

*Placed at the meeting of
Academic Council
held on 26.03.2018*

APPENDIX - CD
MADURAI KAMARAJ UNIVERSITY
(University with Potential for Excellence)

M.Sc.. Zoology (Semester)

REVISED SYLLABUS

(With effect from the academic year 2018-19 onwards)

SCHEME OF EXAMINATIONS AND REGULATIONS

1. Introduction of the Programme

The M.Sc. Zoology is expected to be highly beneficial to the student community. The programme introduces new ideas slowly and carefully in such a manner so as to give the students a good feeling for the subject and develops an interest in the subject to pursue their studies further. It would also prove to be a great support for those preparing for CSIR-NET, SET and other competitive exams. Amalgamation subjects such as microbiology, Immunology, Molecular Biology and Biotechnology.

2. Eligibility for admission

A candidate with a pass in B.Sc., Zoology degree or any other degree accepted by Madurai Kamaraj University as equivalent to B.Sc. Zoology is eligible to join the course.

- 2.1 Duration of the Programme : 2 years**
2.2 Medium of instructions : English

3. Objectives of the Programme

To develop knowledge in basic Zoology and Zoological definitions/theories so that the students are able to develop skills which enable them to apply Zoological techniques for solving problems and help them to appreciate the depth of Zoological ideas that are useful in other areas. Students undergoing this course will make them serve as a good teacher at the U.G level and will also prepare them for pursuing research in areas related to Zoological Sciences.

4. Outcome of the Programme

The syllabi for M.Sc. Zoology have been designed in a such a way that the students, when they go out, will be capable of facing the competitive situation prevailing now and getting placement with developed Zoological knowledge.

5. Core subject papers

M.Sc. Zoology programme consists of number of subjects. The following are the various categories of the courses suggested for the M.Sc. Zoology programme:

Core Subjects (CS) -16

Elective Subjects (ES) -4

Non Major Elective (NME)-3 (For other major students)

6. Subject Elective Papers

The University shall provide all information related to the Elective subject in M.Sc. Zoology to all the students so as to enable them to choose their Elective Subjects in each semester. The list of elective papers in each semester is displayed under the programme structure.

7. Non-Major (Subject) Elective Papers

The University shall provide all information resulting to the Non-Major Elective Subject which is related to competitive examinations in M.Sc. Zoology, to all the students so as to enable them to choose their Elective Subjects in third semester. The list of elective Papers of third semester is displayed under the programme structure.

8. Utilization

Each subject contains five units which are interrelated to each other. Not only core subjects, but elective and non-major electives also contain the same.

9. Pattern of semester exam

Internal	- 25 Marks
External	- 75 Marks
Total	- 100 Marks

10. Scheme for Internal Assessment

For the M.Sc. Zoology Degree, the internal assessment marks will be given as below

Tests	- 10 Marks (average of the best two tests)
Assignment	- 5 Marks
Seminar/Group Discussion	- 5 Marks
Peer-Team-Teaching	- 5 Marks
Total	- 25 Marks

11. External Exam

- There shall be external examination at the end of each semester, odd semesters in the month of October / November and even semesters in April / May.
- A candidate, who has not passed the examination, may be permitted to appear in such failed subjects in the examinations to be held in October/November or April/May. A candidate should get registered for the first semester examination. If registration is not possible, owing to shortage of attendance beyond condonation limit/regulation prescribed OR belated joining OR on medical grounds, the candidates

are permitted to move to the next semester. Such candidates shall re-do the missed semester after the completion of the programme.

- Students must have earned 75% of attendance in each course for appearing for the examination. Students who have earned 74% to 70% of attendance have to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69% to 60% of attendance have to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate.
- Students who have below 60% of attendance are not eligible to appear for the examination. They shall re-do the semester (s) after the completion of the programme.
- The results of all the examinations will be published through the Controller of Examinations where the students underwent the course as well as through University Website. In case of private candidates, the results will be published through the Controller of Examinations in which they took the examinations as well as University Website.

12. Question Paper Pattern

Part-A

Ten questions (No choice)

10×1 =10 marks

Two question from each Unit (Objective type questions)

Part-B

Five questions (either or type)

5×7 =35 marks

One question from each unit

Part-C

Three question out of five

3×10 =30 marks

One question from each unit

13. Scheme of Evaluation

The Performance of a student in each course is evaluated in terms of percentage of marks with a provision of conversion to grade points. Evaluation of each course shall be done by a continuous internal assessment by the concerned Course Teacher as well as by an End of Semester Examination and both will be consolidated at the end of the course.

A mark statement with

$$CCPA = \frac{\sum (\text{Marks} \times \text{Credits})}{\sum (\text{Credits})}$$

Where the summations cover all the papers appeared up to the current semester.

14. Passing Minimum

A Candidate passes the M.Sc., Zoology by scoring a minimum of 50% (internal + external) in each paper of the course. No minimum marks for internal assessment. Minimum for external assessment is 45% i.e., 34 out of 75.

14.1. Classification:

S.NO	Range of CCPA	CLASS
1	50 & above but below 60	II
2	60 & Above	I

15. Model Questions

One Model question paper is displayed at the end of the regulation as per the pattern of the University.

16. Teaching Methodology

Each subject is designed with lectures / tutorials / seminar / Peer-Team-Teaching / PPT presentation/ Assignments etc., to meet the effective teaching and the learning requirements. 10% of the course content must be taught through Peer -Team Teaching methodology.

17. Text Books

List of all the text books is quoted at the end of the syllabus of each subject.

18. Reference Books

The list of all the reference books is followed by the list of text books. This list contains at least two/three books for each subject.

19. Retotaling and Revaluation Provision

Candidates may apply for retotaling and revaluation within ten days from the date of publication of results in the University website along with the required forms and fees.

20. Transitory provision

The candidates of previous scheme may be permitted to write exams in their own schemes up to the examination of April 2020 as a transitory provision.

21. Subjects and Paper related websites

All the subject details along with syllabus may be downloaded from the university website www.mkuniversity.org

Year	Semester	Subject	Credit		Hours		Course	
			T	P	T	P	T	P
I	I	Animal Diversity	5		6		1	
		Cell and Molecular Biology (Major)	5		6		1	
		Biochemistry (Major)	5		6		1	
		Aquaculture (Elective)	5		4		1	
		Lab in Cell and Molecular Biology and Biochemistry		3		8		1
	II	Genetics(Major)	5		6		1	
		Biotechniques (Major)	5		6		1	
		Ecology (Major)	5		6		1	
		Poultry Science(Major Elective)	5		4		1	
		Lab in Genetics and Ecology		2		8		1
II	III	Animal Physiology (Major)	5		6		1	
		Immunology and Microbiology (Major)	5		6		1	
		Biostatistics and Bioinformatics(Major)	5		6		1	
		Human Genetics or Applied Zoology (Non Major)	5		4		1	
		Lab in Animal Physiology and Immunology & Microbiology		3		8		1

	IV	Evolution (Major)	5		6		1	
		Developmental Biology (Major)	5		6		1	
		Lab in Evolution and Developmental Biology		2		8		1
		Project Work		10	10		1	
			70	20	88	32	15	4
			90		120		19	

Scheme of Examinations

Year	Semester	Subject	Theory					Practical				
			Hours	Marks	Int	Ext		Hours	Marks	Int	Ext	
						Min	Max				Min	Max
I	I	Animal Diversity	6	100	25	34	75	8	100	40	27	60
		Cell and Molecular Biology (Major)	6	100	25	34	75					
		Biochemistry (Major)	6	100	25	34	75					
		Aquaculture (Elective)	4	100	25	34	75					
	II	Genetics(Major)	6	100	25	34	75	8	100	40	27	60
		Biotechniques (Major)	6	100	25	34	75					
		Ecology (Major)	6	100	25	34	75					
		Poultry Science(Major Elective)	4	100	25	34	75					
II	III	Animal Physiology (Major)	6	100	25	34	75	8	100	40	27	60
		Immunology and Microbiology (Major)	6	100	25	34	75					
		Biostatistics and Bioinformatics(Major)	6	100	25	34	75					
		Human Genetics or Applied Zoology (Non Major Elective)	4	100	25	34	75					
	IV	Evolution (Major)	6	100	25	34	75	8	100	40	27	60
		Developmental Biology (Major)	6	100	25	34	75					
		Project Work	10									

ANIMAL DIVERSITY (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

CO 1: Discuss the Animal Taxonomy, Speciation

CO 2: Illustrate the structural organization.

