



**THIRUVALLUVAR UNIVERSITY**  
**SERKKADU, VELLORE – 632 115**

**Department of Zoology**

**M.Sc., Zoology (University Department)**

**UNDER CBCS (With effect from 2018-19 onwards)**

## **Regulations**

**The course of study and scheme of examinations**

**1. TITLE:** M.Sc., Zoology.

**2. YEAR OF IMPLIMENTATION:** July 2018 onwards

### **3. COURSE DETAILS:**

Total No. of Semesters	- 04 (2 semesters per year)
Total No. of theory papers	- 15
Total No. of Lab. Courses	- 05
Project	- 4 <sup>th</sup> semester only

### **Total Marks for M.Sc. Degree**

Theory	- 1500 marks
Lab. courses	- 500 marks
Project	- 200 marks
<b>Total</b>	<b>- 2200 marks/90 credits</b>

### **4. PREAMBLE OF THE SYLLABUS:**

Master of Science (M.Sc.) in Zoology is a post graduation course of Thiruvalluvar University. The curriculum is prepared by following the prospectus of various national and international universities. The syllabi are all set to meet the standard of UGC-CSIR (NET) and SLET examinations. The credit system to be implemented through this curriculum would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities. The students pursuing this course would have to develop in-depth understanding of various aspects of Zoology. The conceptual understanding, development of experimental skills, designing and

implementation of novel synthetic methods, developing the aptitude for academic and professional skills, acquiring basic concepts for structural elucidation with hyphenated techniques, understanding the fundamental biological processes and rationale towards computer. The project introduced in the curriculum will motivate the students to pursue the research and find a job in reputed pharmaceutical and other industries including abroad.

### **1. ELGIBILITY FOR ADMISSION**

A candidate who has passed the B.Sc., degree examination with Zoology as the main subject of study of this university or an examination of any other university accepted by the syndicate as equivalent there to shall be eligible for admission to the M.Sc., degree in Zoology.

### **2. DURATION OF THE COURSE**

The course shall extend over a period of two years comprising of four semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall conducted at the end of every semester for the respective subjects. Each semester have 90 working days consists of 5 teaching hours per working day. Thus, each semester has 450 teaching hours and the whole programme has 1800 teaching hours.

### **3. MEADIUM OF INSTRUCTION AND EXAMINATIONS**

The medium of instruction for the courses in English only.

### **4. RESTRICTIONS TO APPEAR FOR THE EXAMINATIONS**

Any candidate having arrear paper(s) shall have the option to appear in any arrear paper along with the regular semester papers, in theory as well as in practical's, as long as the transitory provision is applicable.

## 5. INSTRUCTIONS TO THE STUDENTS

The student admitted to M.Sc. Zoology course that they are supposed to adhere to the following rules:

1. A minimum of 75% attendance for lectures / practical is the pre-requisite for grant of them.
2. There shall be tutorial / practical / surprise test / home assignment / referencing of research papers / seminar / industrial visits / training course as part of internal assessment in each semester. The students are supposed to attend all the tests. The students should note that retest will not be given to the student absent for the test/s.

## 6. PATTERN OF EXAMINATION

Evaluation of Students:

1. The Odd-Semester and even semester examinations will be of 100 marks each.
2. Student has to obtain 50% marks in all the examinations (both theory and laboratory course)

**7. FEE STRUCTURE:** As per Thiruvalluvar University norms

## 8. SCHEME OF EXAMINATION

The semester examination will be conducted at the end of each semester (Both theory & practical examination), for odd semesters in the month of November/December; for even semester in April/May. All theory examination is conducted for 3 hours irrespective of total marks. However, duration of practical examinations is 4 hours.

**Theory paper** will be of 75 marks each for university examination and 25 marks for internal evaluation.

### **Theory question pattern**

Section-A	10×2	= 20 marks	(50 words; 10 out of 12)
Section-B	5×5	= 25 marks	(250 words; either or type)
Section-C	3×10	= 30 marks	(500 words; 3 out of 5)

**Total = 75 marks**

### **University examinations**

**75 marks**

Section-A	10×2	= 20 marks
Section-B	5×5	= 25 marks
Section-C	3×10	= 30 marks

**Total = 75 marks**

### **Internal Assessment**

**25 marks**

Test	: 10 marks (best 2 out of 3)
Assignment	: 05 Marks
Seminar	: 10 Marks
<b>Total</b>	<b>: 25 marks</b>

**Lab. course examinations** will be of 75 marks each for university examination and 25 marks for internal evaluation.

## 9. Distribution of marks for practical examinations

<b>University Examination Experiment</b>	<b>: 75 Marks</b>	
Procedure	: 05 marks	
Experiment	: 30 marks	
Interpretation	: 10 marks	
Result	: 10marks)	
<b>Total</b>	<b>: 75 marks</b>	Practical viva-voce
<b>Lab, course Internal Assessment</b>	<b>: 25 marks</b>	Record
Number of Experiments	: 10 marks	
Performance	: 10 Marks	
Test	: 05 Marks	
<b>Total</b>	<b>: 25 marks</b>	

## 10. Passing Minimum in Lab. course examinations

Internal assessment (Lab. course)	: 12 Marks (50 %)	
University examination	: 38Marks (50 %)	
<b>Total</b>	<b>: 50 Marks</b>	
<b>Project dissertation</b>	<b>: 200 marks</b>	
Dissertation	: 150 marks	
Viva-voce	: 50 marks	
<b>Total</b>	<b>: 200 Marks</b>	

## 11. Distribution of marks for Dissertation/ project

Project will be evaluated by the concerned project guide along with departmental project committee. Assessment will be done by the committee every month. Evaluation will be on the basis of monthly progress of project work, progress report, referencing. Oral, results and documentation.

### **Project guide** **100 marks**

Dissertation format : 20 marks

Scope of the research problem : 20 marks

Methodology : 20 marks

Analysis : 20 marks

Results and findings : 20 marks

**Total : 100 marks**

### **Project committee** **50 marks**

Dissertation format : 10 marks

Scope of the research problem : 10 marks

Methodology : 10 marks

Analysis : 10 marks

Results and findings : 10 marks

**Total : 50 marks**

Project committee will have to conduct the seminar, regular review meetings collection of dissertation and conduct final viva-voce examination.

### **viva-voce examination** **50 marks**

Presentation : 20 marks

Subject knowledge : 20 marks

Interaction : 10 marks

**Total : 50 marks**

## 12. QUESTION PAPER SETTINGS

Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus by our University faculties.

## 13. STANDARD OF PASSING

A candidate should get not less than 50% in the university examination, compulsorily, in all papers, including lab. Course. Also, the candidate who secures not less than 50% marks in the University Examination (UE) and Internal Assessment (IA) examinations put together in any theory paper/practical shall be declared to have successfully passed the examination.

Internal marks will not change. Student cannot repeat internal assessment. If student misses internal assessment examination, she/he will have to score passing minimum in the external examinations only.

**Illustration:** Theory- Internal Assessment - 12 Marks

University Examination - 38 Marks

**OR**

Internal Assessment - 10 Marks

University Examination - 50 Marks

There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.

Internal assessment answer scripts may be shown to the concerned student but not end semester answer script.

## 14. REVISION OF REGULATIONS AND CURRICULAM

The above regulation and scheme of examinations will be in vogue without any for a minimum period of three years from the date of approval of the regulations. The university may revise/amend/change the regulations and scheme of examinations, if found necessary.



