

**ANNAMALAI UNIVERSITY  
FACULTY OF SCIENCE  
DEPARTMENT OF ZOOLOGY  
M.Sc. ZOOLOGY  
(CHOICE BASED CREDIT SYSTEM)  
(TWO YEAR)  
REGULATIONS AND SYLLABUS  
2014 – 2015 (ONWARDS)**

**REGULATIONS**

**Eligibility**

A Pass in B.Sc. Zoology with Chemistry and Botany as Ancillary Subjects with 50% of marks in Part – III Examination.

**Master's Programme**

A Master's Programme consists of a number of Courses. A Master's Programme consists of a set of core courses and Elective courses.

Core courses are basic courses required for each programme. The number and distribution of credits for core courses will be decided by the respective faculties.

The respective departments will suggest elective courses and they may be distributed in all four semesters.

A course is divided into five units to enable the students to achieve modular and progressive learning

**Semester**

An academic year is divided into two semesters, Odd semester and Even semester. The normal semester periods are:

Odd Semester: July to November (90 Working Days)

Even Semester: December to April (90 Working Days)

**Credits**

The term credit is used to describe the quantum of syllabus for various programmes in terms of hours of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design.

The minimum credit requirement for the two year Master's Programme shall be 90, of which the core courses shall carry 70 credits and the elective course shall carry 16 credits and soft skill (English/Tamil/Computer Science) shall carry 4 credits.

**Courses**

Each course may consist of lectures/tutorials/laboratory work/ seminar /project work/practical training /report/Viva-Voce etc.

**Course Weight**

Core and elective courses may carry different weights. For example, a course carrying one credit for lecture, will have instruction of one period per week during the semester if three hours of lecture is necessary in each week for that course then 3 credits will be the weightage. Thus normally, in each of the courses, credits will be assigned on the basis of the lectures/tutorials/laboratory work and other form of learning in a 15 week schedule:

1. One credit for each lecture period per week.
2. One credit for each tutorial per week
3. One credit for every three periods of laboratory or practical work per week
4. One credit for three contact hours of project work in a week
5. One credit for every two periods of seminar

**Grading system**

The term Grading System indicates a 10-point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class.

## **Duration**

The duration for completion of a two year Master's Programme in any subject is four semesters.

## **Structure of the Programme**

The Master's Programme will consist of:

1. Core course, which are compulsory for all students.
2. Elective courses which students can choose from amongst the courses offered by the other Department of faculty as well as by the Department of other faculties. (Arts, Science, Education and Indian language)
3. The Elective subjects will be allotted by counseling by a committee of the respective Heads of the Departments under the Chairmanship of the Dean of the Faculty.
4. Dissertation/ Project work/ Practical training/ Field Work, which can be done in an organization (Government, Industry, Firm, Public Enterprise etc.) approved by the concerned department.

## **Attendance**

Every teaching faculty handling a course shall be responsible for the maintenance of attendance register for candidates who have registered for the course.

The teacher of the course must intimate the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students who have secured less than 80% of attendance.

Each student should earn 80% attendance in the courses of the particular semester failing which he or she will not be permitted to sit for the end-semester examination.

However, it shall be open to the authorities of grant exemption to candidate who has failed to obtain the prescribed 80% attendance for valid reasons on payment of Condonation fee and such exemptions should not under any circumstance be granted for attendance below 70%.

## **Examinations**

The internal assessment for each course carries 25% marks for theory and 40% marks for practical and it is based on two internal assessment tests and a variety of assessment tools such as seminar and assignment. The respective faculty will decide the pattern of question paper. The tests are compulsory.

There will be one End Semester Examination(75% marks for theory and 60% marks for Practical) of 3 hours duration for each course. The respective faculty will decide the pattern of question paper.

## **Evaluation**

The performance of a student in each course is evaluated in terms of percentage of Marks(PM) with a provision for conversion to Grade Point (GP). The sum total performance in each semester will be rated by GPA while the continuous performance from the 2<sup>nd</sup> Semester onwards will be marked by Overall Grade Point Average (OGPA).

## **Marks and Grading**

A Student cannot repeat the assessment of Sessional Test-I and Sessional Test-II. However, if for any compulsive reason, the student could not attend the test. The prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

A student has to secure 50% minimum in the End Semester Examination

The student who has not secured a minimum of 50% of Marks Sessional Plus end semester examination in a paper shall be deemed to have failed in that paper.

A candidate who has secured a minimum of 50 Marks in all the Papers prescribed in the programme and earned a minimum of 90 credits will be considered to have passed the Master's Programme.

### Grading

A ten point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's programme.

Marks	Grade Point	Letter Grade	Class
90 or above	10	S	Exemplary
85-89	9.0	D ++	Distinction
80-84	8.5	D +	Distinction
75-79	8.0	D	Distinction
70-74	7.5	A ++	First Class
65-69	7.0	A +	First Class
60-64	6.5	A	First Class
55-59	6.0	B	Second Class
50-54	5.5	C	Second Class
49 or less		RA	Reappear

The Successful candidates are classified as follows:

I Class–60% Marks and above in overall percentage of Marks (OPM). (6.5 GPA)

II Class – 50-59% Marks in overall percentage of Marks (Less then 6.0 GPA)

Candidates who has obtained 75% and above but below 90% of Marks (OPM) shall be deemed to have passed the examination in First Class (Distinction) provided he/she has passed all the papers prescribed for the programme at the First appearance. Candidates who has obtained 90% and above (OPM) shall be deemed to have passed the examination in First Class (Exemplary) provided he/she has passed all the papers prescribed for the programme at the First appearance.

For the Internal Assessment Evaluation, the break in marks shall be as Follows:

Test (Two) - 20 Marks  
 Assignment - 5 Marks  
 Total - 25 Marks

### Course – Wise Letter Grades

The percentages of marks obtained by a candidate in a course will be indicated in a letter grade.

A student is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA. A “letter grade RA” in any course implies a failure in that course. A Course successfully completed cannot be repeated for the purpose of improving the Grade point.

The RA grade once awarded says in the grade card of the student and is not deleted even when he she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the odd/ even semester in which the candidate has appeared for clearance of the arrears.

A student who secures RA grade in any course which is listed as a core course has to repeat it compulsorily when the examination is held next. If it is an elective course, the student has no option to repeat it when it is offered next or to choose a new elective if he/she so desire in order to get a successful grade. When new elective is chosen in the place of failed elective, the failed elective will be indicated as dropped in the subsequent grade card.

**If a student secures RA grade in the Project Work / Field Work / Practical Work/Dissertation, he/she shall improve it and resubmit it if it involves only rewriting incorporating the classification of the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.**

**M.Sc Zoology(CBCS)**  
**SCHEME OF EXAMINATION**

Code No	Theory/Practical	L	P	C	Int. Mark 25	Ext. Marks 75	Total
<b>I SEMESTER</b>							
ZOO C 101	Developmental Biology	4		4	25	75	100
ZOO C 102	Cell Biology	4		4	25	75	100
ZOO C 103	Genetics	4		4	25	75	100
ZOO P 104	Core Practical I Pre lab Discussion - (1 hour) Practical I (Covering - (9 hours) ZOO C 101, 102 & 103)		1 9	4	40	60	100
<b>Total</b>		<b>12</b>	<b>10</b>				
<b>II SEMESTER</b>							
ZOO C 201	Animal Physiology	4		4	25	75	100
ZOO C 202	Molecular Biology	4		4	25	75	100
ZOO C 203	Environmental Biology	4		4	25	75	100
ZOO P 204	Core Practical II Pre lab discussion- (1 hour) Practical II (Covering- (9 hours) ZOO C 201, 202 & 203)		1 9	4	40	60	100
<b>Soft Skill ( English communication)</b>		<b>4</b>		<b>4</b>	<b>25</b>	<b>75</b>	<b>100</b>
ZOO O 215	Optional I	4		4	25	75	100
<b>Total</b>		<b>20</b>	<b>10</b>				
<b>III SEMESTER</b>							
ZOO C 301	Biotechnology	5		5	25	75	100
ZOO C 302	Immunology	5		5	25	75	100
ZOO C 303	Toxicology	5		5	25	75	100
ZOO P 304	Core Practical III Pre lab discussion- (1 hour) Practical III (covering- (9 hours) ZOO C 301, 302 & 303)		1 9	4	40	60	100
ZOO O 315	Optional II	4		4	25	75	100
<b>Total</b>		<b>19</b>	<b>10</b>				
<b>IV SEMESTER</b>							
ZOO C 401	Entomology	5		5	25	75	100
ZOO C 402	Fisheries and Aquaculture	5		5	25	75	100
ZOO C 403	Endocrinology	5		5	25	75	100
ZOO P 404	Core Practical IV Pre lab discussion- (1 hour) Practical IV (covering- (9 hours) ZOO C 401, 402 & 403)		1 8	4	40	60	100
ZOO O 415-1 (OR) ZOO O 415 -2	Optional III 1-Public Health & Hygiene (OR) 2- Animal Science	4		4	25	75	100
ZOO O 416-1 (OR) ZOO O 416-2	Optional IV 1-Animal Culture Technique (OR) 2- Environmental Science	4		4	25	75	100
<b>Total</b>		<b>23</b>	<b>9</b>	<b>90</b>			