CO 3: Demonstrate the outline classification of animals

CO 4: Understand the basic concepts of taxonomy.

CO 5: Appreciate various levels structural organization of animals.

Unit I:

Animal Taxonomy: Principles and methods of taxonomy, Concepts of species and hierarchal taxa, Biological Nomenclature, Ranking hierarchies, Capacity and limits the Linnaean categories.- The International Code of Zoological Nomenclature-Validity, Synonymy and homonymy-Fossils, fragments and heterogenous type of speciation.

Unit II:

Levels of structural organization: Unicellular, colonial and multicellular forms; coelom, symmetry, levels of organization of tissue, organs and systems; comparative anatomy.

Unit III:

Outline classification of animals: Outline classification of Invertebrates and chordates with examples, Living Fossil – *Latimera*, classical and quantitative methods of taxonomy of animals and microorganisms, criteria used for classification in each taxon.

Unit IV:

Minor Phyla and Organisms of Health: Ctenophora – Ectophora – Endophora – Rotifera – Connecting links – *Limulus* and *Peripatus*. Common parasites and pathogens of humans and domestic animals.

Unit V:

Natural history of Indian Subcontinent: Zoogeography, Major habitat types of the subcontinent, seasonality and phenology of Indian subcontinent- Biodiversity hot spots- National parks and sanctuaries-endemism-conservation –Ecotourism- migration of species: Common Indian mammals, birds.

Text Book:

1. Kotpal RL (2014) Modern TextBook of Zoology Vertebrates. 11th Edition, Rastogi Publishers, Meerut.

Reference Books:

1. Jordan EL and PS Verma (2003) Invertebrate Zoology, S. Chand & Co Ltd, New Delhi.
2. Agarwal VK (2000) Invertebrate Zoology, 1st Edition, S. Chand and Co, Ltd. New Delhi.

3. Ayyar E (1993) Manual of Zoology Vol.I-Invertebrata, S. Viswanath (Printers & Publishers) Pvt, Ltd, Chennai.

CELL AND MOLECULAR BIOLOGY (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

- CO 1:** Illustrate the structure of prokaryotic and eukaryotic cell.
- CO 2:** Elaborate the structure and organization of chromosome.
- CO 3:** Appreciate cell cycle.
- CO 4:** Discuss the gene regulation in prokaryotes and eukaryotes.
- CO 5:** Analyze cell death, cancer and organisms that cause cancer.

Unit I: Cell and Cell organelles

Structure of Prokaryotic and Eukaryotic (Plants and Animals) Cell –types of cells-Epithelial, nerve and muscle cells. Cell theory- Structure and functions of: Nucleus, Golgi, Endoplasmic reticulum, Mitochondria, Ribosomes, Microfilaments and Microtubules.

Unit II: Chromosomes and DNA

Chromosomal structure and organization-Chromosomal types-Metacentric, sub metaacentric, acrocentric and telocentric. Heterochromatin and Euchromatin. DNA as genetic material-Molecular structure and forms-Experimental evidences-properties-Cot analysis, C-Value paradox-replication, damage and repair-RNA-types and function

Unit III: Cell Division

Cell cycle-Mitosis and Meiosis-Protein synthesis, Types of RNA polymerase-Transcription factors and activators-Post transcriptional modifications-splicing-Capping-polyadenylation-folding of proteins.

Unit IV: Cellular Regulation

Cell communication-General principles of signaling-Endocrine, Exocrine, Synaptic Signaling, surface and Intra cellular receptors, G protein and generations of secondary messengers, mode of action of Camp and C⁺⁺ Calmodulin.

Unit V: Cancer Biology

Cell death: programmed cell death: Events of apoptosis and regulation; Cancer: development and causes of cancer- Characteristics of cancer cells – tumor types- hepatitis B & C virus , retrovirus – Oncogenes – tumor suppressor genes.

Text Books :

1. Ajoy Paul (2011) Textbook of Cell and Molecular Biology, Books & Allied Ltd, Mumbai, Maharashtra
2. S. P. Vyas(2011), Cell and Molecular Biology 1st Edition. CBS Publishers, New Delhi.

Reference Books:

1. Cooper G.M., (2007) The cell – A Molecular Approach, 2nd ed., ASM Press, Washington D.C.,
2. Brown TA., (2002) Genomes, 2nd ed., Wiley – Liss publications, New York.
3. Verma PS and Agarwal VK (2008) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Company, New Delhi.
4. Tropp Be., (2012) Molecular Biology – Genes to Proteins, 4th ed., 1st Indian ed., Jones and Bartlett India Pvt. Ltd., New Delhi.

BIOCHEMISTRY (5 Credits / 6 Hrs)**Course Outcomes:**

Upon completion of the course, students will be able to,

CO 1: Understand the physical and chemical concepts in biology.

CO 2: Learn the structure, properties and functions of biomolecules.

CO 3: Analyze enzymes and concepts of bioenergetics.

CO 4: Appreciate the various carbohydrate metabolic pathways.

CO 5: Understand metabolism of nucleic acid, amino acid and lipid.

Unit I: Physical and chemical concepts in biology

Molecular structure of water – properties – dissociation of water-pH- dissociation of weak acids – Henderson and Hasselbach equation – Principle of biophysical chemistry-pH, Buffer solutions. Reaction kinetics and Law of thermodynamics.

Unit II: Biomolecules

Classification, structure, properties and functions of Carbohydrates, Proteins and Lipids, Levels of organization of Protein– primary, secondary, tertiary and quaternary, domains, motif and folds, Ramachandran plot.

Unit III: Enzyme and Bioenergetics

Vitamins: Structure, occurrence and biochemical functions -Enzymes: Properties, classification, mechanism of enzyme action and regulation, enzyme kinetics, Michaelis Menten equation, Line weaver burke's equation, enzyme inhibitors/activators Coenzyme, isoenzyme, allosteric enzyme, abzyme and ribozyme- Bioenergetics – Role of ATP – biological oxidation reduction reaction – redox potentials in biological system – respiratory chain and oxidative phosphorylation – high energy compounds.

Unit IV: Carbohydrate metabolism

Metabolism and its regulation: Glycolysis – Kreb's cycle, Energy budget – gluconeogenesis, glycogenesis, glycogenolysis, HMP shunt, Uronic acid pathway

Unit V Nucleic acid, Amino acid and Lipid metabolism

Nucleic acid biosynthesis and degradation-Amino acids: Biosynthesis and degradation – Biosynthesis and degradation of fatty acids, cholesterol and Ketone bodies.

Text Books:

1. Nelson, D.L., and M.M.Cox, 2010, Lehninger Principles of Biochemistry, 5th edition, Worth Publishers, New York.
2. Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books and Allied Pvt. Ltd., Kolkata.