**திருவள்ளூர் பல்கலைக்கழகம்**  
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**M.Sc. ZOOLOGY**  
**UNDER CBCS**  
 (With effect from 2018 – 19 onwards)  
 The Course of Study and the Scheme of Examinations

Year / Semester	Subject Core/ elective	Paper	Title of the Paper	Credit	Exam hrs	Max. Marks		
						IA	Uni. Exam.	Total
I Semester	Core	Paper I MDZO11	Comparative and functional anatomy of Invertebrates	5	3	25	75	100
	Core	Paper II MDZO12	Comparative and functional anatomy of Chordates	5	3	25	75	100
	Core	Paper III MDZO13	Cell and Molecular Biology	5	3	25	75	100
	Core	Lab Course –I MDZO16	Comparative and functional anatomy of Invertebrates, and Chordates	4	4	25	75	100
	Elective – I MDZO14A		Fisheries and Aquaculture	3	3	25	75	100
	Elective – II MDZO15A		Medical Lab Technology	3	3	25	75	100
II Semester	Core	Paper IV MDZO21	Genetics and Biostatistics	5	3	25	75	100
	Core	Paper V MDZO22	Environmental Biology and Evolution	5	3	25	75	100
	Core	Paper VI MDZO23	Comparative Animal Physiology	5	3	25	75	100
	Core	Lab Course - II MDZO25	Cell and Molecular Biology, Genetics and Biostatistics	5	4	25	75	100
	Core	Lab Course - III MDZO26	Environmental Biology and Comparative animal Physiology	4	4	25	75	100
	Elective III MDZO24A		Entomology	3	3	25	75	100
	Compulsory Paper MDHR20		Human Rights	2	3	25	75	100
III Semester	Core	Paper VII MDZO31	Developmental Biology	5	3	25	75	100
	Core	Paper VIII MDZO32	Microbiology and Immunology	5	3	25	75	100
	Core	Paper IX MDZO33	Biochemistry and Biophysics	5	3	25	75	100



	Core	Lab Course IV MDZO35	Developmental Biology, Microbiology and Immunology	5	4	25	75	100
	Core	Lab Course V MDZO36	Biochemistry and Biophysics	4	4	25	75	100
	Elective IV MDZO34A		Basic concept in Biotechnology	3	3	25	75	100
IV Semester	Core	Paper X	Project	6		50	150	200
	Elective V- MDZO42A		Bio-Instrumentation	3	3	25	75	100
	Total			90				2200

**Name of the course/subject:** M.Sc., Zoology

**Semester :** I

**Name of the Paper:** Comparative and Functional Anatomy of Invertebrates **Credits:**5 **Hours of teaching:** 5

**Paper type:** Core Paper I

### **Objective**

To enlighten the students with adequate scientific details on origin, functional anatomy, mode of life and adaptive radiations with the relationships of invertebrates

### **Course Outcomes:**

- CO1. To acquaint knowledge on Symmetry, Coelom and Metamerism
- CO2. To understand Invertebrates Locomotion, Nutrition and Digestion
- CO3. To equip knowledge on Invertebrates Respiration and excretion
- CO4. To understand Invertebrates Nervous System and Chemical Co-ordination
- CO5. To know about Invertebrates Reproductive mechanism

### **Unit-1: Organization of symmetry, Coelom and metamerism**

Organization- Organization of asymmetry, radial, biradial and bilateral symmetry – Significance. Evolution of coelom. Acoelomate, pseudocoelomate, coelomate groups (Schizocoel, Enterocoel, mesenchyme) –Evolution of metamerism – Pseudometamerism, cyclo metamerism, corm theory, embryological theory – Significance.

### **Unit-2: Locomotion and Nutrition**

Locomotion- Amoeboid, Flagellar and Ciliary movement in protozoa, Hydrostatic movements in Coelenterata , Annelida, Mollusca and Echinoderms Nutrition and Digestion,- Patterns of Feeding and digestion in lower metazoa, Mollusca, - Echinodermata, Filter feeding in polychaeta.

### **Unit-3: Respiration and excretion**

Respiration - Organs of respiration: Gills, lungs and trachea. – Respiratory pigments. - Mechanism of respiration. Excretion in lower invertebrates, Excretion in higher invertebrates. Mechanism of Osmoregulation.

### **Unit-4: Nervous system and Chemical Co-ordination**

Primitive Nervous systems:-Coelentrata and Echinodermata. Advanced nervous system: - Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda) Endocrine glands in Mollusc and insects.

### **Unit-5: Reproductive system**

Pattern of sexual and asexual reproduction – Invertebrate larval forms and their phylogenic significance.

## Reference Books

1. Barrington, E.J.W. (1979)- II edition. Invertebrate structure and function. Thomas Nelson Sons Ltd., London.
2. Hyman, L.H. (1940-1959)-Vol I- Vol-VIII. The Invertebrates, McGraw Hill Co., New York and London.
3. Barnes, R.D. (1982). Invertebrates Zoology, VI edition. W.B. Saunders Co. Philadelphia.
4. Parker, T.J., Haswell W.A. (1991). Text book of Zoology, Macmillan Co., London.
5. Gardinar, M.S. (1972). Biology of invertebrates, MC.Graw Hill Book & Co, New Delhi.
6. Kotpal, R.L. (1997). Modern text Book of Zoology: Invertebrates 7<sup>th</sup> edit. Rastogi publications.
7. Jordan, E.L., Verma P.S. (1997). Invertebrate Zoology, 14<sup>th</sup> edit.-S.Chand & Co, New Delhi.

**Name of the course/subject:** M.sc., Zoology

**Semester :** I

**Name of the Paper:** Comparative and Functional Anatomy of Chordates **Credits:5 Hours of teaching: 5**

**Paper type:** Core Paper II

### **Objective**

To comprehend the systematic position, functional anatomy, mode of life, adaptive radiation of chordates.

### **Course Outcomes:**

CO1. To understand Chordates Phylogeny

CO2. To acquaint knowledge on Structural of Chordates

CO3. To know about Adaptive Radiation of Chordates

CO4. To equip knowledge on Parental care and Migration of Chordates

CO5. To understand Comparative Anatomy of Chordates

### **Unit-1: PHYLOGENY**

Sailent features of Prochordates, -Amphioxus- Ascidian-Balanoglossus.

### **Unit-2: STRUCTURAL**

Peculiarities- Elasmobranch & Bony fish-External characters, Digestive, Respiratory, Circulatory, Nervous System, Sense Organs, Nervous system, Sense organs & Reproductive systems.

### **Unit-3: ADAPTIVE RADIATION OF CHORDATES**

Adaptive radiation of fishes, Amphibians, reptiles, birds and mammals. Structural peculiarities of Prototheria, Metatheria and Eutheria.

### **Unit-4: PARENTAL CARE & MIGRATION**

Parental care in fishes and Amphibia. Migration of fishes. Migration of birds.

### **Unit-5: COMPARATIVE ANATOMY**

Comparative anatomy of Paired fins, limbs, heart, kidney, aortic arches and brain of vertebrates.

## Reference Books

1. Waterman, A.J. (1971). VIIth edition. Chordate Structure and Function. Macmillan Co. London.
2. Young, J.Z. (1981) Life of Vertebrates. 3rd edition ELBS, Oxford.
3. E.L.Jordan & P.S. Verma. 1998. Chordate Zoology. S.Chand & Company (Pvt) Ltd. New Delhi – 110055.
4. Colbert (1981)-Evolution of the vertebrates. 7<sup>th</sup> edition. John Wiley & Sons Company, New York.
5. Kapoor V.C. (1991). Theory and practical of animal taxonomy Oxford & IBH Publishing company, New Delhi.
6. Iyer E.K, & T.N. Anathakrishnan (2000). Manual of Zoology-Vol-II-Chordata. Viswanathan printers & Publishers pvt.Ltd.Chennai.

**Name of the course/subject:** M.Sc., Zoology      **Semester :** I  
**Name of the Paper:** Cell and Molecular Biology      **Credits: 5 Hours of teaching: 5**  
**Paper type:** Core Paper III

### **Objective**

To understand the structure and molecular basis of cellular interactions, energy transformation, regulation and control of genes, cell cycle and information transfer.

### **Course Outcomes:**

- CO1. To acquaint knowledge on Ultra Structures of Cell
- CO2. To know about Structure and Functions of Cell organelles
- CO3. To equip knowledge on Molecular structure of DNA
- CO4. To acquaint knowledge on Molecular structure of RNA
- CO5. To understand Synthesis of Protein

### **Unit-1: ULTRA STRUCTURE OF CELL**

Prokaryotic Cell, Eukaryotic Cell, Structure, Comparison, Plasma membrane – Structure – Passive and active transport - Cellular communication

### **Unit-2: STRUCTURE AND FUNCTIONS OF CELL ORGANELLES**

Ultra structure and function of Endoplasmic reticulum, Ribosome, Golgi bodies, Mitochondria, Lysosome. Nucleo cytoplasmic interactions, nuclear receptors

### **Unit-3: MOLECULAR STRUCTURE OF DNA**

DNA – Chemical composition -Watson Crick model of DNA, Types of DNA, DNA Replication, types, enzymology and mechanism of semi conservative mode of replication – DNA damage and repair.