**Total Core Papers & Practical credits = 70**  
**Total optional & Soft skills credits = 20**  
**Overall Credits = 90**

**Note : Soft skill (English/Tamil/Computer Science) and optional I, II, III, IV are to be offered by other departments.**

**Optional Courses offered by Department of Zoology in the  
IV Semester**

<b>Semesters &amp; Code</b>	<b>Title</b>	<b>L</b>	<b>P</b>	<b>C</b>	<b>Int. Ass. Marks 25</b>	<b>End Sem. Exam Marks 75</b>	<b>Total Marks</b>
<b>IV Semester</b>							
<b>Optional III &amp; IV ZOO O 415-1 (OR) ZOO O 415-2</b>	<b>Public Health &amp; Hygiene (OR) Animal Science</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>25</b>	<b>75</b>	<b>100</b>
<b>ZOO O 416-1 (OR) ZOO O 416-2</b>	<b>Animal Culture Technique (OR) Environmental Science</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>25</b>	<b>75</b>	<b>100</b>

**Optional Courses offered to Other Science Department in the  
II, III and IV Semesters**

<b>Semesters &amp; Code</b>	<b>Title</b>	<b>L</b>	<b>P</b>	<b>C</b>	<b>Int. Ass. Marks 25</b>	<b>End Sem. Exam Marks 75</b>	<b>Total Marks</b>
<b>II Semester</b>							
<b>Optional I ZOO O 215</b>	<b>Animal Culture Techniques</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>25</b>	<b>75</b>	<b>100</b>
<b>III Semester Optional II ZOO O 315</b>	<b>Environmental Science</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>25</b>	<b>75</b>	<b>100</b>
<b>IV Semester</b>							
<b>Optional III &amp; IV ZOO O 417 ZOO O 418</b>	<b>Public Health &amp; Hygiene Animal Science</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>25</b>	<b>75</b>	<b>100</b>

**Internal Assessment Marks**

**Theory Courses**

**Maximum Marks 25 Marks**

**Internal Assessment Test – I**  
**Internal Assessment Test – II**  
**Assignment**

**10**  
**10**  
**5**

<b>Total</b>	<b>25</b>
<b>Practical Courses</b>	<b>Maximum Marks 40 Marks</b>
<b>Test – I</b>	<b>20</b>
<b>Test – II</b>	<b>20</b>
<b>Total</b>	<b>40</b>

**SYLLABUS**  
**FIRST YEAR: I SEMESTER**  
**COURSE: ZOO C 101 DEVELOPMENTAL BIOLOGY**

**Objectives**

To make the students understand the various concepts of development.

**Unit-I: Gametogenesis**

Historical thoughts and concepts, scope of embryology - Gametogenesis - spermatogenesis - Oogenesis - Previtellogenesis - Vitellogenesis: egg membranes.

**Unit-II: Fertilization**

Approach of the sperm to the egg, sperm penetration, essence of activation, acrosome reaction, reaction of the egg, Biochemistry of egg activation-parthenogenesis.

**Unit-III: Beginning of Embryogenesis and aspects of Gastrulation**

Types of eggs, cleavage, laws of cleavage, patterns of cleavage, physiological and biochemical changes, Role of egg cortex.

Fatemap, gastrulation, physiology of gastrulation, cell lineage; organizer-concepts-induction process.

**Unit-IV: Embryonic Adaptation, Organ Formation and Differentiation**

Placentation, Types of placenta, physiology of placenta Organogenesis - development of eye. Differentiation - definition: Chemical basis, selective action of genes, changing pattern of protein synthesis, sequence of gene action in development.

**Unit-V: Morphogenetic Processes in the later part of Ontogenesis**

Metamorphosis - hormonal regulation of metamorphosis in Amphibia and Insects.

Regeneration - regeneration of limb in salamander: Stimulation and suppression:

Histological process: polarity and gradients in regeneration.

**Practical**

1. Structure of spermatozoa of fish, frog, chick and mammal
2. Structure of egg in insects, fish, frog, chick and mammal
3. Study of types of cleavage
4. Vital staining of chick blastoderm
5. Analysis of excretory products during chick development
6. Histology of testis showing spermatogenesis
7. Histology of ovary showing oogenesis
8. Regeneration in amphibian
9. Effect of thyroxine on amphibian metamorphosis
10. Study of insect metamorphosis

**Text Books**

1. Varma, P.S, & V.K. Agarwal and B.S. Tyagi 2003. Chordate Embryology. S.Chand & Company Ltd. New Delhi.

**Reference Books**

1. Philips Grant. 1977. Biology of Developing System. University of Oregon.
2. Berill N.J, and G. Karp 1978. Developmental Biology. Tata McGraw-Hill Publishing Co., Ltd., New Delhi.
3. Balinsky B.I., 1981. An Introduction to Embryology. 4<sup>th</sup> Ed. Saunder's College Publishing Ltd., New York.
4. Gilbert. F 1988. Developmental Biology. Sinaver Associates, Inc. Publishers.
5. McElroy W.D and B.Glaus 1958. The Chemical basis of Development. The Johns Hopkins Press, Baltimore.
6. Hopper A.F. & N.H.Hart. 1980. Foundations of Animal Development. Oxford University Press, New York.
7. Rinehart. H and Winston 1957. Vertebrate Embryology. Holt, Rinehart and Winston, New York.



## **COURSE: ZOO C 102 CELL BIOLOGY**

### **Objectives**

To understand the basic concepts of cell structure, function, cell growth, metabolism and diseases.

#### **Unit-I: Cell Structure and Plasma Membrane**

Structure and organization of bacteria and virus – Difference between prokaryotic and Eukaryotic cells. Plasma membrane – structure – composition – functions.

#### **Unit-II: Mitochondria**

Structure of mitochondria – Shuttle system – Pasteur's effects – role of mitochondria in metabolism – chemical coupling hypothesis – conformational coupling hypothesis - control of respiratory activity enzyme system.

#### **Unit-III: Other Cytoplasmic Organelles**

General morphology and function of Golgi complex and lysosome - Secretory cycles, primary and secondary lysosome, structure and functions of endoplasmic reticulum, structural organization and function of Prokaryotic and Eukaryotic ribosome.

#### **Unit-IV: Nucleus**

Structural organization and functions of nucleus, membrane pore complex and nucleolus - Organization of DNA into chromosome, nucleosome, Solenoid, Loops, rosette coil, chromatid, chromosome, Heterochromatin, Euchromatin, Lampbrush chromosome, Polytene chromosome.

#### **Unit-V: Cell Cycle and Cancer**

Various stages of cell cycle – regulation of cell cycle – cell cycle and its relation to cancer – characteristics of cancer cells – types of cancer – theories of cancer.

### **Practicals**

1. Light microscope – components, uses and principles
2. Mounting of polytene chromosomes
3. Identification of different stages in meiosis in grasshopper
4. Micrometry (A) Camera Lucida (b) Stage Micrometer (C) Ocular Micrometer
5. Determination of Nucleo - Cytoplasmic index
6. Determination of cell diameter
7. Identification of Cancer tissues
8. Preparation of mitosis in Onion root tip
9. Electrophoretic separation of proteins
10. Identification of different tissues – muscle tissues, skeletal tissues- epithelial tissues – nervous tissue and reproductive tissue

### **Text Books**

1. De Robertis E.D.D and De. Robertis E.M.F. 1980. Cell and Molecular Biology. Holt – Sunders International (8<sup>th</sup> Edition)
2. Gupta. P.K., 2003. Cell and Molecular Biology; Rastogi Publication, Meerut, India.

### **Reference Books**

1. Karp, G., 1979. Cell Biology. Mc Graw Hill kogatusha Ltd. Japan.
2. Avers, C.J., 1976. Cell Biology. D.Van Nostrand Co., New York.
3. Watson, J.D., 1977. Molecular Biology of the Gene. 3<sup>rd</sup> edition W.A. Benjamin Inc. London.
4. Lehninger, A.L., 1984. Principles of Biochemistry. CBS Publishers and Distributors, New Delhi.
5. Carr, K.E., and P.G.Toner 1982. Cell Structure. Churchill Livingstone, London.
6. Dupraw,E.J.,1968. Cell and Molecular Biology. Academic Press NewYork.
7. Ambrose, E.J., and D.M.Easty 1970. Cell Biology. Addison, Wesley Publishing Company. London.