Reference Books:

1. Bose, S. 1982. Elementary Biophysics. Vijaya Printers, Madurai.
2. Deb, A.C. 2011. Fundamentals of Biochemistry, 10th Edition, New Central Book Agency Pvt. Ltd., Kolkata.
3. Mckee, T., and J.R.Mckee, 1996, Biochemistry and Introduction, Won.C.Brown Publishers, London.
4. Stryer, L., 2000. Fourth edition Biochemistry, W.H. Freeman and Company, New York.
5. Voet, D., and J.G.Voet, 1995, Biochemistry, second edition John Wiley & Sons Inc, New York.
6. Zubay, G. 1993, Biochemistry, third edition Won.C.Brown Communications Inc., Oxford, England.

AQUACULTURE (5 Credits / 4 Hrs)**Course Outcomes:**

Upon completion of the course, students will be able to,

- CO 1:** Study introductory aspects of aquaculture.
- CO 2:** Demonstrate technical aspects of aquaculture.
- CO 3:** To elaborate the diseases in aquaculture.
- CO 4:** Demonstrate the use of aquaculture accessories in fishing.
- CO 5:** Learn the technicalities of preservation.

Unit I: INTRODUCTION

Importance of aquaculture-Basic qualification of candidate species-Cultivable fresh water and marine species-Construction of ponds-Site selection-Soil and water typer-Types of ponds-Preparation and management –Aquatic plants and their control –Fish enemies and their control-Fertilization of ponds.

Unit II: Fish Breeding and Fish Feed

Brooders care and management –Bund breeding –Artificial breeding –Induced spawning of carps-Application of synthetic hormones-Transportation of fish seed-Natural culture of fish feed organisms-Phytoplankton (diatom) zooplankton (Rotifers cladocerans) Artemia, Tubifex-Artificial feed –Feed formulations and management.

Unit III: Fish Diseases

Animal husbandry cum aquaculture, agriculture cum aquaculture –Fish diseases: Ectoparasite, Bacterial, viral and fungal diseases.

Unit IV: Fishing Methods

Fishing Gears – Line fishing (Hand lines), Barbet trap, Cover pot, Gillnet, beam trawl, Bull trawl- Modern method- Echo sounding method, Electric fishing.

Unit V

Preservation- Extrinsic and intrinsic factors on food spoilage, Drying, salting, smoking, canning, refrigeration- marketing.

Text Books :

1. M. S. Reddy . (2004), A Text Book of Aquaculture, Discovery Publishing Pvt.Ltd, New Delhi.
2. S S Khanna and H R Singh (2014),A Text Book of Fish Biology & Fisheries, Narendra Publishing House, Delhi.

Reference Books:

1. Fish and Fisheries of India, Jingran, V.G.,1997. Hindustan Publishing Co., New Delhi.
2. A Hand book of Fish forming, Agarwal, S.C.,, 1994, Narandra Publishing House Delhi.
3. Fresh water aquaculture, Rath, R.K., 1993, Scientific Publishers, Jodhpur.
4. Pond and Fish culture, Hall, C.B. 1999, Agro Botanical Publishers, India.
5. Manual of fish genetics, Karl Marx, K,Sundararaj, V.and Vasu, 1996, Chennai.
6. Fisheries Science, Santhanum, R.Daya Publishing house, 1995, New Delhi prevention and control of fish and prawn disease II Edn.,, 2000,- Bismas, K.P.Narandra Publishing House, Delhi.

Lab in Cell and Molecular Biology and Biochemistry (3 Credits / 8 Hrs) Hrs)

Biochemistry--List of Practicals:

1. Standard graph for Carbohydrates, Proteins and Lipids.
2. Quantitative estimation of carbohydrates.
3. Quantitative estimation of proteins –phosphotungstic acid method.
4. Quantitative estimation of ascorbic acid – Titrimetric method.
5. Quantitative estimation of salivary amylase activity – Effect of temperature.
6. Estimation of salivary amylase activity – Effect of pH.

7. Determination of K_m and V_{max} of salivary amylase.
8. pH meter- Principles and operation.
9. Titration curve – Estimation of pK value of a weak acid.
10. Amino acids as Zwitterions.
11. Preparation of Buffers.
12. Buffering action of an amino acid.
13. Paper Chromatography.
14. Thin layer Chromatography.
15. Column Chromatography.
16. SDS Polyacrylamide Electrophoresis.

Lab in Cell biology-List of Practicals

1. Microscopy –Bright field microscopy – Principles and operation.
2. Microscopy - Phase contrast microscopy – Principles and operation.
3. Micrometry – measurement of cell size.
4. Micro-technique – Fixation, dehydration, infiltration, embedding, sectioning, staining.
5. Histochemical localization of Proteins.
6. Vital staining.
7. Cellular constituents of Human Blood.
8. Karyotyping (Demo).
9. Isolation of nuclei using centrifugation.
10. Isolation and quantification of DNA from yeast/ liver.
11. Isolation and quantification of RNA.

GENETICS (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

CO 1: Understand the genetics of prokaryotes.

CO 2: Learn the interference, RNA silencing.

CO 3: Understand gene expression, genetic code

CO 4: Understand the chromosomal aberrations

CO 5: Understand the quantitative genetics

Unit 1:Genetics of Prokaryotes

Recombination in Prokaryotes – Bacteria –Transformation – Conjugation – Transduction – Mapping of bacterial chromosome – Conjugation and restriction enzyme mapping – Transposons – Recombination in eukaryotes – Linkage and crossing over – Three point test crosses – Genetic mapping – Problems.

Unit 2:RNA

RNA interference – RNA silencing in cytoplasm and genome levels, ds RNA- ds RNA mediated interference (Si RNA and micro RNA), RNAi pathways– Molecular basis of spontaneous and induced mutations.

Unit 3: Gene Expression

Structure of mRNA- Genetic code –Deciphering the genetic code – Characteristics of genetic code- Translational events – Protein synthesis –Regulation of gene expression – Attenuation and anti termination – Operon concept – lac, ara and trp operon.

Unit 4: Chromosomal Aberrations

Law of DNA constancy – C value paradox – Numerical and structural changes in chromosomes – Chromosomal aberration – Ploidy – Euploidy and Polyploidy – Aneuploidy – Syndromes – Turner's Klinefelter's Down's syndromes – Inherited disorders – Sickle cell anemia, thalassemia– Genetic counseling. Dermatoglyphics in clinical disorders – clinical applications, its advantages and limitations.

Unit 5:Quantitative Genetics

Hardy – Weinberg equilibrium – Gene frequencies in natural populations- dominance, co-dominance, sex-linked genes- Change in gene frequencies due to lethal recessive, over dominance, inbreeding- inbreeding co- efficient- inbreeding depression , Heterosis – Polygenic inheritance – Statistical analysis of quantitative characters – Heritability – Components of phenotypic variance.

Text Books:

- 1.Molecular Biology, 2nd Edition, Freifelder D, 1987, Narosa Publishing House
- 2.Genetics- A blue print of life, Mitra S., 1996, Tata McGraw Hill Pub.,Co
3. Fundamentals of Genetics, B.D.Singh., 2009, Kalyani Publishers,New Delhi.