### **Unit-4: MOLECULAR STRUCTURE OF RNA**

RNA-Chemical composition-Types-Transcription-Enzyme-Synthesis of RNA-RNA polymerase structure, Basic features of RNA synthesis –Template recognition –Core promoters (-10 and 35 box), UP element, Initiation, elongation and termination.

### **Unit-5: SYNTHESIS OF PROTEIN**

Mechanism of protein synthesis, components of protein synthesis-Transcription, Translation, Post translation modification.

## Reference Books

1. De Robertis, E. D.P. and De Robertis. E. M. F., (2001) Cell and molecular Biology. Lippincott Williams & Wilkinson Ltd., USA.
2. Howland, J. L. (1973) Cell Physiology. Mac Millan Publishing Co.
3. Avers, C. J., (1976). Cell Biology. D. Can Nostrand Company. New York.
4. Korenberg, A., (1974). DNA replication. W. H. Freeman and Company. San Francisco.
5. Albert. B and Watson. J. D., (1990) Molecular Biology of the Cell. Garland Publishing. London. Darrtell. J., Lodish, H. and Baltimore, D., 1992. Molecular Cell Biology. Scientific American Books.
6. Nelson D.L, Cox, M.M.(2005). Lehninger principles of Biochemistry, 4<sup>th</sup> edition, W.H. Freeman & Co.
7. Gupta, P.K. (1999). Cell & molecular Biology, Rastogi Publications, Meerut.

**Name of the course/subject:** M.Sc., Zoology      **Semester :** I  
**Name of the Paper:** Fisheries and Aquaculture      **Credits: 3 Hours of teaching:** 3  
**Paper type:** Elective Paper I

### **Objective**

The objective of the paper is to understand both the culture and capture fin and shell fisheries practices in India and World. Survey of seed resources and seed and feed production, animal health management, aquaculture and farm management and aquaculture system being practiced is giving a comprehensive idea to promote both the aquaculture and capture fisheries sectors and also to provide scope for employment opportunities.

### **Course Outcomes**

- CO1. To acquaint knowledge on Importance and Objectives of aquaculture
- CO2. To know about Survey of Seed resources and Seed and Feed Production
- CO3. To understand Animal Health Management
- CO4. To equip knowledge on Aquaculture and farm management
- CO5. To understand aquaculture systems

### **Unit-1: INTRODUCTION TO FISHERIES AND AQUACULTURE**

Importance and objective of aquaculture – Global and Indian scenario:  
Capture and culture fisheries status – prospects and scopes of Fin and shell fisheries:

edible fishes, crustaceans (prawn and crabs) and mollusks (clams, muscle, oyster and cephalopods)

### **Unit-2: SURVEY OF SEED RESOURCES AND SEED & FEED PRODUCTION**

Distribution and abundance of natural seed resources, collection methods and segregation. Artificial seed production - breeding under controlled condition, induced breeding technique, larval rearing, packing and transportation – Live feed culture and its importance: Microalgae, Rotifer and Artemia.

### **Unit-3: ANIMAL HEALTH MANAGEMENT**

Infectious bacterial and viral diseases in fin and shell fishes: Diagnosis, prevention and treatment – Disease control and management: environmental management, chemotherapeutic, vaccine, immunostimulant and probiotic.

### **Unit-4: AQUACULTURE AND FARM MANAGEMENT**

Brackish water aquaculture: site selection, topography, water availability and supply, soil conditions and quality, design and layout, structure and construction Farm management: water quality management; temperature, salinity, pH, O<sub>2</sub>, Co<sub>2</sub> levels, nutrients and trace elements



## Unit-5: AQUACULTURE SYSTEM

Traditional, extensive, semi intensive and intensive aquaculture system

Integrated aquaculture system: Paddy-cum-fish culture, poultry-cum-fish culture, pig-cum-fish culture – culture methods: Cage culture, pen culture and rack culture.

### Reference Books

1. Jhingran, C.G. 1981. Fish and Fisheries of India. Hindustan Publishing Co., India.
2. Balugut, E.A.1989. Aquaculture system and practices. A selected review publishing House, New Delhi.
3. Ghosh, P.K., 2010. Brackishwater aquaculture. Bharat Printing House,Jodhpur.
4. Arlo,W.F and L.James,1992.Marine shrimp culture and practices. Elsevier Science Publishers, B.V.
5. Pandian, T.J.,2001. Sustainable Indian Fisheries. The Coronation Arts Crafts, Sivakasi.
6. Pillay, T.V.R. 1990. Aquaculture Principles and Practices. Blackwell Scientific Publications Ltd.
7. Biswas, K. P. 1996. A Text Book of Fish, Fisheries and Technology. Narendra Publishing House, Delhi.

**Name of the course/subject:** M.Sc., Zoology  
**Name of the Paper:** Medical Lab Technology  
**Paper type:** Elective Paper II

**Semester :** I  
**Credits: 3 Hours of teaching:** 3

### **Objective**

To understand the basic concept of Cell culture and Biochemical assays. To know the various techniques related to examination of Human blood samples.

### **Course Outcomes**

- CO1. To know about Maintenance of Clinical Apparatus
- CO2. To acquaint knowledge on Haematopoietic system
- CO3. To understand haematology
- CO4. To equip knowledge on pathogens
- CO5. To understand microtechniques

### **Unit-1: MAINTENANCE OF CLINICAL APPARATUS**

Common glass wares in clinical laboratory, care and maintenance - Sterilization methods- Physical and chemical agents, Haemocytometry (Neubaur chamber), Blood components, functions, plasma & serum, Red cell indices (MCV, MCH, MCHC)

### **Unit-2: BLOOD**

Haematopoietic system -Erythropoiesis, Leucopoiesis, Thrombopoiesis, Anaemia-classification, Blood clotting factors, mechanisms of coagulation, anticoagulants

### **Unit-3: HAEMATOLOGY**

Bleeding time, Clotting time, Estimation of Haemoglobin, Erythrocyte sedimentation rate(ESR), Packed cell volume (PCV), Differential count, Total red blood cell count, Total white blood cell count, Platelet count, Eosinophil count, Reticulocyte count,

### **Unit-4: PATHOGENS**

Detailed account of *Plasmodium*, *Entamoeba*, *Trypanosoma*, *Ascaris*, *Taenia solium*

### **Unit-5: MICROTECHNIQUE**

Fixation, Dehydration, Clearing, infiltration & impregnation, embedding, sectioning staining, and mounting  
Spermatozoa count & Pregnancy test

## Reference Books

1. Ezhilarasi, 2004. Medical Laboratory Technology (in Tamil), Paavai Printers (P) Ltd & University of Madras, Chennai
2. Kanai L Mukerjee, 2004. Medical Laboratory Technology, Volume I, II, III, Tata McGraw Hill Publishing Company Ltd, New Delhi
3. Manoharan and Sethuraman 2003, Essentials Clinical Haematology, Jaypee Brothers (Medical Publishers (P) Ltd), New Delhi
4. Monica Cheesbrough, 2006, Medical laboratory manual for tropical countries, Volume I & II Cambridge University Press, UK
5. Navanadharao, Z, 2002, Practical Medical Technology, Vasavi Graphics, Nellore
6. Pearse, A.G.E., 1970. Histicchemistry -Theoretical and applied, Vol I Churchill Livingston
7. Ramniksood, 1999, Medical Laboratory Technology- methods and interpretations, 5th Edition, Jaypee Brothers (Medical Publishers (P) Ltd), New Delhi
8. Samuel, K.M, 1989, Notes on Clinical laboratory techniques, MKG Iyer and son (IV edition), Chennai
9. Venkatesan, P. 1998. Essentials of Medical Laboratory Technology, BICOVAS, Chennai
10. Williams and J William, 1990. Haematology, Mc Graw Hill, New York.