8. Watson, D., A. Baker. P. Bell, A.Gann, M.Levine, R.Losick, 2004. **Molecular Biology of the Gene.** "Peasson Education (Singapore) Pvt. Ltd. India Branch" 482. F.I.E Patpargani Delhi- 110 092.

#### **COURSE: ZOO C 103 GENETICS**

##### **Objectives**

To make the students to understand the fundamental concepts of genetics, human health related genetic problems, inborn errors and genetic counselling.

##### **Unit-I: Mendel's Laws & Gene Expression**

Principles of segregation and independent assortment-deviation from Mendel's findings - the chromosome theory of inheritance -DNA is the genetic material-Tobacco Mosaic Virus-penetrance and expressivity-effect of temperature and light on gene expression-environmental effects and twin studies.

##### **Unit-II: Polygenic Inheritance**

Polygene concept-mode of inheritance of kernal color in wheat-skin color in man-transgressive variation-heritability-Multiple alleles-ABO blood groups in man-MN blood group-Rh blood group-erythroblastosis foetalis-sickle cell anemia-Thalasemia.

##### **Unit-III: Linkage, Crossing over and Gene Mapping**

Bateson and Punnett coupling and repulsion concept-Morgan and Bridges theory of linkage and crossing over - chiasma frequency-genetic map-gene mapping in *Drosophila* using three point test cross - interference, Hardy-Weinberg law of genetic equilibrium.

##### **Unit-IV: Gene fine structure & Molecular Mechanism of Gene Mutations**

Fine structure of gene - 'Lac' and 'his' Operon - Mutable and mutator genes- DNA damage and DNA repair mechanism-point mutation-chemical mutagens-molecular mechanism of gene mutation-mutation and amino acid sequence in protein.

##### **Unit-V: Genetics of Human Metabolic Disorders**

Garrod's discovery-defects in amino acid, lipid and sugar metabolism - one gene and one enzyme theory - one gene one polypeptide theory - co-linearity of gene and its polypeptide products - chromosomal disorders. Genetic counselling

##### **Practicals**

1. Experiments on Mendelian inheritance
2. Experiments on polygenic inheritance
3. Human traits survey
4. Gene frequency calculations.
5. Statistical analysis of genetic data using Chi-square test.
6. Human pedigree construction for a family data.
7. Tracing of genes in family pedigree studies
8. Collection and identification of human finger prints
9. Study of hereditary disorders with the aid of chromosome karyotyping
10. Identification of sex and mutant characters in *Drosophila*

**Text Books**

1. Karvita B. Aluwalia, 1991. 'Genetics' Wiley Eastern Ltd., New Delhi.
2. Robert. H Tamirin 2004. 'Principles of Genetics'. Tata Mc. Graw-Hill Publishing Company Ltd. New Delhi.

**Reference Books**

1. Sarin, C. 1990 'Genetics'. Tata McGraw-Hill Publishing Co Ltd New Delhi.
2. Gupta, P.K, 1996. 'Genetics'. Rastogi publications, Meerut, India.
3. Burns, G.W. and Boltsmo, P.J, 1989. 'The Science of Genetics'. Macmillan Publishing Co., New York.
4. Lewin B.J, 1993. Genes. Wiley Eastern Ltd., New Delhi.
5. James.D Watson, 1987. 'Molecular Biology of Gene'. W.A. Benjamin Inc.
6. Curt Stern, 1983. 'The Principle of Human Genetics'. W.H. Freeman & Co., San. Francisco.
7. Demirc, 1950. 'Biology of Drosophila'. John Wiley and sons Inc. New York.
8. Verma P.S. and Agarwal V.K. 1998. 'Genetics'. S.Chand and Co., New Delhi.
9. Gurbachan S.Miglani-2003 "Advanced Genetics". Narosa Publishing House, New Delhi.
10. Daniel. J. Fairbanks, W.Ralph Anderson – 1999. "Genetics The Continuity of Life". Wadsworth Publishing Com. U.S.A.

**FIRST YEAR: II SEMESTER  
COURSE: ZOO C 201 ANIMAL PHYSIOLOGY**

**Objectives**

To expose the students to understand the various physiological mechanisms functioning in animal kingdom.

**Unit-I: Food and Digestion**

Composition of food-classification of nutritive substances-digestion-digestive enzymes-absorption-hormonal control of digestion.

**Unit-II: Excretion and Osmoregulation**

Organs of Excretion in different animal groups – vertebrate kidney – Urine formation – Nitrogenous wastes – Acid base regulation in vertebrate kidney, ion exchange mechanism in fish gills – Hormonal control of kidney function in mammal. General concepts of osmoregulation – osmoregulation in invertebrates and vertebrates.

**Unit-III: Circulation**

Circulation of the blood – Open and Closed systems – vascular pumps – Arthropod heart – Chambered hearts and booster pumps.

Structure of mammalian heart, origin, conduction and regulations of heart beat – patterns of circulations in the vertebrates – ECG – Composition of blood – clotting mechanism – blood groups – buffer system of blood- circulation of body fluids and their regulations.

**Unit-IV: Respiration**

Respiratory organs and their ventilation – Integumentary respiration – bronchial respiration – lungs – mechanism of respiration in vertebrates – Regulation of breathing – Transport of Oxygen - Respiratory pigments – Bohr's effect – Transport of CO<sub>2</sub> – Haldane's effect.

**Unit-V: Neuromuscular and Receptors**

Structure of neuron-electrical phenomena of nerves-theories of excitation-synaptic transmission-neuroendocrine system - hormones and their functions.

Structure of muscle-chemical - composition – mechanism of muscle contraction-energy for muscle contraction

Mechanoreceptors – chemoreceptors - photoreceptors – phonoreceptors

**Practicals**

1. Activity of salivary amylase.
2. Effect of substrate concentration and activity of salivary amylase
3. Effect of enzyme concentration and activity of salivary amylase
4. Effect of P<sup>H</sup> concentration and activity of salivary amylase
5. Quantitative estimation of proteins.
6. Quantitative estimation of haemoglobin.
7. Counting of blood cells.
8. Identification of blood groups.
9. Oxygen consumption of fish.
10. Effect of thyroxin on the respiratory metabolism of fish.

**Text Books**

1. P.S.Verma, B.S. Tyagi and U.V.Agarwal, 2005. Animal Physiology. S.Chand & Company Ltd, New Delhi.
2. S.T.Rastogi, 1988. Essentials of Animal Physiology. Wiley, Eastern Limited, Madras.
3. Williams S.Hoar, 1966. General and Comparative Physiology. Prentice Hall of India, New Delhi.

**Reference Books**

1. Wilson. A, 1979. Principles of Animal Physiology. Macmillan Publishing Co., Inc. New York.

2. Leon Goldstein, 1977. Introduction to Comparative Physiology. Holt, Rinehart and Winston, New York.
3. Prosser, L. and A. Brown, 1965. Comparative Physiology. Saunders Company, London.

**COURSE: ZOO C 202 MOLECULAR BIOLOGY**

**Objectives**

To understand the molecular basis of the cell structure, function and to familiarise the recent developments and techniques in the field of molecular biology.

**Unit-I : Structure and properties of DNA**

DNA- Primary, Double helical and Alternative double helical structures. Properties of DNA – Denaturation, Renaturation, Hypochromic effect, Melting temperature, Liquid and filter hybridization.

**Unit-II: Replication of DNA**

Semi conservative replication – DNA polymerizes in prokaryotes and eukaryotes – Klenow fragment – Processivity – proof reading –Replisome – Leading and lagging strands –SSB protein and Co-operative binding –Okazaki fragment. Mechanism and enzymology of DNA replication.

**Unit-III : Structure and properties of RNA**

RNA polymerases in prokaryotes and eukaryotes. Types, structure and functions of RNAs, Transcription in prokaryotes and eukaryotes, ‘rho’ dependent and independent termination, TATA box and Pribnow box.

**Unit-IV: RNA Processing, Editing and Genetic Code**

Processing of mRNA, rRNA, tRNA and splicing mechanisms- RNA editing, Genetic code and its properties – Protein synthesis – Protein secretion and Signal hypothesis.

**Unit-V: Recombinant DNA Technology**

Reverse transcription and cDNA synthesis – steps involved in the recombinant DNA technology –gene targeting –apoptosis and cancer, role of oncogene in cancer.

**Practicals**

1. Identification of drum stick chromosome in human blood
2. Identification of Barr body in buccal epithelial cells
3. G-banding of chromosome –Geimsa stain
4. Mitotic index
5. Localization of DNA
6. Localization of RNA
7. Localization of carbohydrates
8. Localization of protein
9. Estimation of DNA
10. Estimation of RNA.

**Text Books**

1. Lodish.H, Berk.A, Zipursky.SL, Matiudaira.P, Baltimore.D and Darnell.J (2000). Molecular Biology of the cell. W.H. Freeman and company, New York.
2. Lewin.B, 2000. Gene VII, Oxford University Press, London.