Reference Books:

1. Principles of Genetics, 8th Edition, Gardner E.J., Simmons M.J.,Snustad D.P., 1991, John Willey & Sons
2. Genetic analysis, 4th Edition, Griffith, Miller, Suzuki, Lewontin, Gerbart, 1993, W.H.Freeman and Co., New York.
3. Genetics, 3rd Edition, 2002, Strickberger, 2002, Prentice Hall of India
4. Genes VII, Lewin B., 2000, Oxford University Press
5. Microbial genetics, 2nd Edition, Maloy S.R., Cronan J.E., Freifelder D., 1994 Panima Pub.Co.,

BIO-TECHNIQUES (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

- CO 1:** Illustrate the principles and types of microscopes.
- CO 2:** Demonstrate the various biochemical techniques.
- CO 3:** Discuss the techniques of molecular biology.
- CO 4:** Analyze molecular structure using different methods.
- CO 5:** Appreciate the principles and applications of tracer techniques.

Unit 1: Microscopy

Microscopy – Principles – Magnification – Resolution – Contrast – Types of Microscopes – Light (Bright field, Dark field, Phase contrast, Fluorescent microscopes) – Electron (Transmission and Scanning electron) microscopes – Flow cytometry-Histological technique and Histochemistry.

Unit 2: Separation Techniques

Separation of molecules: Chromatography-principles and applications- paper, Thin layer, gel filtration, ion exchange, affinity, high pressure liquid chromatography- Electrophoresis- Principles and applications- PAGE and Agarose Gel- Centrifugation – Principle, Types and Application-High Speed and Ultracentrifuge.

Unit 3: Nucleic acid methods

Nucleic acid hybridization- Principles and applications – DNA denaturation and renaturation – Cot curves – Sequencing of protein and nucleic acids- Southern, Northern and South-Western blotting techniques-Polymerase chain reaction (PCR)-RT-PCR.

Unit 4: Biomolecules Analysis

Analysis of molecular structure of biomolecules- X-ray diffraction- Spectroscopy- Visible, FTIR- NMR, ESR-Atomic absorption and plasma emission spectroscopy.

Unit 5: Radioactive Methods

Principles and applications of tracer technique- Isotopes –Radioactive isotopes- Measurement of radioactivity –GM Counter – Scintillation counter – Solid and Liquid scintillation counters – Autoradiography.

Text Book:

1. Practical Biochemistry, 3rd Edition, Plummer D.T., 1987, Tata McGraw Hill Pub.Co.Ltd.,

Reference books:

1. Principles and Techniques of Practical Biochemistry, 4th Edition, Wilson K, and Walker J. 1994, Cambridge University Press.
2. Quantitative analysis, 5th Edition, Day R.A. Underwood A.L., 1988 Prentice Hall of India Pvt. Ltd., New Delhi.
3. Chromatographic methods, 4th Edition, Braithwaite A., Smith F.K., 1985, Chapman and Hall, London
4. A Biologist's guide to principles of Practical, Biochemistry 3rd Edition, Wilson K., Goulding K.H., 1986, ELBS.
5. Electrophoresis – A Practical approach, Anbalagan K., 1985, Life science Book House, Madurai.
6. Laboratory Manual in Biochemistry, Jayaraman J., 1992, Willey Eastern Ltd.,

ECOLOGY (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

- CO 1:** Introduce the basic concepts of ecology.
- CO 2:** Focus on population and community ecology.
- CO 3:** Illustrate the different types of resources.
- CO 4:** Demonstrate the various types of pollution.
- CO 5:** Discuss the environment management and protection.

Unit I: Introduction

Scope importance and need for public awareness. Ecosystem-Concept, types-terrestrial and aquatic ecosystems, Pond is an example for typical aquatic ecosystem; components-biotic and abiotic, and functional aspects of and ecosystem- flow of energy, Productivity, food chain, food webs, ecological pyramid. Matter in ecosystem (biogeochemical cycles)- Types of nutrient cycles-Gaseous cycle-water, carbon and nitrogen. Sedimentary cycles-sulphur. Limiting factors-Liebig-Blackman Law of Limiting Factors, Threshold and Rate and Shelford's Law of Tolerance.

Unit II: Population and Community Ecology

Population characteristics- Population size, Age structure, Natality, Mortality, Biotic potential and dispersion. Characteristics of a Community, structure/stratification, Niche-habitat niche, Trophic niche and multifactor niche ecotone and edge effect, ecological indicator. Ecological succession.

Unit III: Resources

Types of natural resources-renewable resources-water and forest resources and their conservation. Non-renewable resources-Minerals and fossil fuels-conservation. Problems associated with natural resources-Role of an individual in conservation of natural resources. Equitable use of resources for sustainable life styles.

Unit IV: Pollution

An introduction-Sources-Causes, effects and control measures of Air, water, soil, marine, noise and thermal pollution. Role of an individual in the prevention of pollution. Special reference to case studies of pollution-Bhopal gas study, The Ganga pollution, Minamata tragedy, Tajmahal issue, Global warming and Acid rain.

Unit V: Management and Environmental Protection

Solid waste Management, Rain water harvesting, Disaster Management. Role of ministry of Environment and forests (MoEF). Environmental Acts-Water (Prevention and Control of pollution) Act, 1974, Air (prevention and control of pollution) Act,1981, The environment (Protection) Act, 1986. Forest (Conservation) Act, .1980.

Text Books :

1. P S Verma, B S Tyagi and V K Agarwal,ENVIRONMENTAL BIOLOGY (PRINCIPLES OF ECOLOGY) , S chand Publisher.
2. A. L. Bhatia(2010) Textbook Of Environmental Biology, I K International Publishing House, New delhi.

Reference Books:

1. Pandey, S.N., and S.P. Misra (2011). Environment and Ecology. I Edition published by Ane Books Pvt.Ltd. New Delhi – 110002. ISBN: 978-93-8116-214-9.
2. Durga Nath Dhar, Shalin Kumar and Triloki Vaish (2000). Environment and Ecology, First Edition, Published by Vayu Education of India, New Delhi-110002. ISBN: 978-93-80097-73-8.
3. Narayanan, P (2016) Environmental Pollution, Principles, analysis and Control. CBS Publishers & Distributors Pvt.Ltd.ISBN:81-239-1451-2.
4. Sharma, P.D., (2006).Environmental Biology, Published by Rastogi Publications, Meerut-250002.
5. Odum, E.P., (1985): Fundamentals of Ecology Published by Tata Mc Craw Hill Publishing Co., Ltd., New Delhi 110002. ISBN: 0-07-460103-2
6. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub House, Delhi 284 p.
7. Kumarasamy, K, Moses, A.A. and Vasanthy, M. 2007. Environmental Studies, BDU,Trichy.
8. Mohan P.Arora (2017). Ecology Published by Himalaya Publishing House Pvt. Ltd, Chennai.ISBN: 978-93-5262-165-1.

POULTRY SCIENCE (5 Credits / 4 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

CO 1: Introduce the various aspects of poultry.

CO 2: Illustrate poultry housing.

CO 3: Appreciate the various types of poultry nutrition.

CO 4: Demonstrate the practical aspects of chick rearing.

CO 5: Discuss the poultry health management.

UNIT I: Introduction

Introduction to Poultry- History of poultry in India – Economic importance of Poultry – Role of eggs in human nutrition and poultry manure; Common poultry birds. Choosing commercial laying stock – Egg laying breeders – Leghorns and Anconas; Table breeds or Broilers – Sussex and Darking; Production of commercial laying stock – Pure line strain and strain crosses, Breed crosses and Inbred crosses; Sexing in one day old chicks – colour sexing, Vent sexing and Feather sexing.

UNIT II: Poultry Housing

Poultry housing – 1+3 system and its advantages; Deep litter system – Litter Management, Advantages and disadvantages – dropping pit, Nest Boxes, Feeder and waterers Cage Rearing for layers- Californian cages, Feeder, waterers. Management of cage birds – Advantages and disadvantages of cage rearing.