## Reference Books

1. Barrington, E.J.W. (1979)- II edition. Invertebrate structure and function. Thomas Nelson Sons Ltd., London.
2. Hyman, L.H. (1940-1959)-Vol I- Vol-VIII. The Invertebrates, McGraw Hill Co., New York and London.
3. Barnes, R.D. (1982). Invertebrates Zoology, VI edition. W.B. Saunders Co. Philadelphia.
4. Parker, T.J., Haswell W.A. (1991). Text book of Zoology, Macmillan Co., London.
5. Gardinar, M.S. (1972). Biology of invertebrates, MC.Graw Hill Book & Co, New Delhi.
6. Kotpal, R.L. (1997). Modern text Book of Zoology: Invertebrates 7<sup>th</sup> edit. Rastogi publications.
7. Jordan, E.L., Verma P.S. (1997). Invertebrate Zoology, 14<sup>th</sup> edit.-S.Chand & Co, New Delhi.
8. Waterman, AJ. (1971). VIIth edition. Chordate Structure and Function. Macmillan Co. London.
9. Young, J.Z. (1981) Life of Vertebrates. 3rd edition ELBS, Oxford.
10. E.L.Jordan & P.S. Verma. 1998. Chordate Zoology. S.Chand & Company (Pvt) Ltd. New Delhi – 110055.
11. Colbert (1981)-Evolution of the vertebrates. 7<sup>th</sup> edition. John Wiley & Sons Company, New York.
12. Kapoor V.C. (1991). Theory and practical of animal taxonomy Oxford & IBH Publishing company, New Delhi.
13. Iyer E.K, & T.N. Anathakrishnan (2000). Manual of Zoology-Vol-II-Chordata. Viswanathan printers & Publishers pvt.Ltd.Chennai.

**Name of the course/subject:** M.Sc., Zoology  
**Name of the Paper:** Genetics and Biostatistics  
**Paper type:** Core Paper IV

**Semester :** II  
**Credits: 5 Hours of teaching: 5**

### **Objective**

To understand the basic concept of genetic, Material, Mendelians rule, sex determination in human beings, and the mechanism of multiple in skin colour formation. To know the various genetic disorders and understand about the statistical population, variables, primary, secondary data, different kind of data presentation in the form of diagrams and various types of statistical applications.

### **Course Outcomes:**

- CO1. To acquaint knowledge on Microbial Genetics
- CO2. To know about Enzyme regulation of gene action
- CO3. To equip knowledge on Human genetics and chromosome anomalies and diseases
- CO4. To acquaint knowledge on data collection, screening of data, tabulation, diagrams
- CO5. To understand Regression and Correlations, flow charts and programming techniques

### **Unit-1: Microbial Genetics**

Conjugation, Transformation, transduction and sexduction. Chromosome mapping in prokaryotes (Virus & Bacteria) and eukaryotes (Drosophila and man).

### **Unit-2: Enzyme regulation of gene action**

Gene regulation-Gene action-Operon concept- GAL & LAC operon system. Evidences of regulation of gene action. Inborn errors of metabolism, with reference to protein lipid, carbohydrate & nucleic acid.

### **Unit-3:**

Human genetics- karyotype and nomenclature of metaphase chromosome bands; chromosome anomalies and diseases- chromosomal anomalies in malignancy (chronic myeloid leukemia, Burkitt's lymphoma, retinoblastoma and Wilms' tumor); genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits; human genome and mapping.

### **Unit-4:**

Population, Sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, per diagram, and cumulative frequency curves. Mean median, mode, quartiles and percentiles, measures of dispersion : range, variance, standard deviation , coefficient of variation, symmetry : measures of skewness and kurtosis

## **Unit-5:**

Simple linear regression and correlations. Understand and interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations' flow charts and programming techniques in statistics with R Programming

### **Text Books**

1. Robert P. Wagner. (1980). Introduction to modern Genetics-John Wiley & Sons, USA.
2. Snustad Y, and Simmons W.E, (2005), Principles of Genetics, John Wiley & Sons, USA.
3. Anothony, J.F. Griffiths (2000). An introduction to Genetic analysis- 7<sup>th</sup> edition W.H Freeman & Co, USA.
4. Gardner. (1984) 7th edition.Principles of Genetics, W.H Freeman & Co, USA.
5. Snedecor, Gm, Wand Cochran, W.G.(1967). 3rd edition, Statistical methods in Biology- Oxford publications, New Delhi.
6. Gupta, S.P. (1988). An easy approach to statistics-S.Chand & Co, New Delhi.
7. Pillai, R.S.N, Bagawathi, V. (2005). Statistics - S.Chand & Co, New Delhi.

**Name of the course/subject:** M.Sc., Zoology

**Semester :** II

**Name of the Paper:** Environmental Biology and Evolution **Credits:5 Hours of teaching: 5**

**Paper type:** Core Paper V

### **Objectives**

To generate up-to-date knowledge on environmental conservation and management through a comprehensive understanding of the components of ecosystem, biological cycles, habitat ecology, resource ecology, pollution and its management and To comprehend the scientific concepts of animal evolution through an understanding of its evidences, its mechanics, process and products.

### **Course Outcomes**

- CO1. To acquaint knowledge on Ecosystem and Community
- CO2. To know about Population Ecology, Population regulation and human population control
- CO3. To understand Resources Ecology and Biological cycles
- CO4. To equip knowledge on Environmental Conservation, Environmental Pollution and management
- CO5. To understand Human evolution

### **Unit-1: ECOSYSTEM AND COMMUNITY**

Ecosystem and Community - Review of concept of ecosystem - Natural and Man-made ecosystem, with examples. Energy flow - Trophic structure and levels - Pyramids, food chain and web - ecological efficiencies, and productivity and its measurement.

### **Unit-2: POPULATION ECOLOGY**

Structure and distribution - Growth curves - Groups, natality, Mortality – Density indices, Life study tables - factors affecting population growth – Carrying capacity. Population regulation and human population control.

### **Unit-3: RESOURCES ECOLOGY AND BIOLOGICAL CYCLES**

Renewable and non - renewable resources - animal resources. Conventional and non - conventional energy sources. Review of Biogeochemical cycles : Nitrogen, Phosphorous and sulphur.

### **Unit-4: ENVIRONMENTAL CONSERVATION, POLLUTION AND MANAGEMENT**

Principles of conservation – ethics and values of wild life, National parks, Rain water harvesting. Bioremediation - Need & Scope of Bioremediation - Environmental applications – Phytoremediation – Biomagnification -Bioavailability.

### **Unit-5: EVOLUTION**

Adaptation - Nature and types of adaptation - Adaptive trends quantifying adaptation - Batesian and Mullerian mimicry Polymorphism and Evolutions. Speciation - Structure of



species - clones, peripheral population and peripheral isolates. Human evolution - Sociobiology: Definition and scope - selfish gene, altruism and kin selection - bioethics.

### **Text Books**

1. Odum. E.P. (1996) 2nd Edition. Fundamentals of Ecology. Nataraj Publishers, Dehra Dun.
2. Trivedi, P.R.and Gurdeepraj, K. 1992. Environmental Biology. Akashdeep Publishing House New Delhi.
3. Sharma, P.D. (1995). Ecology and environment. Rastogi Publications.
4. Smith, R.L.1986. Elements of Ecology. Harpet and Row Publishers, New York.
5. D. S. Bendall (ed) 1983). Evolution from Molecules to Men. Cambridge University Press.
6. E.C. Minkoff (1984). Evolutionary Biology. Addison-Wesley. London.
7. A.P. Kamalakara rao, Ittasambasivah, & T.S. Gopala Krishnan (1983) 4<sup>th</sup> edition .Principles of organic evolution- Pearl Publications.

**Name of the course/subject:** M.Sc., Zoology

**Semester :** II

**Name of the Paper:** Comparative Animal Physiology **Credits: 5 Hours of teaching: 5**

**Paper type:** Core Paper VI

### **Objective**

To derive an unified knowledge of the functions of animals, their parts, organs and their behaviour, through and understanding of their nutrition, respiration, circulation, excretion and physico-chemical coordination with a phylogenetic tinge.

### **Course Out Comes:**

- CO1. To acquaint knowledge on Nutrition, Nutritive requirements and role of gastrointestinal Hormones
- CO2. To know about Population Ecology, Population regulation and human population control
- CO3. To equip knowledge on Respiration and Circulation
- CO4. To acquaint knowledge on Neuro muscular Co-ordination and Hormones and Functions
- CO5. To understand Chronobiology

### **Unit-1: NUTRITION**

Nutritive requirements – Digestion and adsorption of proteins, carbohydrates and lipids. Role of gastrointestinal hormones in digestion.

### **Unit-2: RESPIRATION & CIRCULATION**

**Respiration:** The exchange of gases- integumentary respiration, branchial respiration and gill respiration - physiology of respiration in Man. Respiratory Pigments, BMR. **Circulation:** Types of hearts - physiology of cardiac muscle - heart beat and its regulation – Composition of blood coagulation.