**Reference Books**

1. Rastogi S.C, Sharma.V.N. and Tandon.A. 1993. Concepts in Molecular Biology. Wiley-Eastern Ltd, Madras.
2. Klug.W.S. and Cummings, M.R. 2000. Concepts of Genetics. 6<sup>th</sup> Ed. Prentice Hall, Inc. New Jersey.
3. Friedfelder.D 1994 Molecular Biology. 2<sup>nd</sup> Ed. Jones and Bartlett Publishers, Inc.
4. De.Robertis E.D.D and De Roberties E.M.F.1980. Cell and Molecular Biology. Holt Sunders International Edition.
5. Lehninger, Nelson and Cox 1993. Principles of Biochemistry. CBS Publishers New Delhi.

- 6. Karp.G. 1979. Cell Biology. Mc Graw – Hill Book Company New York**
- 7. Dupraw G.J. 1968. Cell and Molecular Biology. Academic Press, New York.**

## **COURSE: ZOO C 203 ENVIRONMENTAL BIOLOGY**

### **Objectives**

To make students to realize the structure and function of ecosystem, wealth of our natural resources and conservation measures to be taken and create awareness of the laws governing environment.

#### **Unit-I: Ecosystem**

Composition of atmosphere - structure and stratification of atmosphere - Hydrological cycle-kinds of ecosystem-structure and functions of ecosystem-energy flow in ecosystem-trophic levels

#### **Unit-II: Natural Resources and Conservation**

Types of resources-conventional and non- conventional sources of energy-conservation of soil, land and forest - Deforestation and Afforestation - Conservation strategies (WCS &NCS) - Wild life management in India.

#### **Unit-III: Air and Water Pollution**

Air pollution-types of air pollutants-classification and effect of pollutants on vegetation, farm animals and human health-prevention and control of air pollution. Water pollution-sources of water pollution-water quality standards - Eutrophication-prevention and control of water pollution.

#### **Unit-IV: Radiation, Noise and Industrial Pollution**

Radiation pollution-sources and effects of ionizing radiation.

Noise pollution - sources of noise pollution - effects of noise pollution - control measures. Pollution control and abatement on cement industry - leather industry - textile industry.

#### **Unit-V: Environmental Impact Assessment and Law**

The objective of Environmental Impact Assessment (EIA) - Environmental Appraised Committee (EAC) - The Environmental Management Plan (EMP) - Control of Environmental pollution through law - Environmental Protection Act (1986).

### **Practicals**

1. Estimation of dissolved Oxygen.
2. Oxygen sag curve from river.
3. Estimation of dissolved Carbon-di-oxide
4. Estimation of Hydrogen sulphide
5. Estimation of Residual chlorine
6. Estimation of total dissolved Solids
7. Determination of sulphate in water
8. Determination of iron in water
9. Determination of silicate in water
10. Determination of Nitrite/Nitrate in water.

### **Text Books**

1. Sharma.P.D., 1995. Environmental Biology and Toxicology. Rastogi and Company, Meerut, India.
2. Trivedi P.R.,& Gurdeepraj., 1992. Environmental Biology. Akashdeep Publishing House, New Delhi.
3. Pal, B.P.,1982 Environmental Conservation and Development, Nataraj Publishers, Dehra Dun, India.
4. Agarwal, K.C., 1989. Environmental Biology. Agro Botanical Publishers, India.

### **Reference Books**

1. Trivedi, P.R.& Gurdeepraj., 1992. Water Pollution. Akashdeep Publishing house, New Delhi.
2. Break Mely, W.1980. Chemicals in the Environment. Marshal Dokker INC Newyork.

3. Irving Sax, N.1974. Industrial Pollution. Van Nostrand Raingold Co., Newyork.
4. Pandey G.N.& G.C.Carney, 1989. Environmental Engineering. Tata McGraw-Hill Publishing Co., Ltd.

### **ZOO O 215: Optional – I : Statistical Methods**

#### **Unit-I**

**Definition, scope, functions and limitations of Statistics-Collection, Classification, Tabulation of data, Diagrammatic representation of data-Simple, Multiple and Percentage Bar diagram, Pie diagram and Graphical representation of data-Histogram, frequency polygon, frequency curve and Ogives. Primary and Secondary data - Questionnaire method.**

#### **Unit-II**

**Measures of Central tendency-Mean, Median and Mode and their practical usages. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance and Coefficient of Variation. Measures of Skewness-Pearson's, Bowley's method. Application of Binomial and Normal distributions.**

#### **Unit-III**

**Measure of Bivariate data- Simple, Partial and Multiple Correlation. Scatter diagram and Pearsons method, Rank correlation. Regression and their equations-Prediction. Basic concept of Sampling- Parameter and Statistics – Sampling distribution and Standard Error – Simple random sampling and stratified random sampling.**

#### **Unit-IV**

**Tests of Significance with their important concepts. Tests for large samples-Test for mean, difference of means, proportion and equality of proportions . Small sample tests – test for mean, difference of Means, paired samples, test for correlation and regression coefficients, Chi square test for goodness of fit and independence of attributes.**

#### **UNIT –V**

**Applications and analysis using SPSS – Analysis of variance one way and two way classifications. Multiple regression analysis, Logistic regression analysis, Factor analysis, Cluster analysis, Discriminant function analysis.**

**(Note: The emphasis is only on the application of the methods. The derivations of the formulae are not necessary).**

#### **Books for study and References:**

- 1.Gupta , S.P. (2011). Statistical Methods, Sultan Chand & Sons, Pvt. Ltd., New Delhi.
- 2.Gupta, S.C. and V.K. Kapoor, (2011). Fundamentals of Mathematical Statistics , Sultan Chand & Sons, Pvt, Ltd., New Delhi.
- 3.Darren George, Paul Mallery (2011). SPSS for Windows, 10<sup>th</sup> Edition, PEARSON.



**Second year: III Semester**  
**COURSE: ZOO C 301 BIOTECHNOLOGY**

**Objectives**

To make the students to learn the application of scientific and Engineering principles to the processing of materials by biological agents to provide goods and service.

**Unit-I: Basic Biotechnology**

**Definition – Scope – Achievements of Biotechnology – Restriction Enzymes, DNA ligases, polymerase etc. Cloning vehicles – Plasmid Bacteriophage, Cosmids, Yeast plasmids- Genomic DNA libraries, cDNA libraries.**

**Unit-II: Techniques in Biotechnology**

**Southern blotting, Northern blotting, Western blotting, *In-situ* hybridization, DNA sequencing PCR, DNA finger printing, DNA probes, site – directed mutagenesis, particle gun, microinjection, electroporation.**

**Unit-III: Medical Biotechnology**

**Insulin, Somatotrophin, somatostatin, hormone production, vaccines, interferons, gene therapy, monoclonal antibodies, Antenatal diagnosis, Invitro fertilization technology, Human genome project.**

**Unit-IV: Agricultural Biotechnology**

**Micropropagation, protoplast culture, Encapsulated seed, Symbiotic and Non symbiotic nitrogen fixation, Biofertilizers- Mass - production of BGA, VAM Rhizobium culture. Biopesticides-single cell protein-transgenic plants and animals. Mushroom culture.**

**Unit-V: Microbial and Environmental Biotechnology**

**Bioreactor, Growth curve, primary metabolites – Vitamins, alcohols, Secondary metabolites – Antibiotics and Toxins, Microbial enzyme production – amylase. Biomass as a source of energy. Biogas production, Vermicomposting, Microbial leaching. Ethical issues and biosafety regulations, Intellectual Property Right (IPR) and Protection (IPP).**

**Practicals**

1. Methods of sterilization
2. Preparation of culture media and Agar slants
3. Estimation of microflora of milk by MBR test & RESAZURINE Test.
4. C.S. of stem and Root nodule of leguminous plants
5. Conn's direct microscopic count of soil microbial population
6. Standard plate count
7. Antibiotic assay – *Streptomycin*
8. Purification of Bacteria
9. Agarose Gel Electrophoresis
10. Study of Biogas Plant.

**Text Books**

1. Dubey.R.C. 2004. A Text Book of Biotechnology. S.Chand & Co. Ltd. New Delhi.
2. Gupta. R.K. 1996. Elements of Biotechnology. Rastogi & Company, Meerut.

**Reference Books**

1. Kumar .H.D. 1998. A Text Book of Biotechnology. Affiliated East – West press Pvt., New Delhi.
2. Purohit .S.S 2000 Biotechnology, Fundamentals and Application. Agrobios. Jodhpur.
3. Primrose .S.B 1991. Molecular Biotechnology. 2<sup>nd</sup> Edition Blackwell, Oxford.
4. Meyers.R.A., 1995. Molecular Biology and Biotechnology. VCH publishers.