UNIT III: Poultry Nutrition

Poultry Nutrition: Energy and its types – Sources of energy – Vegetable protein sources, Animal protein sources. Energy metabolism in chicken – carbohydrate and lipids. Protein and aminoacid nutrition of poultry. Nutritional deficiency Diseases – Vitamin deficiency diseases A, E, and D. Essential inorganic elements – calcium, Phosphorus, sodium, potassium, magnesium, manganese and iodine. Non-nutritive feed additives

UNIT IV: Rearing and Management

Practical aspects of Chick rearing: Brooding lighting programme, Debeaking and forced moulting. Management of growers, layers and broilers; Seasonal Management of poultry bird – Summer Management and Winter Management.

UNIT V: Poultry Health Management

Poultry Health Management: Common diseases of Poultry – Its symptoms, prevention, control and treatment methods of the following diseases: Bacterial Diseases (Salmonellosis and Pullorum Disease), Viral Diseases (New Castle and Infectious Bronchitis), Fungal

Diseases (Brooder Pneumonia and Mycotoxicosis), Protozoan Disease (Coccidiosis), Parasitic Disease (Lice, Ticks and mites) Vaccination Programme.

Text Book:

1. Gnananmani M.R (2003). Modern Aspects of Commercial Poultry Keeping, 9th Edition, Giri Publication, Alwar Nagar, Nagamalai, Madurai 19, Tamilnadu.

Reference Books:

1. Ensminger, M.E., 2015. Poultry Science. 3rd Edition, International Book Distribution Co., Lucknow, India.
2. Bell, D. Donald and Weaver D William Jr. 2007. Commercial chicken meat and egg production. 5th Edition. Springer India Pvt. Ltd., Noida.
3. Singh, R.A., 2011. Poultry Production. 3rd Edition, Kalyani Publishers, New Delhi.
4. Jull, A., Morley, 2007. Successful Poultry Management. 2nd Edition, Biotech Books, New Delhi.
5. Hurd M. Louis, 2003. Modern Poultry Farming. 1st Edition. International Book Distributing Company, Lucknow.

LAB IN GENETICS AND ECOLOGY (2 Credits / 8 Hrs)

Genetics-List of Practicals:

1. Law of segregation – Demonstration with coins/beads.
2. Law of independent assortment – Demonstration with coins/beads.
3. Probability – coin toss.
4. Probability- Demonstration using playing cards.
5. Probability- Number of boys and girls in a family of three children.
6. Observation of simple Mendelian traits in the class population.
7. Pedigree analysis for any two of simple Mendelian traits.
8. Chromosomal disorders in human – Down's Turner's and Klinefelter's syndromes.
9. Statistical analysis – Variation in height/weight of students.
10. Correlation analysis – height and weight/ length and width.
11. ABO blood grouping in the classroom population.
12. Calculation of gene and genotype frequency- using ABO blood group data.
13. Study of normal and mutant forms of *Drosophila*.

Ecology-List of Practicals:

1. Estimation of primary productivity of aquatic macrophytes – Light and Dark bottle method.
2. Estimation of primary productivity of terrestrial plants – Harvest method.
3. Estimation of primary productivity of terrestrial plants –Chlorophyll content method.
4. Estimation of secondary productivity – Biomass production in silkworm – long tern study.
5. Estimation of ecological efficiencies – Field study
6. Analysis of Industrial effluents/ sewage water – Total and dissolved solids
7. Analysis of Industrial effluents/ sewage water – Biological oxygen demand (BOD).
8. Analysis of Industrial effluents/ sewage water – Chemicaloxygen demand(COD).
9. Bioassay of pesticide – Estimation of LC50 value for fish/ any aquatic animal
10. Estimation of dust pollution in an urban locality – Time course kinetics of deposition of dust.
11. Educational tour and submission of field study report

ANIMAL PHYSIOLOGY (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

CO 1: Learn the nutrition, feeding and digestion.

CO 2: Appreciate the aspects of respiration and circulation.

CO 3: Discuss the various aspects of excretion, Osmo and thermo regulation.

CO 4: Demonstrate the nervous system and sense organ.

CO 5: Discuss the endocrine glands and reproduction.

UNIT – I: Nutrition and Digestion: Nutritive patterns, feeding and digestion

Nutritional requirement –components of adequate diet-Digestion – Intracellular & Extracellular digestion– Digestive enzymes -digestion of protein, carbohydrate & fat – Absorption at different regions- co-ordination of digestive activities & control of digestive secretions. Metabolism – metabolic rate- metabolism of protein, carbohydrate & fat - Respiratory quotient, Energy storage

UNIT – II: Respiration, Circulation

Respiratory organ –Gill - Respiratory mechanism in Fish & respiratory pigments in animals– transport of oxygen & carbon dioxide in human– physiological adaptation at high altitudes & in deep sea.Types of heart with special reference to arthropods, annelids, mollusca, tunicates and vertebrates. Circulating fluids- cytoplasm, Haemolymph, Hydrolymph, Lymph and blood. Circulating mechanism -pacemaker of myogenic heart – regulation of blood flow & blood pressure – valves & stopcock, elasticity of blood vessels & sustained pressure, peripheral resistance, vasomotor reflexes, vasoconstrictor & vasodilator substances-

UNIT-III: Excretion and Osmo & Thermo regulation

Excretion of nitrogenous wastes– ammonotelic, ureotelic and uricotelic animals - excretory organs in animals. Structure and function of human kidney, Mechanism of urine formation. Osmoregulation– osmoregulators & osmoconformers, osmoregulation in aquatic, terrestrial & desert animals. Mechanism of temperature regulation in animals – Ectotherms and Endotherms.

UNIT – IV: Nervous system & Sense organs:

Central nervous system– Autonomous nervous system, Neuron – structure- Impulse transmission – myelinated and non-myelinated – Synaptic transmission. Membrane potentials: Measuring membrane potentials – resting, action potentials – ionic basis of action potential. Reflex action. Neurotransmitter substances – pharmacological effects of neurotransmitters- Sense organ in vertebrates – chemoreceptor, mechanoreceptor, thermoreceptor, photoreceptor. **Muscle & Movement:** Types of muscle – ultra structure of striated muscle – Mechanism of muscle contraction. Biochemical changes during muscle contraction. neuromuscular junction– physiology of electric organ.

UNIT – V: Endocrine glands and Reproduction:

Endocrine glands and Reproduction: Glandular secretions – endocrine & exocrine glands, endocrine systems – chemical types – regulation of hormone secretion– glandular hormones – neurohormones – mechanism of hormone action – metabolic & developmental of hormones– glucocorticoids & catecholamines, growth hormones, insulin, thyroxine, epinephrine & norepinephrine- Hormones that regulate water & electrolyte balance– antidiuretic hormone, aldosterone, parathyroid hormone- Reproductive hormone– male & female sex hormones, oestrous cycle in mammals – menstrual cycle.

Text Books:

1. Text Book of Animal Physiology, 2nd Edition, Nagabhushanam R., Kodarkar M.S., Sarojini R. (1999) Oxford & IBH
2. General and Comparative Physiology, 3 rd Edition, S. William Hoar (1984) Prentice Hall of India.

Reference Books:

1. Eckert Animal Physiology : Mechanisms & Adaptations, 4 th Edition, Randall D., Burgren W., French K. (1997) W.H. Freeman and Company, New York
2. Animal Physiology: Adaptation and Environment, 4 th Edition, Knut Schmidt Nielson., 1994, Cambridge University Press.
3. Comparative Animal Physiology, 3 rd Edition, Prosser C.L. (1984) W B. Saunders Company.