### **Unit-3: EXCRETION & OSMOREGULATION**

**Excretion:** Nitrogenous waste- Ammoniotelism, Ureotelism, Uricotelism – Structure of mammalian kidney – Nephron - formation of urine - physiology of excretion in Man.

**Osmoregulation:** Osmo – iono regulation in crustaceans, fishes, birds and mammals - hormonal control.

### **Unit-4: COORDINATION**

Neuro muscular co-ordination - types of neurons, transmissions of nerve impulse and reflex action. Chemical composition of muscle fiber and physiology of muscle contraction. Endocrine glands with special reference to man - Hormones and Functions. Receptors – Classification & function – Mechanism of hearing – Physiology of vision in man.

## **Unit-5: CHRONOBIOLOGY**

Chronobiology - (types - trophism, taxis, kinesis, reflex, learning). Temperature regulation: Poikilotherms, homeotherms and heterotherms - hibernation, aestivation - diapause.

### **Reference Books**

1. Hoar, W.S.1991, General and Comparative Physiology. Prentice Hall of India, New Delhi.
2. Prosser, C.L. 1973, (III Edition) Comparative Animal Physiology, W.B. Saunders & Co., Philadelphia.
3. Welson, A. 1979. Principles of Animal Physiology, McMillan Publishing Co. Inc. New York.
4. Schmidt Nelssen, K.1985. Animal Physiology, Adaptation and Environment Club, London.
5. Verma PS, Tyagi and Agarwal, V.K. 2010 Animal Physiology. S Chand & company (P) Ltd, New Delhi
6. Goel, K.A and Sastry, K.V, 1998 (IV Edition) A text book of Animal Physiology, Rastogi Publication, Meerut 250 002.
7. A.P. Kamalakara rao, Ittasambasivaiah, & T.S. Gopalakrishnan. (1983) 4<sup>th</sup> edition. Animal Physiology, Pearl Publications.

**Name of the course/subject:** M.sc., Zoology

**Semester :** II

**Name of the Paper:** Entomology

**Credits: 3 Hours of teaching: 3**

**Paper type:** Elective Paper III

### **Objective**

To catch up with the tremendous strides of expansion of knowledge in Entomology, this paper is meant to comprehend the classification of insects, economic importance of Entomology with special reference to beneficial insects, sericulture, insect pests & vector and their control, vector borne diseases etc.

### **Course Outcomes**

- CO1. To equip knowledge on Classification of Insects
- CO2. To know about Pollinators, predators and scavengers
- CO3. To acquaint knowledge on Sericulture and Nutrition
- CO4. To understand Agricultural Entomology
- CO5. To know about Medicinal Entomology

### **Unit-1: INSECT CLASSIFICATION**

Outline classification of insects with examples

### **Unit-2: APPLIED ENTOMOLOGY**

Pollinators, Predators and scavengers- Biology of honey bees, lac insects and their management.

### **Unit-3: SERICULTURE**

Biology of silkworm (*Bombyx mori*) - life cycle - organization of larvae, pupae and moth – types – rearing techniques, Reeling, structure of the silk gland, diseases. Moriculture – Silk worm nutrition

### **Unit-4: AGRICULTURAL ENTOMOLOGY**

Pest of Paddy with five examples, Pest of Sugarcane with two examples, Pest of Beverages – Coffee & Tea, Pest of stored products with five examples, internal feeder -external feeder- secondary pest and scavengers- Preventive and control measures

### **Unit-5: MEDICAL ENTOMOLOGY**

Mosquitoes- Lifecycle- *Aedes*, *Anopheles*, *Culex* –vector borne diseases-preventive and control measures, Housefly & Diseases.

## Reference Books

1. Ahsan,J and Sinha, S.P, 2009. A hand book on Economic Zoology, S. Chand & company Ltd, New Delhi
2. David, B.V and Ramamoorthy,V.V. 2012. Elements of Economic Entomology (VII edition), Popular Book Depot, Chennai.
3. Nalinasundari, M.S. and Santhi, R. 2006. Entomology. MJP Publishers, Chennai.
4. Nayar, K.K., Ananthakrishnan, T.N. and David, B.V, 1989. General and Applied Entomology. Tata McGraw Hill Publications, New Delhi.
5. Ramakrishna Ayyar T.V. 1989. Handbook of Economic Entomology for South India. Books and Periodicals Supply Service, New Delhi.
6. Veda, K., Nagai, I. and Horikomi, M. 1997. Silkworm Rearing (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Ekambaranatha Iyer and Ananthakrishnan, T.N. 1987, Manual of Zoology, S.Viswanathan and Co., Chennai.

**Name of the course/subject:** M.Sc., Zoology

**Semester :** II

**Name of the Paper:** Human Rights

**Credits: 3 Hours of teaching: 3**

**Paper type:** Compulsory Paper

**Course Out Comes (five outcomes for each units should be mentioned)**

CO1. To know about Historical development and theories

CO2. To understand International Human Rights

CO3. To acquaint knowledge on Human Rights Declarations

CO4. To equip knowledge on International Human Rights in Domestic courts

CO5. To know about Human Rights in Children and Women

**Unit-1: HISTORICAL DEVELOPMENT AND THEORIES**

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights.

**Unit-2: INTERNATIONAL HUMAN RIGHTS**

Prescription and Enforcement up to World War II - Human Rights and the U.N .O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Covenant on Economic, Social and Cultural Rights and Optional Protocol.

**Unit-3: HUMAN RIGHTS DECLARATIONS**

U.N. Human Rights Declarations - U.N. Human Commissioner.

**Unit-4: INTERNATIONAL HUMAN RIGHTS**

Amnesty International - Human Rights and Helsinki Process – Regional Developments - European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

**Unit-5: HUMAN RIGHTS IN CHILDREN AND WOMEN**

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment. Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

## Reference Books

1. International Bill of Human Rights, Amnesty International Publication, 1988.
2. Human Rights, Questions and Answers, UNESCO, 1982
3. Mausice Cranston- What is Human Rights
4. Desai, A.R.- Violation of Democratic Rights in India
5. Pandey- Constitutional Law
6. Timm. R.W.- Working for Justice and Human Rights
7. Human Rights, A Selected Bibliography, USIS
8. J.C.Johari-Human Rights and New World Order
9. G.S. Bajwa-Human Rights in India
10. Amnesty International- Human Rights in India.
11. P.C.Sinha - International Encyclopedia of Peace, Security.
12. K. Cheous (Ed) Social Justice and Human Rights (Vols 1-7).
13. Devasia, V.V- Human Rights and Victimology.

**Name of the course/subject:** M.Sc., Zoology  
**Name of the Paper:** Cell and Molecular Biology,  
Genetics and Biostatistics

**Semester :** II  
**Credits: 4 Hours of teaching:** 4

**Paper type:** Practical Paper II

### **Course Out Comes**

- CO1. To acquaint knowledge on Cell division, Structure of cell and Mitosis
- CO2. To understand the measurement of cells
- CO3. To know about Culture of *Drosophila* method and Mounting of Salivary gland
- CO4. To equip knowledge on Identification of Syndromes and Blood Grouping
- CO5. To understand data collection, Measurements, Correlation and Chi square test

#### **A. MOLECULAR CELL BIOLOGY**

1. Preparation of Buccal smears to show squamous epithelial cells.
2. Onion root tip squash preparation- Study of Mitosis.
3. Measurement of cell by using stage and ocular micrometer.
4. Slides (With reference to cell organelles).

#### **B. MOLECULAR GENETICS**

1. Culture of *Drosophila* method of maintenance, sex identification.
2. Mounting of salivary gland of *Drosophila* and *Chironomous* larva.
3. Karyotyping, identification of syndromes (Down, Klineflelter and Turner).
4. Identification of blood groups A, B, AB, O and Rh factors with reasons.

#### **C. BIOSTATISTICS**

1. Data collection and frequency
2. Measurements of central tendency-Mean, Median & Mode.
3. Simple Correlation.
4. Test of Significance- Chi square test.