## Course: ZOO C 302 IMMUNOLOGY

### Objectives

To make the students to aware of the basic principles of immunology and expose to the organs and mechanism of immunity.

#### Unit-I: Immune System

Scope of immunology-Humoral and Cell mediated immunity - Innate immunity - Acquired immunity - HLA system - Graft rejection.

#### Unit-II: Cells and Organs of the Immune System

'B' Lymphocytes-'T' Lymphocytes -Antigens presenting cells-Null cells - Mononuclear phagocytic cells - Granulocytic cells-Clonal selection of lymphocytes-Primary lymphoid organs-Secondary lymphoid organs.

#### Unit-III: Antigens

Definition-Immunological properties of antigen-Immunogenicity, Antigenicity, Allergenictiy, Tolorogenicity.Factors affecting immunogenicity-Foreignness, Molecular size, Chemical composition and Degradabilty, Adjuvants-Epitopes-Heptens-Mitogens.

#### Unit-IV: Antibodies

Basic structure of immunoglobulins - classification - functions of immunoglobulins - antibody diversity.

#### Unit-V: Antigen Antibody Interactions

Strength of antigen antibody interactions-Antibody affinity-Antibody avidity-Cross reactivity, Precipitin reaction-Agglutination reaction-Haemagglutinations-RadioImmuno Assay (RIA), Enzyme linked Immunosorbant Assay (ELISA)-western blotting.

#### Practicals

1. Preparation of solutions of different normality, molarity, and dilutions.
2. Demonstration of lymphoid organs
3. Cell imprinting of lymphoid organs
4. Histology of lymphoid organs
5. Study of bone marrow cells
6. Identifications of Leucocytes in human blood smear.
7. Differential count of W.B.C. from blood smear preparation
8. Human blood grouping
9. Antigen antibody interaction-immunology
10. Rapid plasma regain (RpR) test for syphilis

#### Text Books

1. Joshi K.R.and N.O.Osama. Immunology. 4<sup>th</sup> Revised Ed. Agrobotanical publishers, Daryageanj, New Delhi.
2. Roitt., I.M.,1988. Essential Immunology. 6<sup>th</sup> ed. EIBS Blackwell scientific publishers

#### Reference Books

1. Coleman M.R., M.F.Lombard, R.E.Sicard., 1992. Fundamental immunology. 2<sup>nd</sup> Ed., Wm. C.Brown Publishers.
2. Hood Wood W., Wilson 1984. Immunology. 2<sup>nd</sup> Edn. The Benjamin/Cummings Publishers INC London.
3. Lars .A.Hanson and Hans Wigzell 1985. Immunology. 6<sup>th</sup> Edn. Butterworth and co. Publishers
4. Nossal G.J.and G.L.Ada 1971. Antigens Lymphoid Cells and the Immune Response. Academic Press, New York, London
5. Kabat E.A. and M.M.Mayer 1961. Experimental Imunochemistry. Charles C.Thomas Publishers Springfield USA.

## **COURSE: ZOO C 303 TOXICOLOGY**

### **Objectives**

To make the students to understand the various types of toxicants and its impact on living organisms.

#### **Unit-I: Absorption, Distribution and Excretion of toxicants**

Definition and scope of toxicology – Chemical interaction – Membrane permeability – Diffusion, filtration and engulfing by cells – absorption – distribution – excretion.

#### **Unit-II: Bio-Transformation of Toxicants**

Definition – general principles – receptor site – degradation reaction – conjugation – bioactivation – complex nature of bio-transformation – Antidotes – mechanism of antidotal action – assessment of antidotal efficacy.

#### **Unit-III: Bio-chemical basis of Toxicology**

Mechanism of Toxicity – receptor mediated events – disturbance of excitable membrane function, biochemical process – Ca<sup>+</sup> homeostasis – covalent binding – genotoxicity – Tissue specificity – Target organs – mechanism of action.

#### **Unit-IV: Methods of Toxicology**

Bio-assay test-single species test-mutli species test – acute toxicity test – subacute toxicity test – chronic toxicity test – determination of LC<sub>50</sub> value – pathological techniques – autopsy and histology – histopathology – histochemistry – cytochemistry – morphometric methods.

#### **Unit-V: Chemical and Immuno toxicology**

Toxic chemicals: Pesticides – automobile emission – heavymetals – fertilizers – food additives – animal, plant and mushroom toxins

Immunotoxicology – General concepts – lymphocytes – Natural killer cells – macrophages – hypersensitivity reaction – immunosuppression – molecular immunotoxicology.

### **Practicals**

1. Observation and recording of Behavioural changes of normal and treated fish.
2. Estimation of oxygen consumption of normal and toxicant treated fishes.
3. Analysis of pesticide residues in vegetables by finger printing technique.
4. Estimation of acid and alkaline phosphatase activity of normal and toxicant treated animal tissue.
5. Estimation of SDH activity in liver tissue of normal and malathion treated fish.
6. Estimation of total protein content in the muscle tissue of normal and endosulfan treated fish.
7. Estimation of Glucose and Glycogen level in the liver tissue of normal and Lead treated fish.
8. Estimation of AchE activity in brain tissues of normal and mercury treated mouse.
9. Estimation of GSH level in liver tissue of normal and endrin treated mouse.
10. Determination of cell volume in liver tissue of normal and copper treated fish.
11. Histopathological observation of the following  
1.Liver 2.Kidney 3. Brain 4. Intestine 5. Muscle
12. Determination of LC<sub>50</sub> value of Zinc on fish.

**Text Books**

1. Sharma, P.D. 1996 Environmental Biology and Toxicology. Rastroggi Publication, Meerut, India.
2. LU, F.C. 1985. Basic Toxicology. Hemisphere Publication. Corporation, Washington, N.Y. London
3. Gupta, P.K and Salunka, D.K. 1985. Modern toxicology. Vol I and II, Metropolitan, New Delhi.
4. Sood, A. 1999. Toxicology. Sarup & sons, New Delhi.

**Reference Books**

1. Butler, G.C. 1978. The Principles of Ecotoxicology Scope. 12, ICSO Scope John Wiley and sons, Chichester.
2. Finney D.J 1971. Probit Analysis, Cambridge University Press.
3. Adrien Albert 1981. Selective Toxicity. University press Cambridge.
4. Gupta, P.K and V.Raviprakash 1988. Advance in Toxicology and Environmental Health. Jagmandar Book Agency, New Delhi.

## ZOO O 315 : Optional –II : Basic Biochemistry

### Objective:

To understand the physiochemical principles in biochemistry and the basic concepts of the chemistry and metabolism of major biomolecules.

### Unit-I

Classification and general properties of carbohydrates. Functions of biologically important monosaccharides, disaccharides, homopolysaccharides and heteropolysaccharides. Carbohydrate metabolism: glycolysis, citric acid cycle, gluconeogenesis, pentose phosphate (HMP shunt) pathway, glycogen metabolism (Overview only, structures not required). Diabetes mellitus (elementary details).

### Unit-II

Amino acids: classification and general properties. The peptide bond. Biologically important peptides. Proteins-classification, functions, denaturation and renaturation. Orders of protein structure: Primary, Secondary ( $\alpha$  - helix,  $\beta$  - pleated sheet), supersecondary, tertiary and quaternary structures. Protein metabolism: Catabolism of amino acid nitrogen-transamination, deamination, ammonia formation, urea cycle, (Overview only, structures not required).

### Unit III

Classification of lipids. Fatty acids. Eicosanoids: biological functions of prostaglandins, thromboxanes and leucotrienes. Phospholipids and sphingolipids-biological functions. Structure and functions of cholesterol. Brief account of lipoproteins. Lipid metabolism: transport of fatty acids into mitochondria-role of carnitine,  $\beta$ -oxidation of fatty acids, biosynthesis of fatty acids (overview only, structure not required). Coronary heart disease (elementary details).

### Unit IV

Enzymes: Classifications and nomenclature. Specificity, factors affecting enzyme activity-substrate, pH and temperature. Michaelis – Menten equation and Lineweaver Burk plot. Coenzymes and Isoenzymes (brief account only). Enzyme inhibition- competitive, non-competitive and uncompetitive (derivation of rate equation not required). Allosteric enzymes, feedback inhibition.

### Unit V

Nucleic acids: purine and pyrimidine bases, nucleosides and nucleotides. Biologically important nucleotides. DNA structure-Watson and Crick model. A, B, and Z forms of DNA. Triple and quadruple structures. DNA supercoiling. DNA denaturation. Differences between DNA and RNA. Major classes of RNA-Structure and biological functions.Minor classes of RNA.

### Textbooks:

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 6<sup>th</sup> edition, 2012.
2. Murray *et al.* Harper's Illustrated Biochemistry 29<sup>th</sup> edition, McGraw Hill, 2012.
3. Satyanarayana U. Biochemisrty. Books and Allied Pulb, latest ed.

