analysis in Biology, Chapman Hall, London.
4. Kothari C. R., Research Methodology: Methods & Techniques. New Age Publ., New Delhi, 2012

**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.
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**SCP 2.1 Environmental Physiology**

1. Heart perfusion and recording of cardiogram of frog by CD/Model/Virtual demonstration.
2. Estimation of rate of O<sub>2</sub> 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 aflatoxins, or CCl<sub>4</sub> 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.
2. Measures of dispersion.
3. Coefficient of variation.
4. Correlation coefficient and regression coefficient (Ungrouped data)
4. Problems based on classical definition of probability.
5. Example based on Chi-square test.
6. Example based on Student's t test.
7. 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
10. Procedure for copyright, trademark.
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.

(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. (14)

#### Unit 2.

##### 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. (12)

#### 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, Gyrase, Methylases, Nucleases, restriction endonucleases, Plasmids and bacteriophage based vectors for cDNA and genomic libraries. (10)

#### Unit 4.

##### Human cytogenetics:

Techniques in human chromosome analysis. Molecular cytogenetic Approach. Human karyotype, banding, nomenclature. Chromosome based heritable diseases in human. Sickle Cell Anemia, PKU, thalassemia and glaucoma (10)

## **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. **(14)**

### **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

## 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 (10)

### 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.  
(14)

### 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.  
(10)

### Unit 4.

Biosynthesis of fatty acids, triglycerides, phospholipids and steroids.  $\beta$ - Oxidation of lipids.  
Metabolic regulation during hypoxia. (12)

### 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.  
(14)

### 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)

## SCT 3.1 Comparative Animal Physiology

Marks=100

Teaching periods 60 =4credits

### 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

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

## SCT 3.2 Economic Entomology

### Unit 1.

Industrial Entomology (12)

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 (12)

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 pumpkin beetle, *Pieris brassicae*, brinjal fruit borer, The *Hadda* beetle

### Unit 3

Methods of pest control (14)

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 (10)

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**

1. A text book of Applied Entomology, vol.2 - K. P.Srivastava, 1996.
2. Elements of Entomology- Rajendra singh.
3. A text book of Forest Entomology – T.V. Sathe, 2009.
4. Sericulture and Pest Management – T.V. Sathe and D. Jadhav, 2001.
5. Sericultural crop protection – T.V Sathe, 1998.
6. Agricultural Pests of India and South East Asia – A.S. Atwal, 1993.
7. Crickets and Household pests – T.V. Sathe and M.R. Awate, 2009.
8. Beekeeping in the tropics – G.S. Smit, 1960.
9. Beekeeping in India, ICAR, New Delhi, S. Singh, 1975.
10. A handbook of practical Sericulture, CSB, Ullal and Narsimhanna, 1981.
11. Lac culture in India farm information unit, DEMOFA, New Delhi S.Krishnaswami,
12. A text book of applied entomology- K. P. Srivastava.
13. Elements of entomology- Rajendra singh.
14. Invertebrate Zoology –Jordan Verma .
15. A text book of Entomology – B.D Pattnaik.
16. A text book of Entomology – S.K Kochhar
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 **(10)**

**Unit 2.**

**Factors affecting ecosystem and community structure:**

a. Natural factors: Earthquakes, Tsunamis, volcanoes, landslides.

b. Intracommunity factor- competition, antagonism.

c. Anthropogenic factors: Introduction of exotic species, urbanization, industrialization, Patch formation,

Breaking of food chain **(14)**

**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.**

**(12)**

**Unit 4.**

Modern conservation practices,

Reserve forests, sanctuaries, national parks,

Biodiversity hotspots etc.

Captive breeding of endangered species **(14)**

**Unit 5.**

Indian Forest Acts, Indian wild life act,

red data book ,

Earth Summit and agenda,

Environment impact assessment (EIA) **(10)**

**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

## OET 3.2 Ecology and Ethology

Marks=100

Teaching periods 60 =4credits

### Unit 1. (12)

Ecosystem:

- 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. (12)

Habitat and niche:

- 2.1. Concept of habitat and niche;
  - 2.2. Niche width and overlap;
  - 2.3. Fundamental and realized niche;
- Ecological succession:1. Types;2. Mechanisms;3. Changes involved in succession; 4. Concept of climax

### Unit 3. (12)

Species interactions:

- 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. (12)

Population ecology & Ethology:

- 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. (12)

Applied ecology:

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
6. Colorimetric estimation of Lactose in Milk.
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)
4. Demonstration of Blood gas analysis.
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  $MgCl_2$  gradient methods.
8. Any other practical set by Department

### **SCP3.2 Economic Entomology**

1. Pests of stored grains.
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
9. Study of nutritional 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.
6. Case studies of habitat loss and wild life protection act. Data collection in practical hand book expected.
7. Any other practical set by Department.

### **OEP3.2 Ecology & Ethology**

1. Study of ecosystem biodiversity of local area.
2. Estimation of DO/ BOD
3. Estimation of hardness of water sample.
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 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 cell 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

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.

## HCT4.2 Applied Zoology

Marks=100

Teaching periods 60 =4credits

### Unit 1

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. (10)

### 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

(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. (10)

### 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

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.

## 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 (15)

### **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. (15)

### **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. (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. (10)

### **Unit 4.**

Conservation of natural resources. Rain water harvesting system. Water recycling. Waste water management (10)

### **Unit 5.**

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. (10)

### **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)

## 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,

(12)

### 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.

(14)

### Unit 4.

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

(14)

### Unit 5.

Animal house management- rodent management growth, maintenance, housing,

feeding, disinfection procedures in animal house.

Taxidermy and applications.

(10)

### 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 Press1996

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

**SCT 4.2****FISHERY SCIENCE****Marks 100****Teaching periods 60= 4 Credits**

- Unit -1** (10)  
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** (10)  
Aquatic ecosystems: Fresh, brackish and marine water ecosystems.  
Identification of plankton, nekton and benthos.  
Role of plankton in fish culture.
- Unit -3** (14)  
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** (14)  
Conventional and non-conventional fishing methods.  
Fishing crafts and gears.  
Fish products and by-products.  
Fish preservation techniques.
- Unit -5** (12)  
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
4. Boyd, C.E. -Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Company, 1982.
5. Jhingran, V.G. -Fish and Fisheries of India. Hindustan Publishing Corporation India, 1982
6. Bardach, et. al. -Aquaculture – The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, NY, 1972.
7. Chondar, C.L. -Hypophysation of Indian major carps. Satish Book Enterprise, Agra, 1980.
8. Santhanam, R. et. al. -A Manual of Freshwater Aquaculture. Oxford & IBH Publishing Co. Pvt. Ltd., 1987.
9. Cheng, T.C. -The Biology of Animal Parasites. Saunders, Philadelphia, 1964.
10. Ribelin, W.E. & G. Miguki- The Pathology of Fishes. The Univ. of Wisconsin Press Ltd., Great Russel st., London, 1975.
11. Karunasagar, I. -Aquaculture and Biotechnology. Oxford-IBH Publishers, New Delhi,
12. Govindan, T.K. -Fish Processing Technology, Oxford-IBH, 1985.
13. Shang, Y.C. -Aquaculture Economic Analysis – An Introduction. 1990.
14. 19. Nikolsky, G.V. -Ecology of Fishes. Academic Press, NY, 1963.
15. Day, F. -The fishes of India.

**MP 4. 1Project:** 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 1<sup>st</sup> 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.