## Text Books

1. De Robertis, E. D.P. and De Robertis. E. M. F., (2001) Cell and molecular Biology. Lippincott Williams & Wilkinson Ltd., USA.
2. Howland, J. L. (1973) Cell Physiology. Mac Millan Publishing Co.
3. Avers, C. J., (1976). Cell Biology. D. Can Nostrand Company. New York.
4. Korenberg, A., (1974). DNA replication. W. H. Freeman and Company. San Francisco.
5. Albert. B and Watson. J. D., (1990) Molecular Biology of the Cell. Garland Publishing. London. Darrtell. J., Lodish, H. and Baltimore, D., 1992. Molecular Cell Biology. Scientific American Books.
6. Nelson D.L, Cox, M.M.(2005). Lehninger principles of Biochemistry, 4<sup>th</sup> edition, W.H. Freeman & Co.
7. Gupta, P.K. (1999). Cell & molecular Biology, Rastogi Publications, Meerut.
8. Robert P. Wagner. (1980). Introduction to modern Genetics-John Wiley & Sons, USA.
9. Snustad Y, and Simmons W.E, (2005), Principles of Genetics, John Wiley & Sons, USA.
10. Anothony, J.F. Griffiths (2000). An introduction to Genetic analysis- 7<sup>th</sup> edition W.H Freeman & Co, USA.
11. Gardner. (1984) 7th edition. Principles of Genetics, W.H Freeman & Co, USA.
12. Snedecor, Gm, Wand Cochran, W.G.(1967). 3rd edition, Statistical methods in Biology- Oxford publications, New Delhi.
13. Gupta, S.P. (1988). An easy approach to statistics-S.Chand & Co, New Delhi.
14. Pillai, R.S.N, Bagawathi, V. (2005). Statistics - S.Chand & Co, New Delhi.

**Name of the course/subject:** M.Sc., Zoology

**Semester :** II

**Name of the Paper:** Environmental Biology and  
Comparative Animal Physiology

**Credits: 4 Hours of teaching:** 4

**Paper type:** Practical Paper III

### **Course Outcomes**

CO1. To know about Estimation of Oxygen, Salinity, Nitrites, Phosphates, calcium and alkalinity

CO2. To equip knowledge on Industrial effluents and study of sandy

CO3. To understand Animal association and Field Visit

CO4. To acquaint knowledge on Estimation of RQ, salt loss and salt gain, Protein, carbohydrate and lipid

CO5. To know about Estimation of Bleeding, Clotting time, ESR and PCV

### **A. ENVIRONMENTAL BIOLOGY**

1. Estimation of dissolved Oxygen – River, Pond and Industrial effluents.
2. Estimation of salinity, Nitrites, Phosphates, Calcium and Alkalinity in water samples.
3. Analysis of industrial effluents- TDS, TSS, BOD, COD.
4. Study of sandy, Muddy and rocky shore fauna with reference to adaptation to the environment
5. Animal association parasitism, Mutualism and Commensalism.
6. Field visit – To visit various industries & Processing Centres
  - i. Tanneries
  - ii. Dyeing industry.
  - iii. Sugar mill.
  - iv. Dairy farm.
  - v. Food Processing Industries.

### **B. COMPARATIVE ANIMAL PHYSIOLOGY**

1. Estimation of RQ in fish reference to light and temperature.
2. Estimation of salt loss and salt gain in fish.
3. Estimation of protein, carbohydrate and lipid in tissue of fish.
4. Estimation of bleeding, clotting time and haemoglobin concentration
5. Estimation of ESR and PCV.
6. Principle and Application of Sphygmomanometer, Haemocytometer, Kymograph, Electrophoresis.

### **Reference Books**

1. Odum. E.P. (1996) 2nd Edition. Fundamentals of Ecology. Nataraj Publishers, Dehra Dun.
2. Trivedi, P.R. and Gurdeepraj, K. 1992. Environmental Biology. Akashdeep Publishing House New Delhi.
3. Sharma, P.D. (1995). Ecology and environment. Rastogi Publications.
4. Smith, R.L. 1986. Elements of Ecology. Harper and Row Publishers, New York.

5. Hoar, W.S.1991, General and Comparative Physiology. Prentice Hall of India, New Delhi.
6. Prosser, C.L. 1973, (III Edition) Comparative Animal Physiology, W.B. Saunders & Co., Philadelphia.
7. Welson, A. 1979. Principles of Animal Physiology, McMillan Publishing Co. Inc. New York.
8. Schmidt Nelssen, K.1985. Animal Physiology, Adaptation and Environment Club, London.
9. Verma PS, Tyagi and Agarwal, V.K. 2010 Animal Physiology. S Chand & company (P) Ltd, New Delhi
10. Goel, K.A and Sastry, K.V, 1998 (IV Edition) A text book of Animal Physiology, Rastogi Publication, Meerut 250 002.
11. A.P. Kamalakara rao, Ittasambasivaiah, & T.S. Gopalakrishnan. (1983) 4<sup>th</sup> edition. Animal Physiology, Pearl Publications.

**Name of the course/subject:** M.Sc., Zoology

**Semester :** III

**Name of the Paper:** Developmental Biology

**Credits: 5 Hours of teaching: 5**

**Paper type:** Core Paper VII

### **Objective**

To imbibe the current knowledge pertaining to the development of animal embryos of diverse taxonomic groups through experimental analyses based on modern biological tools.

### **Course Outcomes:**

1. To acquaint knowledge on History of Embryology, Spermatogenesis and Acrosomal reaction
2. To equip knowledge on Fertilization and Types
3. To understand Gastrulation Movements, cell adhesion and cell communication
4. To know about Organogenesis and regulations
5. To acquaint knowledge on Genes, Development and Nuclear transplantation

### **Unit-1: GAMETOGENESIS**

History of Embryology - Ovists Vs Animalculist Preformation and Epigenesis - Descriptive and Experimental Embryology - Molecular Embryology gametogenesis: Spermatogenesis – Structure, motility of sperm-Egg activation – Acrosomal reaction - Growth of Oocytes - Synthesis and storage of macromolecules in the oocytes - Nuclear activities during oocytes growth. Hormonal control of ovulation.

### **Unit-2: FERTILIZATION**

Fertilization: polyspermy - Androgenesis - Egg activation - Electron microscopic and biochemical aspects - Fertility of sperm and its in vitro fertilization - artificial fertilization Chemodifferentiation.

### **Unit-3: DEVELOPMENT**

Gastrulation movements: role of egg cortex - Cell surface in morphogenesis - Cell adhesion and cell communication. Chemotactic induced aggregation - Aggregation in sponges. Experimental analysis in the early development of Echinoderms, Amphibians and Birds.

### **Unit-4: ORGANOGENESIS AND REGULATION**

Organogenesis - formation of organ. Rudiments: Differentiation and development of limb, thymus, spleen, salivary glands, heart and kidney in a mammal. Organiser: Inductive tissue interactions in developments. Metamorphosis - morphological and biochemical changes during amphibian metamorphosis - Hormonal control of metamorphosis in amphibians - Neuro - endocrine control of insect metamorphosis - Biochemistry and mechanism of action of hormones during metamorphosis

## **Unit-5: GENES AND DEVELOPMENT**

Nuclear transplantation. Cellular differentiation. Differential activation. Developmental genetic defects. Role of cell death in development. Teratogenesis - Ageing, transgenics.

### **Text Books**

1. Balinsky, B. L., 1981. An introduction to embryology, Saunders, Philadelphia.
2. Karp, G. and Berrill, N.J. 1981. Development, McGraw Hill, New York.
3. Grant, P., 1978. Biology of developing systems, Hoit Rein chart and Winston, Inc. New York and Chicago.
4. Saunders, J. W. 1982. Developmental Biology. Macmillan Co., London.
5. Gilbert, Scott. F. 1985. Developmental Biology. Sinauer Association, Inc., Publishers.
6. Raven, P. (1997). An outline of developmental physiology, Pergamon Press, New York.
7. Browder, W. (1984). Developmental Biology. Saunder college Publishing Company. India.

**Name of the course/subject:** M.Sc., Zoology

**Semester :** III

**Name of the Paper:** Microbiology and Immunology

**Credits: 5 Hours of teaching: 5**

**Paper type:** Core Paper VIII

### **Objective**

To acquire a basic knowledge of the microbes in general and of the environmental, medical and industrial important microbes in particular in order to have an integrated approach in biology and functional basis of immunoglobulin's, the mechanism, mediators, detection and application of antigen-reaction in the immune system.