**Second year: IV Semester**  
**COURSE: ZOO C 401: ENTOMOLOGY**

**Objectives**

To make the students to understand the insect by study of their morphology, anatomy and physiology of various systems, acquire knowledge of Sericulture, Apiculture, Vector insects and integrated pest management.

**Unit-I: Insect Morphology**

Insect taxonomy upto orders - Salient features with suitable examples of the insect orders - Thysanura, Odonata, Isoptera, Orthoptera, Hemiptera, Coleoptera, Lepidoptera, Hymenoptera and Diptera - Insects collection - Preservation - Identification - insect head - types of antennae - mouth parts and wing venation.

**Unit-II: Insect Physiology**

Structure and physiology of integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive and nervous system.

**Unit-III: Agricultural Entomology**

Insect - pests outbreak - assessment of insect population - Identification, seasonal history, biology, nature of damage and control measures of major pests of paddy, sugarcane, vegetables (Brinjal).

**Unit-IV: Principles and methods of Pest Management**

Principles of Insect control - Prophylactic measures - cultural, mechanical, physical methods - Genetic control and quarantine. Biological control : parasites, Predators and Microbial agents. Chemical methods: Pesticides- general classification - classification based on mode of action, mode of entry and Biopesticides: Integrated Pest Management (IPM) - definition, Integration of methods - potential components - need for IPM and uses.

**Unit-V: Beneficial insects and Vector insects**

Sericulture: biology of silk worm, silk gland, cultivation of mulberry plants, rearing silkworm and uses of silk - Apiculture: types of bees, bee colony, life history, Beekeeping accessories and byproducts of bees and its uses. Useful insects - Biology and control measures of important insect vectors - mosquitoes and houseflies.

**Practicals**

1. Methods of harmful insect collection, preservation and submission of insect box.
2. Identification of at least 10 insects belonging to different orders.
3. Mounting of salivary gland of cockroach, mouth parts of cockroach, housefly, and mosquito.
4. Mounting of different types of antennae and legs of insects, wings and their venation.
5. Demonstration of digestive, reproductive (male and female) and nervous system of insects (Cockroach and Odontopus).
6. Histological slides - T.S. of foregut, midgut and hindgut, T.S of testis, L.S. of ovary and types, T.S. of carpus cardiacum and T.S. of carpus allatum.
7. Life history of silkworm (egg, larva, cocoon and adult).
8. Bee keeping equipments and its accessories.
9. Bioassay of insecticides on insects (LC50)
10. Collection and Identification of medically important arthropods (Mosquitoes, house flies, lice and mites).

#### **Text Books**

1. **Temphare D.B. 1984. A Text Book of Insect Morphology, Physiology and Endocrinology. S.Chand and Co., New Delhi.**
2. **Chapman R.F. 1982. The Insect Structure and Functions. English Language Book society, Hoober Strongron.**

#### **Reference Books**

1. **Vasantharaj David.B. and V.V. Ramamurthy (2011). Elements of Economic Entomology, Namrutha publications, Chennai 600 116.**
2. **Temphare, D.B. (2009). Modern Entomology, Himalaya publishing Mumbai.**
3. **Ambrose, Dunston P,. (2004). The Insects: Structure, function and Biodiversity. Kalyani publishers, Ludhiana – New Delhi – Chennai.**
4. **Chapman, R.F. (2002). The Insect structure and functions. English Languages Book Society, Hoober Strongton.**
5. **Mike, W,. Service (1999). Medical Entomology for Student, Cambridge Press.**
6. **Nayer, K.K., Ananthakrishnan T.N. and David B.V. General and Applied Entomology. Mc.Grow Hill Publications, New Delhi.**
7. **Rathanswamy, G. K. (1986). A Handbook of Medical Entomology and Elementary Parasitology. S. Viswanathasn Printers & Publishers Pvt. Ltd.**
8. **Srivastava, K.P. (1993). A Text Book of Applied Entomology. Vol I & II Kalyani Publishers, New Delhi.**
9. **P.G. Fenemore, Allaprakash, (1992). Applied Entomology : Wiley Eastern Ltd., Delhi.**
10. **Ullal, S.R. and M.N. Narasimhanna (1987). Hand book of practical sericulture, Central silk board (Ministry of textiles – Government of India), United Mansion, 39, Mahatma Gandhi road, Bangalore.**

## **COURSE: ZOO C 402: FISHERIES AND AQUACULTURE**

### **Objectives**

To make the students to understand the Indian fisheries scenario in relation to world aquaculture and learn culture practices.

#### **Unit-I: Capture Fisheries**

Present status and scope of capture fisheries -commercially important fishes-Food and feeding habits of important edible fishes-Age and growth-Method of age determination – length - weight relationship.

#### **Unit-II: Culture Fisheries**

Present status and scope of culture fisheries- Biology of important cultivable fishes – Marketing of cultured fishes-Major diseases – symptoms and treatments.

#### **Unit-III: Aquaculture Principles and Practices**

Aquaculture - types of culture-fish farm-types of ponds-maintenance and management-eradication of algal bloom-predators - induced breeding-hypophysation –factors of induced spawning – transport of fish seed.

#### **Unit-IV: Culture Methods**

Culture of freshwater prawn - *Macrobrachium*-Marine Prawn *Penaeus monodon*-Pearl oyster-Green Mussel – Sea Weeds – Lobster.

#### **Unit-V: Fish Harvest Technology**

Harvesting methods-handling and preservation-Fishing Gears-Fish preservation-fishery byproducts - marketing and economics.

#### **Practical**

1. Estimation of pH, total hardness, dissolved O<sub>2</sub>, salinity
2. Determination of nitrate, sulphate, phosphate and silicate
3. Identification and biology of important cultivable fishes.
4. Morphology and Morphometry study of fish
5. Types of scales in fishes
6. Analysis of gut content of fish
7. Collection and identification of fish parasites
8. Collection and identification of fish predators
9. Identification of commercially important species
10. Demonstration of Hypophysation technique in fish

#### **Text Books**

1. Pillay T.V.R.1995. Aquaculture Principles and Practices. Fishing News Books, Blackwell Science Ltd., Oxford.
2. Jhingran V.J., 1991. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.

#### **Reference Books**

1. Santhanam, Sugmaran and P.Natarajan, 1997. Manual of Fresh Water Aquaculture. Oxford and IBH Pub.Co., Ltd., New Delhi.
2. Shanmugam.K, 1990. Fishery Biology and Aquaculture. Leo Pathippagam, Madras – 600 083.
3. Biswas S.P., 1993. Manual of Methods in Fish Biology. South Asian Publishers Pvt. Ltd., New Delhi.
4. Kurian C.V. and V.O. Sebastien 1982. Prawns and Prawn Fisheries of India. Hindustan Publishing Corporation New Delhi.
5. Govindan T.K. 1985. Fish Processing and Technology. Oxford and IBH Pub.Co., Ltd., New Delhi.
6. Srivastava, C.B.L., 1985. A Text book of Fishery Science and Indian Fisheries. Kitab Mahal, Allahabad.



## **COURSE : ZOO C 403 : ENDOCRINOLOGY**

### **Objectives**

To make the students to learn the objectives and scope of comparative endocrinology, anatomy, morphology and histology of endocrine tissues of vertebrates, crustacean and insect endocrine organs and their functions.

### **Unit-I: Pituitary Gland**

General characteristics of hormones-Pituitary gland-structural organization-Pituitary hormones functions - hypothalamic control.

### **Unit-II: Thyroid Gland**

Thyroid gland-structural organisation- metabolic effects of thyroid hormone- effects of thyroid on reproduction - Parathyroid - structure - function of parathyroid hormone.

### **Unit-III: Pancreas and Adrenal Glands**

Structure of pancreas- function of Insulin and glucagon- Adrenals - structural organization, functions of cortical and medullary hormones.

### **Unit-IV: Vertebrate Reproductive Endocrinology**

Structure of mammalian testis and ovary-male and female sex accessory organs-hormones of testis and ovary - estrus and menstrual cycle -hormones of pregnancy - parturition - hormonal control of lactation.

### **Unit-V: Insect and Crustacean Endocrinology**

The concepts of neurosecretion - Endocrine system in crustacea - endocrine control of moulting and metamorphosis - Neuroendocrine system in insects-endocrine control of moulting and metamorphosis.

### **Practicals**

1. Demonstration of endocrine organs in vertebrates
2. Demonstration of reproductive systems in vertebrates
3. Histological study of pituitary, adrenal, testis, ovary, corpus luteum, pancreas and thyroid gland
4. Demonstration of reproductive system in insects
5. Demonstration of neuroendocrine complex in insects.
6. Histology of ovary, accessory glands, corpus allatum and brain in insects
7. Demonstration of Parabiosis in cockroach
8. Demonstration of Ovariectomy in cockroach.
9. Vaginal smear showing various stages of estrus cycles
10. Demonstration - influence of insulin on blood glucose level.