IMMUNOLOGY AND MICROBIOLOGY (5 Credits / 6 Hrs)**Course Outcomes:**

Upon completion of the course, students will be able to,

- CO 1:** Discuss the types of lymphoid organs and detection of antigen antibody reaction.
CO 2: To appreciate the components of the human immune response and hypersensitivity.
CO 3: Demonstrate the various immunotechniques.
CO 4: Elaborate the Classification of prokaryotes and culture methodology of microbes.
CO 5: Illustrate the economic importance of microbes.

Unit 1: Cells, Organs and Immunoglobulins

Lymphoid Lineage- T-cells and its types, B cells and its types, Null cells and its types
Myeloid lineage- Eosinophil, Basophil, neutrophil, mast cell, Antigen presenting cell, platelet, monocytes and macrophages – primary lymphoid organs (Thymus, Bone marrow, Bursa of Fabricius- Secondary Lymphoid organs – Lymph node, spleen, Payer's patches (GALT), Tonsils(MALT) Structure and functions of immunoglobulin-Types of Immunoglobulin (structure, Biological properties of Immunoglobulin G, M, A, D and E)- Detection of antigen antibody reaction- Precipitation agglutination, cytolysis, complement fixation, flocculation, opsonisation, immunofluorescence) – classical and alternate pathways of complement system, complement fixation test.

Unit 2: Hypersensitivity and Transplant Immunology

Hyper sensitivity response- Types of hypersensitivity response (Type I, II, III, IV and V) – Major Histocompatibility Complex-Structure of MHC Molecules and their polymorphism- Transplantation-Classification of Graft-Mechanism of graft rejection-Host vs Graft reaction-Graft vs Host reaction-Immuno suppressive therapy during transplantation – Properties of tumour cells, causes of tumour antigens, immune response to tumour, immune diagnosis of tumour, immunotherapy of tumour.

Unit 3: Immunotechniques and Vaccines

Immunotechnology-Hypersensitivity-Immuno diagnosis Widal test for typhoid – VDRL test for syphilis – ELISA and western blot for AIDS- Immunization and Immunization schedule – Vaccines: Killed and attenuated and Recombinant vaccinia vector vaccine, DNA vaccine, multivalent sub unit vaccines

Unit 4: Media, Staining and Culture Methods

Structure of prokaryotic cell – structure of bacterium- Classification of prokaryotes Identification- Staining – Gram and acid fast staining – Structure of Virus- Bacteriophage- Growth of microorganisms – Nutrition – Nutrient media – Culture methods – Physiology of growth- Methods-physiology of growth – Methods of measurement of growth – Growth curve.

Unit 5: Applied Microbiology

Biology and economic importance of *Agaricus bisporus*, *Rhizobium* and *Pseudomonas*- Food preservation-Spoilage of milk and mild products, meat and meat products by microorganisms- pasteurization and other processing techniques – Fermentation technology- Fermentor- types of fermentor – production of microbial products through fermentor- Production of alcohol, vinegar, penicillin. Biology, pathogenesis and control of diseases- *Vibrio cholera*, Tubercle bacilli, Immunodeficiency virus.

Text Books:

1. Immunology, Chakravarty A.K., 2000, Tata McGraw-Hill
2. Text Book of Microbiology, 5th Edition, Ananthanarayanan, Jayaram Paniker, 1997, Orient Longman.

Reference Books

1. Kuby immunology, 4th Edition, Goldsby R.A., Kindt T.J., Osborne .A. 2000 W.H. Freeman and Company.
2. Roitt's Essential immunology, 9th Edition, 1994, Roitt, I.M. Blackwell Science
3. Immunology- A short course, 3rd Edition, Benajamini E., Sunshine G., Leskowitz S., 1996, Wiley –Liss

4. Immunology, 8th Edition, Weir D.M., Stewart J., 1997, Churchill livingstone
5. An Introduction to Immunology, C.V.Rao, Narosa Publishing House, 35, Grams Road, Thousand Lights, Chennai-600 006.
6. Microbiology, 5th Edition, Pelczar M.J.Chan E.C.S, Kreigh N.R, 1998 Tata McGraw Hill publications Co.Ltd.
7. General Microbiology, 7th edition, Hans G.Schlegel, 1995, Cambridge University Press.
8. Basic Immunology, 2010, Arun Ingale , New central book agency Kolkata.
9. Textbook Of Immunology, 2012, Basir F., Prentice Hall India Learning Private Limited

BIOSTATISTICS AND BIOINFORMATICS (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

CO 1: Illustrate the basic concepts of probability and biostatistics.

CO 2: Describe statistical methods and probability distributions relevant for molecular biology data.

CO 3: Perform and interpret bioinformatics and statistical analyses with real molecular biology data.

CO 4: Know the applications and limitations of different bioinformatics and statistical methods.

CO 5: Discuss the theory behind fundamental bioinformatics analysis methods and widely used bioinformatics databases.

UNIT I: INTRODUCTION TO BIOSTATISTICS

Definition-Statistics, Data- Population, Sample, Sampling-Collection of data- Presentation of data Tables, graphs, diagrams, Summarizing data- Measures of Central tendency-Mean, median, mode, percentiles, Measures of dispersion – Range, variance, Standard deviation, standard error, and confidence limit.

UNIT II: DISTRIBUTION AND TESTING OF HYPOTHESIS

The normal distribution – skewness & kurtosis, proportions of a normal curve –hypothesis Testing- Null and alternate – Importance & types – X^2 square test- Bivariate – Student 't' test, comparison of means of two large samples, means of two small samples, paired and unpaired tests.

UNIT III: CORRELATION & REGRSSION

Correlation types, Pearson's Correlation coefficient, simple linear regression, test of significance. The analysis of variance –basic assumptions of ANOVA, One way and two way ANOVA.

UNIT IV: SEQUENCING METHODS & BIOLOGICAL DATABASES

Sanger's Chemical, and Automated methods – Hierarchical sequencing and shot gun sequencing – Contigs assembly – Human Genome Project Bioinformatics: Definition – Scope – Nucleic acid databases: GenBank, EMBL, DDBJ – Protein Databases: UNIPROT, TrEMBL. Secondary Databases: PROSITE, PRINTS – PDB.

UNIT V: SEQUENCE ANALYSIS AND STRUCTURE PREDICTION

Scoring matrices: PAM, BLOSUM – Sequence similarity tools: working principle and types of BLAST & FastA – Multiple Sequence alignment: Principle and applications – ClustalW – Phylogenetic analysis – Molecular modeling – Drug designing.

Text Book:

1. Biostatistics, Computer Application and Bioinformatics. Paper back – 2015. by V. Kumaresan, N. Arumugam, A. Meena, R. Sundaralingam A. Gopi.
2. Introduction to Bioinformatics, Lesk A.M, 2003 Oxford University press

Reference Books:

1. Biostatistician Analysis, 2nd edition, Zar. J.H., 1984, Prentice Hall Inc.
2. Mathematics and Statistics for the Bioscience, Eason, Coles and Getting by, 1980 Ellis Harwood Ltd.,
3. Statistical Methods, 6th Edition, Snedecor G, W, Cochran W,G, Oxford & IBH Publishing Co.
4. Biostatistics-A foundation for analysis in the Health Science 5th Edition Daniel W.W.1991 John Wiley & Sons.
5. Introduction to Biostatistics, 2013, Banerjee P K., S.Chand.
6. Fundamentals of Bioinformatics, 2007. S. Harisha, I K International Publishing House Pvt. Ltd

APPLIED ZOOLOGY (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

CO 1: Discuss the vermicomposting method and its application.