### **Course Out Comes**

CO1. To acquaint knowledge on Sterilization and Culture Techniques

CO2. To understand Environmental Microbiology

CO3. To know about Industrial Microbiology

CO4. To equip knowledge on Antigens and Antibodies Reactions

CO5. To acquaint knowledge on Mechanism of immune systems

### **Unit-1: STERILIZATION AND CULTURE TECHNIQUES**

Sterilization: Principles - dry heat, moist heat, filtration, Tyndilization, pasteurization, Radiation - disinfection - Antimicrobial chemotherapy - Antibiotics source - Tests for sensitivity to antimicrobial agents and its quality control. Culture techniques - media preparation - preservation of cultures - Aerobic and anaerobic culture techniques- pure and mixed cultures.

### **Unit-2: ENVIRONMENTAL MICROBIOLOGY**

Microbial ecology, role of microorganisms in the productivity of ecosystems - Interactions between microorganisms and plants and animal- Microbiology of soil, water and air.

### **Unit-3: INDUSTRIAL MICROBIOLOGY**

Industrial microbiology - Industrial uses of microbes - fermentation products, bioconversions - bioremediation. Products of industrial microbiology - Penicillin, fuel ethanol, vinegar, vitamin B12, citric acid, glutamic acid, protease. Food and Dairy microbiology - Microbes in food - Role of microbes in food production. Dairy and non-dairy products - fermented foods and alcoholic beverages. Pharmaceuticals (antibiotics, vaccines etc.)

### **Unit-4: ANTIGENS & ANTIBODIES**

Antigens-Immunogenicity Vs Antigenicity, Haptens. Factors influencing Immunogenicity. Epitopes - B cell epitope and T cell epitope.

Antigen - Antibody interaction and immunodiagnostics. MHC - Restriction, Organization and inheritance of MHC, Antigen processing and presentation.

## Unit-5: MECHANISM OF IMMUNE SYSTEMS

Immunoglobulin - structure, isotypes and biological function. Immune response & theories. Antigenic determinant on immunoglobulin - isotype, allotype and idiotype. B-cell receptor, immunoglobulin super family, Monoclonal antibody, Polyclonal antibody. T cell receptor, cytokine, adhesion molecules.

Complement, Hypersensitive reaction, Transplantation immunology. Vaccines - Principles and types of Vaccines - DNA Recombinant Vaccine, Serum therapy.

### Text Books

1. Richard, A Golds, Thomas J. Kindt & Barbara A. Osborne. 2000. Kuby - Immunology. Freeman and Co. New York.
2. D.P. Stites, A.I. Terr and T.G. Parsloio. 1997. Medical Immunology. Prentice Hall, New Jersey.
3. Janeway, C.A. and P. Travers. 1997. Immunobiology. Current Biology Ltd. London.
4. Prescott L.M. Harley J.O. Klein D.A. 1990. Microbiology. WCB Publishers, Sydney.
5. Ananthanaryanan, T. and Paniker, J.C.K. 2000. Text Book of Microbiology Oriental Longman Ltd., Madras.
6. Ahmed, M. and Basumatary. S.K. 2006. Applied Microbiology. MJP Publishers, Chennai.
7. Alcas, R.M. (1995). Principles of Microbiology. Mosby-Year Book.

**Name of the course/subject:** M.Sc., Zoology  
**Name of the Paper:** Biochemistry and Biophysics  
**Paper type:** Core Paper IX

**Semester :** III  
**Credits: 5 Hours of teaching:** 5

### **Objective**

To comprehend the chemical constituents of living matter, chemistry of food substances and their transformation in animal system. The energy changes associated with hormonal regulation. The structure of biomolecules energy transformation in living system and modern physical instruments for the exploration of knowledge in biology.

### **Course Outcomes**

- CO1. To equip knowledge on Biological importance of water
- CO2. To know about Hormones, Enzymes, Vitamins and Amino acids
- CO3. To understand Bio-Kinetics
- CO4. To acquaint knowledge on Structure of Biomolecules
- CO5. To know about Photo Bio Physics

### **Unit-1: WATER**

Water – Biological importance – pH, Acid and base balance – Henderson, Hasselbach equation – Buffers – Biological importance. Acidosis, Alkalosis.

### **Unit-2: HORMONES, ENZYMES, VITAMINS & AMINOACIDS**

Chemistry and functions of steroid Hormones. Enzymes, Vitamins and amino acids Structure, Classification and Properties. Bioenergetics – High energy phosphates, Role of ATP, Biological Oxidation, Reductions – Mechanism of oxidative phosphorylation

### **Unit-3: BIO-KINETICS**

Classification, Structure and properties of mono, di and poly saccharides. Defects in carbohydrate metabolism. Glycolysis, Krebs's cycle. Structure and chemistry of simple and compound lipids. Defects in lipid metabolism.

### **Unit-4: STRUCTURE OF BIOMOLECULES**

Electron configuration of atom – Bonds forces between molecules – Electrostatic force, Vander Waal's forces – Hydrophobic and Hydrophilic – Biological importance. Law of thermodynamics- concept of free energy and entropy. Effects of sunlight and temperature on reaction. Energy of activation. Diffusion, Oxidation and reduction reaction. Bioluminescence.

### **Unit-5: PHOTO BIO PHYSICS**

Effects of UV in biological system. Delayed effects of radiation – Ageing, reduction in life span, cancer. Radioactive Isotopes and their importance. Measurements, Auto radiography. Effects of radiation.



## **Reference Books**

1. Harper's Biochemistry-Murray, Robert K. Harper
2. Principles of Biochemistry-Lehninger & Neilson
3. Biochemistry-Rastogi
4. Text book of Biochemistry- by A.V.S.S. RAO
5. Biochemistry by C.V. Pawar & G.R. Chatwal
6. Essentials of Biochemistry by J.L. Farley
7. Physiology and Biophysics by Ruch & Pattern

**Name of the course/subject:** M.Sc., Zoology  
**Name of the Paper:** Basic Concepts in Biotechnology  
**Paper type:** Elective Paper IV

**Semester :** III  
**Credits: 3 Hours of teaching:** 3

### **Objective**

To familiarize the use of the data and techniques of engineering and technology in biology for the study of living organisms, or derivatives of thereof, to make or modify products or processes for specific use. Also, to find solution of problems concerning human activities including agriculture, medical treatment, industry and environment and to find out the biological application of data base.

### **Course Outcomes**

- CO1. To acquaint knowledge on Genetic Engineering
- CO 2. To know about Hybridoma and Transgenic Technology
- CO 3. To understand Animal Biotechnology
- CO 4. To equip knowledge on microbial Biotechnology
- CO 5. To know about Environmental Biotechnology

### **Unit-1: GENETIC ENGINEERING**

Definition, objectives and outline of recombinant DNA technology procedure-RFLP - the PCR techniques - Genomic library - Blotting techniques – Southern blotting - Northern & Western blotting. cDNA - Changing genes . Enzymes: Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase. Cloning vectors: Plasmids, Phages, M13 mp vectors, Cosmids, Phagemids, Bluescript vefctors. Cosmids, Artificial chromosomes (YAC, BAC, HAC), Animal Virus derived vectors-SV-40, vaccinia/baculovirus & retroviral vectors, Expression vectors; pMal; GST; pET.

### **Unit-2: HYBRIDOMA AND TRANSGENIC TECHNOLOGY**

Scope of the technique, production of Monoclonal antibodies. Applications of monoclonal antibodies. genetically modified organisms; gene knockouts and mouse disease models Transgenic animals; Drosophila, fish, and mouse.

### **Unit-3: ANIMAL BIOTECHNOLOGY**

Cell culture - Organ culture - Whole embryo culture - Embryo transfer - In vitro fertilization (IVF) technology - Dolly - In vitro fertilization and embryo transfer in human - Cryobiology. Transgenic animal. Human genome project- Human gene therapy.

### **Unit-4: MICROBIAL BIOTECHNOLOGY**

Fermentation - bioreactor - Microbial products - Primary & Secondary Metabolites - enzymes technology - single cell protein (SCP).Biopolymers, Biopesticides and Biofertilizers.

## Unit-5: ENVIRONMENTAL BIOTECHNOLOGY

Bioremediation - bioremediation of hydrocarbons - Industrial wastes – Heavy metals - Xenobiotics - bioleaching – bio-mining – bio-fuels. Applications of biotechnology in agriculture, medicine and food science. Genetically modified organism (GMO'S) - GM foods. Biotechnology & bio-safety - IPR.