### **Text Books**

1. Turner C.D, 1966, General Endocrinology. 4<sup>th</sup> Ed, W.B.Saunders Co., London.
2. Bentley P.J., 1985. Comparative Vertebrate Endocrinology. S.Chand and Co.,
3. Barrington E.J.W., 1968. An Introduction to General and Comparative endocrinology. Academic press, London.

### **Reference Books**

1. Harris.G.W. and B.T.Donovan (Ed) 1968. The Pituitary Gland. Vol.3
2. Williams.R.M, 1974, Text Book of Endocrinology 5<sup>th</sup> Ed.
3. BentleyP.J. 1982. Comparative Vertebrate Endocrinology Cambridge University Press.
4. Michael .P. 1968. Endocrinology and Human Behaviour. Oxford University Press, New York.

**Optional for students of Zoology Department to be offered in the  
IV Semester**

**Optional - III  
ZOO O 415-1 PUBLIC HEALTH AND HYGIENE**

**Objectives**

To make the students to aware of public health importance, different diseases, causing organisms to human beings and control measures.

**Unit - I**

Introduction to important disease to human beings. Mosquito – borne diseases – malaria, filariasis and chikungunya. Morphology, life cycle of vector mosquitoes - Anopheles, Culex and Aedes species and vector management.

**Unit - II**

Protozoan and human diseases (Kala-azar, typhoid, amoebic dysentery, cholera, sleeping sickness). Morphology, life cycle and control measures of sand flies, Houseflies and Tsetse fly.

**Unit - III**

Protozoan and Human diseases. Life cycle and Public Health Importance of Trypanosomiasis, Leishmaniasis and Trichomoniasis

**Unit - IV**

Protozoan and Human diseases. Life cycle and Public Health Importance of Taenia solium, Schistosoma and Ascaris.

**Unit - V**

Air, food and water – borne diseases. Air – borne diseases – Tuberculosis, Diphtheria and pneumonia. Food and water – borne diseases – sources of water pollutants – cholera, botulism, shigellosis and typhoid fever. Cancer – sources, different types of tumors and treatment.

**TEXT BOOK**

1. Rathinasamy G.K., 1974. A Handbook of Medical Entomology and Elementary Parasitology. S. Viswanathan Printers and Publication Pvt., Ltd.
2. Dubey, R.C. and D.K. Maheswari, 2005. A text book of Microbiology, S.Chand & Company Ltd., New Delhi.
3. Gupta, P.K and V.Ramprakash, 1985. Advance in Toxicology and Environmental Health. Jagmender Book GENCY, New Delhi
4. Jordon, E.L. and P.S.Verma, 2005, "Invertebrate Zoology", S.Chand & Company Ltd., New Delhi.
5. Parthiban, M. and B. Vasantharaj David, 2007. "Manual of Household & Public Health pests and their control", Namrutha Publications, Chennai.

**REFERENCE BOOK**

1. Mike, W. Service, 2004. Medical Entomology for students, Cambridge University Press, New York.
2. Ernest Carroll Faust, 1955. Animal Agents & Vectors of Human Disease, Lea & Febiger, Philadelphia.
3. James R. Busvine, 1983. Insects and Hygiene, Chapman and Hall, New York.

**Optional for students of Zoology Department to be offered in the  
IV Semester**

**Optional - III  
ZOO O 415 -2 ANIMAL SCIENCE**

**Objectives**

To make the students to acquire knowledge of the biological diversity and their interspecific relations.

**Unit-I**

Characteristic features of major Invertebrate and Vertebrate phyla. (Protozoa, Porifera, Coelenterata, Platyhelminthes, Annelida, Arthropoda, Mollusca and Echinodermata. Protochordata, Fishes, Amphibia, Reptiles, Birds and Mammals)

**Unit-II**

Arthropods and vectors of human diseases (mosquitoes, lice, House fly and ticks). Mode of transmission of pathogens by vectors: control measures of vectors. Useful insect: silkworm

**Unit-III**

Important human and veterinary parasites (protozoans and helminthes): morphology and life cycle of Ascaris, Wuchereria. Fasciola. Schistosoma Leishmania and plasmodium.

**Unit-IV**

Gametogenesis in animals - Molecular events during fertilization. Cleavage patterns and fate maps- and gastrulation

**Unit-V**

Origin of life-different concepts, Theories of organic evolution. (Darwinism, Neo-Darwinism, Lamarckism and Neo-Lamarckism): speciation.

**TEXT BOOKS**

1. Ekambaranatha Ayyar, M. and T.N.Ananthakrishnan, 1987. A Manual of Zoology. Vol.I (Invertebrata). S.Viswanathan Pvt.Ltd. Chennai.
2. Ekambaranatha Ayyar, M. and T.N.Ananthakrishnan, 1987. A Manual of Zoology. Vol.II (Chordata) S.Viswanathan Pvt. Ltd., Chennai.
3. Rathinaswamy, G.K. 1974. "A Hand Book of Medical Entomology and Elementary Parasitology", S.Viswanathan Printers and Publishers Pvt. Ltd., Chennai.
4. Gupta P.K. 1995 Cytology, Genetics and Evolution. Rastogi Publications Meerut.

**REFERENCE BOOKS**

1. Rober D. Barnes 1994. Invertebrate Zoology. 6<sup>th</sup> ed. Brooks W.B.Saunders company. Philadelphia.
2. Madan Mohan Rao. M. 1999 Applied Entomology. Mittal Publications, New Delhi.
3. Deepak Kumar Verma, 1999 Applied Entomology. Mittal Publications, New Delhi.
4. Balinsky B.I. 1970, An Introduction to Embryology. Saunder's college, publishing Ltd., Tokyo.
5. Diwan, A.P. and N.K.Dhakad 1996. Principles of Developmental Biology. Anmol publications Pvt. Ltd., New Delhi.
6. Veer Bala Rastogi 1989. Organic Evolution. Rastogi and company Meerut.

## Optional - IV

### ZOO O 416-1 ANIMAL CULTURE TECHNIQUES (Optional for students of Zoology Department to be offered in the IV Semester)

#### Objectives

To make the students to understand the methods of vermicomposting and techniques of Sericulture, Apiculture and Aquaculture.

#### Unit - I

Method of composting - factors responsible for composting -vermicomposting - biofertilizers

#### Unit- II

Types of honey bees- bee colony-social life in honey bees-types of beehives and other accessories-uses of honey.

#### Unit - III

Silk worm, *Bombyx mori* - cultivation of mulberry plants-rearing of silkworms-silk production-composition and uses of silk.

#### Unit - IV

Types of culture-general culture techniques-induced breeding-culture of edible fishes.

#### Unit - V

Ornamental Fish Culture – Angel fish-Fighter fish-Gold Fish-Gurami and Guppies.

#### TEXT BOOK

1. Vasantaraj David.B and Kumaraswamy.T 1988. Elements of Economic Entomology. Popular Book Depot, Madras.
2. Pillay T.V.R.. 1995 Aquaculture Principles and Practices Fishing. News Books Survery, England.

#### REFERENCE BOOKS

1. Biswas T.D.and S.Kmukhrjee. Text Book of Soil Science. Tata. McGraw Hill, 1994. New Delhi
2. Agarwal S.C.1994. A Hand Book of fish Farming. Narendra publishing House, Delhi.
3. Axalrod H.Immeris, C.W. Burgens, W.S. 1986, Exoitic Tropical Fishes. T.F.H.Publications U.S.A.

## **Optional - IV**

### **ZOO O 416-2 ENVIRONMENTAL SCIENCE (Optional for students of Zoology Department to be offered in the IV Semester)**

#### **Objectives**

To make the students to become aware of the environmental problems of pollution, wild life sanctuaries and conservation and environmental educations.

#### **Unit-I**

Environment – Atmosphere – Stratification of the atmosphere – light and temperature as ecological factors – Hydrological cycle.

#### **Unit – II**

Environmental education – Definition – Goals, objectives – Guiding Principles – Classification - Formal environmental education – Primary level, Secondary level, Tertiary level – Non Formal environmental education.

#### **Unit-III**

Conventional and Nonconventional Sources of energy – conservation of land and forest – social forestry – World and – National conservation Strategy.

#### **Unit-IV**

Air pollution and its effect on organisms – Water pollution and its effect on organisms – industrial and agricultural wastes – pollution control Board – Regulatory Authorities – Pollution Protection Act.

#### **Unit – V**

Wild life of India – National Parks and Sanctuaries – Endangered Fauna of India – Wild life conservation and Management.

#### **TEXT BOOKS**

1. Agarwal K.C., 1989. Environmental Biology. Agro Botanical Publishers, India.
2. Sharma P.D.,1991 Ecology and Environment. 6<sup>th</sup> Ed. Restogi Publication. Meerut.