CO 2: Illustrate the concepts of sericulture and life cycle of silk worm.

CO 3: Elaborate the life history of honey bee, methods of bee keeping and its life threatening diseases.

CO 4: Discuss the various methods of prawn culture, harvesting and preservation.

CO 5: Illustrate pearl culture techniques and types of pearls.

Unit – I: Vermiculture

Vermiculture - general morphology and ecotypes of earthworms, vermiculture techniques-Vermicomposting methods (Pit system and Wedge system) -Application of vermicompost

Unit – II: Sericulture

Sericulture- Morphology and life cycle of *Bombyx mori* -Types of silkworm-diseases and pest of silkworm (Pebrine, Septicima, Cytoplasmic polyhedrosis, White muscardine and Uzifly)

Unit – III: Apiculture

Apiculture- Types of honey bees- Life history of honey bees- bee colony (Caste system)-Bee Keeping Primitive and modern methods- Bee keeping equipments-Enemies and diseases of bee (Wax moth, Wasp, Nosema and Acarine disease)

Unit – IV: Prawn/Shrimp Culture

Prawn culture- Shrimp Culture- Methods of culture of marine prawn – harvesting and preservation- Fresh water prawn culture- culture methods- seed collection – culture practice- feeding – harvesting- preservation

Unit – V: Oyster Culture

Oyster culture- Edible and Pearl oyster culture – Pearl culture - types of pearls- composition of pearls and formation – pearl producing animals- Pearl culture techniques

Text Books:

1. Applied Zoology, Arumugam, N., Murugan, T., Johnson Rajeswar and R. Ram Prabhu (2009) Saras Publication, Nagercoil.

Reference Books:

1. A Hand book on Economic Zoology, Jawaid Ahsan and Subhas Prasad Sinha (2009) S. Chand Publications, New Delhi.
2. Economic Zoology, Arumugam, N., Murugan, T., Johnson Rajeswar and R. Ram Prabhu (2012) Saras publication, Nagercoil.

HUMAN GENETICS (5 Credits / 4 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

CO 1: Learn genetic material and concept of gene.

CO 2: Illustrate the chromosomal aberration and types of syndromes.

CO 3: Know the basics of cancer, types and therapeutic advancements.

CO 4: Discuss various genetic and metabolic disorders.

CO 5: Summarize types, applications and ethics involved in PCR typing and genetic testing.

UNIT –I:Human Genome, Genes and Alleles

Human Genome: Characteristics – Concept of Gene – Intron and Exon- Repetitive DNA – Transposons – Medallion Inheritance in man – Non Mendelian Inheritance – Alleles – Gene Interactions – Co Dominance and Epistasis.

UNIT – II:Syndromes and Chromosomal Analysis

Pedigree analysis – Autosomal inheritance – Dominant and Recessive – Sex-Linked inheritance – X and Y chromosome – Sex Limited and Sex Influenced Traits – Down's, Turner's and Klinefelter's Syndromes – Genetic basis of Male and Female infertility- Chromosomes- Karyotyping .

UNIT – III:Cancer Genetics

Basis of Cancer – Oncogenes – Retinoblastoma – Breast cancer – Tumor Suppressor genes – Cancer and Therapeutics.

UNIT – IV: Genetic Disorders

Genetic Disorders/diseases: Inborn Errors of Metabolism – Phenylketonuria – Galactosemia; Cystic Fibrosis – Alzheimer's disease – Sickle Cell Anemia – Haemophilia – Color Blindness-Glaucoma.

UNIT – V:DNA Methods and Ethical Aspects

DNA Typing – Polymerase chain Reaction (PCR) – DNA Fingerprinting - Definition and Objectives of Eugenics and Euthenics – Ethics of Genetic Testing-Genetic counselling

Text Book:

1. Human Genetics, 5th Edition, 2017. SD Gangane.

Reference Books:

1. Peter J. Russel. 2009. I Genetics: A Molecular Approach. Benjamin Cummings.
2. Ricki Lewis. 2017. Human Genetics: Concepts and Applications; 12th edition. McGraw Hill Education.
3. Strachan, T. and A.P. Read. 2004. Human Molecular Genetics. 3rd Edition. Garland Science, UK.
4. A Cellular and Molecular Foundation for Understanding Cancer. **Science**.313:762. 2006
5. Human Genetics ,2004, Pawan kumar dhar, Jaypee brothers Publisher.
6. Human Genetics, 2017, SD Gangane, Elsevier Publisher.

LAB IN ANIMAL PHYSIOLOGY AND IMMUNOLOGY & MICROBIOLOGY
(3 Credits / 8 Hrs)

Animal Physiology: List of Practicals

1. Observation of Fish gill structure.
2. Effect of temperature on oxygen consumption in fish.
3. Effect of temperature on opercular movement in fish.
4. Effect of salinity on oxygen consumption in fish.
5. Effect of salinity on opercular movement in fish.
6. Estimation of Salt Loss by the Freshwater Fish.
7. Estimation of Salt Gain by the Freshwater FiSH.
8. Qualitative examination of Human Haemin crystals.
10. Sphygmomanometer - Measurement of Blood pressure.
11. Kymograph – properties of Skeletal muscle.
12. Study of Oxygen consumption by the fish in Pond water.
13. Study of gills in various fishes collected from fish market.
14. Effect of Acetylcholine on the Gastronemius muscle of Frog – Demonstration.
15. Histology of thyroid, Islets of Langerhans, testes and Ovary – Slides.

Immunology: List of Practicals

1. Demonstration of primary and secondary lymphoid organs of Chick.
2. Histology of Lymphoid organs (Demo).

3. Isolation of Lymphocytes.
4. Heam-agglutination.
5. Ouchterlony technique of gel diffusion.
6. Immuno-electrophoresis of Human serum and anti Human serum.

Microbiology List of Practicals

1. Counting of viable cells by serial dilution and spread plates or pour plate.
2. Estimation of microflora of milk by methylene reductions (MBR).
3. Microbial analysis of food products – bacterial and fungal.
4. Gram's Staining.
5. Isolation of microbes from yoghurt, curd, Root Nodule.
6. Test for Antibiotic Sensitivity.

EVOLUTION (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

CO 1: Discuss the history, concepts of evolution and know the theories of evolution.

CO 2: Illustrate the concepts of mutation variation and role of isolation mechanism.

CO 3: Discuss genetics, structure and ecology of speciation.

CO 4: Discuss the origin of higher categories, connecting link and rates of evolution.

CO 5: Summarize the cultural evolution and recent findings of fossil records of human evolution.

Unit 1:Evidences and Theories

Origin of life- Evidence for evolution from biogeography comparative anatomy, embryology, physiology, biochemistry, palaeontology, genetics, -Theories of evolution- Darwinism, Lamarckism, Mutationism.

Unit2:Mutation and Isolation Mechanisms

Genetic basis of variation –Mutation-Neutralist hypothesis–Hybridization and evolution Role of isolation mechanisms-pre-mating and post-mating problems of isolating mechanism.

Unit 3: Speciation

Speciation –Structure of species – Genetics and ecology of speciation- Mayor's Founder principle –Modes of speciation –Allopatric and Sympatric speciation-

Unit 4: Fossils, Rates of Evolution and Extinction

Origin of higher categories- Simpson's definition –Evidences from fossil record- Polyploidy- Modes of origin of higher taxa – Mosaic mode- Connecting link-Quantum-evolution-Simpson's adaptive grid-Rates of evolution- Punctuated equilibrium- Extinction and its causes.