### Text Books

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K and Watson, J.D. 1994. Molecular Biology of the cell III edn. Garland publishing, New York.
2. Advice., J. 1994. Molecular markers. Natural history and evolution. Chapman & Hall, New York.
3. Purohit, S. S. and S. K. Mathur, (1999), Biotechnology: Fundamentals and Application. Agro Botanica, New Delhi. ISBN. 81-87167-IO-b.
4. Alan scragg, (1999), Environmental Biotechnology; Long Mann Publication. ISBN. 0582 276829.
5. R. C. Dubey, (2001). A text book of biotechnology, Rajendra Printer. New Delhi. ISBN. 81-219-09 16-3.
6. T.A Brown Gene cloning and DNA analysis. (1996) Blackwell science, Osney Mead, Oxford, OX20EL.
7. Sathyanarayane,U. (2006) Biotechnology Books and Allied (p) Ltd, India

**Name of the course/subject:** M.Sc., Zoology

**Semester :** III

**Name of the Paper:** Developmental Biology,  
Microbiology and immunology

**Credits: 4 Hours of teaching: 4**

**Paper type:** Practical Paper IV

### **Course Outcomes**

CO1. To know about Developmental stages of frog, Chick Embryo and Study of Larval forms

CO2. To equip knowledge on Observation, Identification and Collection of microbes.

CO3. To understand staining Methods and demonstration methods

CO4. To know about study of Antigen, Antibody reaction, Rh Factor, Lymphoid organs

CO5. To acquaint knowledge on Immune Electrophoresis and Electrophoretic separation of serum Proteins

### **A. DEVELOPMENTAL BIOLOGY**

1. Developmental stages of frog.
2. Development stages of Chick embryo.
3. Study of larval forms (Nauplius, Zoea, Mysis, Bipinaria).

### **B. MICROBIOLOGY**

1. Microscopic observation and identification of microorganisms in Pond water.
2. Types of bacteriophage, bacteria, fungi and algae from the prepared slides / Photographs from the book.
3. Collection and Identification of fungus: Bread mould and Coconut mould.
4. Identification of parasitic protozoan's (e.g. Plasmodium, Endameba, Trypanosoma, Leishmania donovani)
5. Identification of bacteria - staining methods - Gram positive and Gram negative bacteria.
6. Demonstration of
  - a. Isolation of single colonies streak plate and serial dilution.
  - b. Enumeration of microorganisms spread plate and pour plate methods.
  - c. Preparation techniques of culture medium for bacterial growth.

### **C. IMMUNOLOGY**

1. Study of antigen and antibody reaction through human blood group and Rh factor.
2. Study and identification of primary and secondary Lymphoid organs.
3. Demonstration of immune electrophoresis.
4. Slides showing Spleen TS, Thymus TS, Limp node TS and bone marrow.
5. Electrophoretic separation of serum proteins.

## Reference Books

1. Balinsky, B. L., 1981. An introduction to embryology, Saunders, Philadelphia.
2. Karp. G. and Berrill, N.J. 1981. Development, McGraw Hill, New York.
3. Grant, P., 1978. Biology of developing systems, Hoit Rein chart and Winston, Inc. New York and Chicago.
4. Saunders, J. W. 1982. Developmental Biology. Macmillan Co., London.
5. Gilbert, Scott. F. 1985. Developmental Biology. Sinauer Association, Inc., Publishers.
6. Raven, P. (1997). An outline of developmental physiology, Pergamon Press, New York.
7. Browder, W. (1984). Developmental Biology. Saunder college Publishing Company. India.
8. Richard, A Golds, Thomas J. Kindt & Barbara A. Osborne. 2000. Kuby - Immunology. Freeman and Co. New York.
9. D.P. Stites, A.I. Terr and T.G. Parsloio. 1997. Medical Immunology. Prentice Hall, New Jersey.
10. Janeway, C.A. and P. Travers. 1997. Immunobiology. Current Biology Ltd. London.
11. Prescott L.M. Harley J.O. Klein D.A. 1990. Microbiology. WCB Publishers, Sydney.
12. Ananthanaryanan, T. and Paniker, J.C.K. 2000. Text Book of Microbiology Oriental Longman Ltd., Madras.
13. Ahmed, M. and Basumatary. S.K. 2006. Applied Microbiology. MJP Publishers, Chennai.
14. Alcas, R.M. (1995). Principles of Microbiology. Mosby-Year Book.

**Name of the course/subject:** M.Sc., Zoology  
**Name of the Paper:** Biochemistry and Biophysics  
**Paper type:** Practical Paper V

**Semester :** III  
**Credits: 4 Hours of teaching:** 4

### **Course Outcomes**

- CO1. To acquaint Buffer, pH, Enzyme Kinetics
- CO2. To equip knowledge Qualitative analysis of urine
- CO3. To understand Chromatography, Quantitative analysis
- CO4. To know about Application of spectrophotometry, colorimetry
- CO5. To understand drop weight method and liquid lens- refractive index

### **A. BIOCHEMISTRY**

1. Buffer preparation & determination of pH-Demonstration.
2. Enzyme kinetics - anyone enzyme (Salivary amylase) Maltose standards, influence of enzyme concentration, time course, pH, Temperature, Substrate concentration (Line weaver Burk Plot) on enzyme activity.
3. Qualitative analysis of urine - protein, glucose, Ketone and acetone bodies.
4. Chromatography: Determination of amino acids in body fluids and tissues given samples.
5. Quantitative estimation of glucose, protein, cholesterol, urea and creatinine in the serum given samples.

### **B. BIOPHYSICS**

- 1) Principles and application of spectrophotometry or colorimetry- Demonstration.
- 2) Polarizing microscope, phase contrast microscope, ultra & electron microscopes demonstration.
- 3) Surface tension by drop weight method.
- 4) Liquid lens-refractive index.

### **Reference Books**

1. Harper's Biochemistry-Murray, Robert K. Harper
2. Principles of Biochemistry-Lehninger & Neilson
3. Biochemistry-Rastogi
4. Text book of Biochemistry- by A.V.S.S. RAO
5. Biochemistry by C.V. Pawar & G.R. Chatwal
6. Essentials of Biochemistry by J.L. Farley
7. Physiology and Biophysics by Ruch & Pattern

Annexure C  
Course Structure

**Thiruvalluvar University, Vellore 632115**

**Name of the course/subject:** M.Sc., Zoology

**Semester :** IV

**Name of the Paper:** Bioinstrumentation

**Credits: 3 Hours of teaching: 3**

**Paper type:** Elective Paper V

### **Objective**

The objective of this paper is to understand principle and application of instrument related to life science. Practical orientation towards application of instruments.

### **Course Outcomes**

- CO1. To understand Microscopy and its application
- CO2. To acquaint knowledge on Histology and specimen preparation
- CO3. To understand Separation Techniques
- CO4. To know about Biomolecular structure analysis
- CO5. To equip knowledge on Radiation tracer technique

### **Unit-1: Microscopy and its application**

Principle and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, confocal microscopy, cytophotometry and flow cytometry.

### **Unit-2: Histology and specimen preparation**

Preparation of microbial, animal and plant samples for microscopy and staining techniques. Types of microtomes and microtomy.

### **Unit-3: Separation Techniques**

Centrifugation, Basic principle and application. Differential, density and ultracentrifugation. sonication, lyophilization, Principles, methodology and applications of gel – filtration, ion – exchange and affinity chromatography; thin layer and gas chromatography; high performance liquid chromatography, FPLC. Electrophoresis: Principle and applications of Native, SDS, Agarose and 2D gel electrophoresis.

### **Unit-4: Biomolecular structure analysis**

Principle and method of biophysical analysis of biopolymer structure; X ray diffraction, fluorescence. UV, visible Spectroscopy, Atomic absorption and plasma emission spectroscopy. IR, NMR and ESR spectroscopy, MS and MALDI-TOF.

## **Unit-5: Radiation tracer technique**

Principle and applications of tracer technique in biology: Radioactive Isotopes and half life of isotopes; Effect of radiation on biological system; autoradiography; Cerenkov radiation; radiation dosimetry; scintillation counting. Biosensors: Principle and application.

### **Reference Books**

1. Instrumental method of chemical analysis -Shrama BK
2. Instrumental methods of analysis- DA Skoog
3. An introduction to practical Biochemistry – Plummer
4. Instrumentation -Chatwal and Anand
5. Modern experimental Biology- Boyer

\*Yellow highlights indicate employability of syllabus.