#### **REFERENCE BOOKS**

1. Odum, EP. 1971. Fundamentals of Ecology, 3<sup>rd</sup> Ed. W.B.Saunders & Co. Philadelphia
2. Odum. EP. 1983. Basic Ecology. Holt-Saunders International Ed. Japan.
3. Pal B.P.,1982. Environmental Conservation and Development. Nataraj Publishers, Dehra Dun, India.

(Optional for students of other Departments to be offered in the II, III or IV Sem.)

**Optional-I**

**ZOO O 215 ANIMAL CULTURE TECHNIQUES**

(Optional for students of other science departments to be offered in the II Sem.)

**Objectives**

To make the students to understand the methods of vermicomposting and techniques of Sericulture, Apiculture and Aquaculture.

**Unit - I**

Method of composting - factors responsible for composting -vermicomposting - biofertilizers

**Unit- II**

Types of honey bees- bee colony-social life in honey bees-types of beehives and other accessories-uses of honey.

**Unit - III**

Silk worm, *Bombyx mori* - cultivation of mulberry plants-rearing of silkworms-silk production-composition and uses of silk.

**Unit - IV**

Types of culture-general culture techniques-induced breeding-culture of edible fishes.

**Unit - V**

Ornamental Fish Culture – Angel fish-Fighter fish-Gold Fish-Gurami and Guppies.

**TEXT BOOK**

2. Vasantaraj David.B and Kumaraswamy.T 1988. Elements of Economic Entomology. Popular Book Depot, Madras.
3. Pillay T.V.R.. 1995. Aquaculture Principles and Practices Fishing. News Books Survery, England.

**REFERENCE BOOKS**

1. Biswas T.D.and S.Kmukhrjee. Text Book of Soil Science. Tata. McGraw Hill, 1994. New Delhi
2. Agarwal S.C.1994. A Hand Book of fish Farming. Narendra publishing House, Delhi.
3. Axalrod H.Immeris, C.W. Burgens, W.S. 1986, Exoitic Tropical Fishes. T.F.H.Publications U.S.A.

**Optional - II**  
**ZOO O 315 ENVIRONMENTAL SCIENCE**

(Optional for students of other science departments to be offered in the III sem.)

**Objectives**

To make the students to become aware of the environmental problems of pollution, wild life sanctuaries and conservation and environmental educations.

**Unit-I**

**Environment – Atmosphere – Stratification of the atmosphere – light and temperature as ecological factors – Hydrological cycle.**

**Unit – II**

**Environmental education – Definition – Goals, objectives – Guiding Principles – Classification - Formal environmental education – Primary level, Secondary level, Tertiary level – Non Formal environmental education.**

**Unit-III**

**Conventional and Nonconventional Sources of energy – conservation of land and forest – social forestry – World and – National conservation Strategy.**

**Unit-IV**

**Air pollution and its effect on organisms – Water pollution and its effect on organisms – industrial and agricultural wastes – pollution control Board – Regulatory Authorities – Pollution Protection Act.**

**Unit – V**

**Wild life of India – National Parks and Sanctuaries – Endangered Fauna of India – Wild life conservation and Management.**

**TEXT BOOKS**

1. Agarwal K.C., 1989. Environmental Biology. Agro Botanical Publishers, India.
2. Sharma P.D.,1991 Ecology and Environment. 6<sup>th</sup> Ed. Restogi Publication. Meerut.

**REFERENCE BOOKS**

1. Odum, EP. 1971. Fundamentals of Ecology, 3<sup>rd</sup> Ed. W.B.Saunders & Co. Philadelphia
2. Odum. EP. 1983. Basic Ecology. Holt-Saunder International Ed. Japan.
3. Pal B.P.,1982. Environmental Conservation and Development. Nataraj Publishers, Dehra Dun, India.

(Optional III & IV for students of other science departments to be offered in the IV semester)

**Optional - III  
ZOO O 417 PUBLIC HEALTH AND HYGIENE**

**Objectives**

To make the students to aware of public health importance, different diseases, causing organisms to humanbeings and control measures.

**Unit - I**

Introduction to important disease to human beings. Mosquito – borne diseases – malaria, filariasis and chikungunya. Morphology, life cycle of vector mosquitoes - Anopheles, Culex and Aedes species and vector management.

**Unit - II**

Protozoan and human diseases (Kala-azar, typhoid, amoebic dysentery, cholera, sleeping sickness). Morphology, life cycle and control measures of sand flies, Houseflies and Tsetse fly.

**Unit - III**

Protozoan and Human diseases. Life cycle and Public Health Importance of Trypanosomiasis, Leishmaniasis and Trichomoniasis

**Unit - IV**

Protozoan and Human diseases. Life cycle and Public Health Importance of Taenia solium, Schistosoma and Ascaris.

**Unit - V**

Air, food and water – borne diseases. Air – borne diseases – Tuberculosis, Diphtheria and pneumonia. Food and water – borne diseases – sources of water pollutants – cholera, botulism, shigellosis and typhoid fever. Cancer – sources, different types of tumors and treatment.

**TEXT BOOK**

1. Rathinasamy G.K., 1974. A Handbook of Medical Entomology and Elementry Parastitology.S.Viswanathan Printers and Publication Pvt., Ltd.
2. Dubey, R.C. and D.K. Maheswari, 2005. A text book of Microbiology, S.Chand & Company Ltd., New Delhi.
3. Gupta, P.K and V.Rampraksh, 1985. Advance in Toxicology and Environmental Health. Jagmender Book GENCY, New Delhi
4. Jordon, E.L. and P.S.Verma, 2005, “Invertebrate Zoology” , S.Chand & Company Ltd., New Delhi.
5. Parthiban, M. and B. Vasantharaj David, 2007. “Manual of Household & Public Health pests and their control”, Namrutha Publications, Chennai.

**REFERENCE BOOK**

1. Mike, W. Service, 2004. Medical Entomology for students, Cambridge University Press, New York.
2. Ernest Carroll Faust, 1955. Animal Agents & Vectors of Human Disease, Lea & Febiger, Philadelphia.
3. James R.Busvine, 1983. Insects and Hygiene, Chapman and Hall, Newyork.



**Optional - IV**  
**ZOO O 418 ANIMAL SCIENCE**

(Optional for students of other science departments to be offered in the IV semester)

**Objectives**

To make the students acquire knowledge of the biological diversity and their interspecific relations.

**Unit-I**

Characteristic features of major Invertebrate and Vertebrate phyla. (Protozoa, Porifera, Coelenterata, Platyhelminthes, Annelida, Arthropoda, Mollusca and Echinodermata. Protochordata, Fishes, Amphibia, Reptiles, Birds and Mammals)

**Unit-II**

Arthropods and vectors of human diseases (mosquitoes, lice, House fly and ticks). Mode of transmission of pathogens by vectors: control measures of vectors. Useful insect: silkworm

**Unit-III**

Important human and veterinary parasites (protozoans and helminthes): morphology and life cycle of Ascaris, Wuchereria. Fasciola. Schistosoma Leishmania and plasmodium.

**Unit-IV**

Gametogenesis in animals - Molecular events during fertilization. Cleavage patterns and fate maps- and gastrulation

**Unit-V**

Origin of life-different concepts, Theories of organic evolution. (Darwinism, Neo-Darwinism, Lamarckism and Neo-Lamarckism): speciation.

**TEXT BOOKS**

1. Ekambaranatha Ayyar, M. and T.N.Ananthakrishnan, 1987. A Manual of Zoology. Vol.I (Invertebrata). S.Viswanathan Pvt.Ltd. Chennai.
2. Ekambaranatha Ayyar, M. and T.N.Ananthakrishnan, 1987. A Manual of Zoology. Vol.II (Chordata) S.Viswanathan Pvt. Ltd., Chennai.
3. Rathinaswamy, G.K. 1974. "A Hand Book of Medical Entomology and Elementary Parasitology", S.Viswanathan Printers and Publishers Pvt. Ltd., Chennai.
4. Gupta P.K. 1995 Cytology, Genetics and Evolution. Rastogi Publications Meerut.

**REFERENCE BOOKS**

1. Rober D. Barnes 1994. Invertebrate Zoology. 6<sup>th</sup> ed. Brooks W.B.Saunders company. Philadelphia.
2. Madan Mohan Rao. M. 1999 Applied Entomology. Mittal Publications, New Delhi.
3. Deepak Kumar Verma, 1999 Applied Entomology. Mittal Publications, New Delhi.
4. Balinsky B.I. 1970, An Introduction to Embryology. Saunder's college, publishing Ltd., Tokyo.
5. Diwan, A.P. and N.K.Dhakad 1996. Principles of Developmental Biology. Anmol publications Pvt. Ltd., New Delhi.
6. Veer Bala Rastogi 1989. Organic Evolution. Rastogi and company Meerut.