Unit 5: Human Evolution

Fossil records of human evolution- Recent findings in East and south Africa-Trends in human evolution- Cultural evolution-Osteodontokeratic culture- Pebble tool culture – Paleolithic culture- Neolithic culture- Language, Self awareness and death awareness- Sociobiology-Selfish gene –Altruism-Kin selection.

Text Books:

1. Dawkins, R. 1982. The Extended Phenotype. New York: W. H. Freeman.
2. Williams, G. C. 1966. Adaptation and Natural Selection. Princeton: Princeton Univ. Press (destined to be classic).
3. Williams, G. C. 1992. Natural Selection: Domains, Levels and Challenges. New York: Oxford Univ. Press.

Reference Books:

1. Introduction to Evolution, Moody P.A., 1978, Harper international
2. Process of organic Evolution, Stebbins, G.L., 1979, Prentice hall India
3. Evolution, Dodson E.O., 1980 Reinhold,
4. Evolution from molecules to Man, Bendall D.S., 1983, Cambridge University Press.
5. Dimensions Of Darwinism, Grene M., 1983 Cambridge University press.
6. Evolution Biology, Minkoff E.C., 1984 Addison Wesley
7. Evolution, 2005, Burt, Guttman, Oneworld Publisher
8. Sociobiology examined, Montagu, 1980, Oxford university press
9. Human Biology and behavior-An anthropological perspective, 4th Edn. 1985 Weiss M.L and Mann A.E., Little Brown & Co.,

DEVELOPMENTAL BIOLOGY (5 Credits / 6 Hrs)

Course Outcomes:

Upon completion of the course, students will be able to,

- CO 1:** Discuss the development of gametogenesis, Oogenesis, spermatogenesis and fertilization.
- CO 2:** Illustrate the patterns of cleavage, neural induction and morphogenetic movements.
- CO 3:** Discuss the chemical basis of differentiation, development of ageing and teratogenesis.
- CO 4:** Summarize the morphogenetic process of ontogenesis and asexual reproduction.
- CO 5:** Accentuate the developmental genetics of *Drosophila*, Zebra fish and tissue regeneration.

Unit1: Gametogenesis and Fertilization

Gametogenesis-Oogenesis-Types of eggs –Growth, development and maturation of oocyte – Nuclear activities during oocyte growth –Spermatogenesis-Seminiferous tubules-

Differentiation of spermatozoa-Fertilization –Approach of spermatozoon-Reaction of egg-Essence of activation-changes in the egg cytoplasm caused by fertilization.

Unit 2: Cleavage and Morphogenesis

Cell divisions in cleavage-Chemical changes –Patterns of cleavage-Morula and Blastula-Role of egg cortex-Morphogenetic gradients-Manifestation of maternal genes –Fate map-Gastrulation-Primary organ rudiments-Metabolism and gene activity during gastrulation –Spemann’s primary organizer –Morphogenetic movements – Neural induction-Induction and differentiation of Brain, eye, ear, limb, heart, kidney-Inductive tissue interactions in development –Salivary gland, eye lens, thymus, metanephric kidney.

Unit 3: Differentiation and Teratogenesis

Differentiation –Chemical basis of differentiation –Selective action of genes –Sequence of gene action in development –Nuclear transplantation –Role of cell death in development-Aging –Teratogenesis-Malignant growth –Neoplasia

Unit 4: Developmental Process and Regeneration

Morphogenetic processes in later part of ontogenesis –Metamorphosis-Changes in organization of tissues –Causation of metamorphosis –Hormonal control of amphibian and insect metamorphosis-Regeneration –Regenerative ability in animals –Histological processes involved in Salamander limb regeneration –Polarity and gradients in regeneration –Stimulation and suppression of regeneration –Asexual reproduction-Forms of asexual reproduction-Sources of cellular material in asexual reproduction.

Unit 5: Developmental genetics

Drosophila- segmentation genes-Segment sector genes, Mouse Hox genes-structure and activity. Zebrafish: Differential gene expression-Development. **Stem cell biology:** Primordial germ cells-Adult stem cell niches-Differentiation potential-stem cell plasticity-Tissue regeneration-imprinting and banking.

Text Book:

1. Wolpert, L., Beddington, R., Jessell, T., Lawrence, P., Meyerowitz, E, and Smith, J. Principles of Development, Second Edition. Oxford University Press: Oxford, 2002.

Reference Books:

1. An introduction to Embryology, 5th Edition, Balinsky B.L.1981. Holt Saunders International Edition.
2. Developmental Biology, Berrill N.J.,1974, TMH Edition
3. Developmental Biology, 2nd Edition, Browder, 1984, Saunders College Publishing
4. Development,Berrill, N.J.,Karp G,1976,McGraw Hill
5. Biology of developing Systems, Grant P., 1978, Holt Rinehart and Winston
6. Animal regeneration,Diwan A.P.,Dhakad N.K.,1996, Anmol Publications Ltd.,
7. Fertilization, Metz C.B.,Monroy A., 1967,Academic press

LAB IN EVOLUTION AND DEVELOPMENTAL BIOLOGY (2 Credit / 8 Hrs)

Evolution-List of Practicals:

1. Calculating gene frequencies and genotype frequencies in the light of Hardy-Weinberg Law.
2. Comparison of forelimbs and hind limbs of vertebrates.
3. Study of the skull of vertebrates – Varanus, Crocodile, Bird, Dog, Rabbit/Rat (Chart/Pictures).
4. Mimicry – Krait; adaptive colouration – chameleon.
5. Study of museum specimens – Evolution of horse, connecting links

Developmental Biology-List of Practicals:

1. Oogenesis –Histological studies
2. Spermatogenesis –Histological studies
3. Induced ovulation in frog fish
4. Observation of developmental stages of frog
5. Observation of metamorphic changes by rearing of amphibian larvae
6. Wound healing and cell aggregation in frog embryos
7. Induction and differentiation of lens in frog embryo
8. Influence of hormones on amphibian metamorphosis
9. Regeneration of tail in amphibian larvae
10. Polarity and gradients in regeneration of tail in amphibian larvae
11. Observation of developing chick embryo-Vital staining
12. Identification of developmental stages of chick embryo
13. Oestrous cycle of rat –Histological studies of vaginal smear
14. Histology –Development of heart, limb, kidney and lungs in chick embryo
15. Histology-Development of heart, limb, kidney and lungs in a mammalian embryo

ECOLOGY (M.Sc.)

Time: Three hours

Maximum: 75 Marks

SECTION – A (10 × 1 =10)

Choose the correct answer:

1. Where will you find energy the highest energy in this food chain: Acorns ---> squirrels ---> fox ---> bacteria
A) Acorns B) Squirrels C) Fox D) Bacteria
2. Inorganic nutrients are released from dead organic matter and animal wastes by _____.
A) Decomposers B) secondary consumers C) producers D) Autotrophs
3. Which is the possible path of movement of nitrogen in the nitrogen cycle?
A) soil- air - plants- animals – soil B) air -soil - plants - animals -soil – air
C) air -animals - soil - plants – air D)soil -animals - plants - air – soil.

4. Organic resources mainly contain _____
A) Carbon B) Hydrogen C) Nitrogen D) Oxygen.
5. _____ is the renewable resources. A) Hydropower B) Coal C) Natural gas D) Nuclear fuels.
6. _____ index diversity is the relative richness of different species in an area.
A) Alpha B) Beta C) Gamma D) Delta.
7. Atropine is obtained from _____ to cure Diahorrhoea.
A) Belladonna B) Pine Apple C) Papaya D) Chinconna.
8. Which dispersion pattern is most common in nature?
A) Randomly spaced. B) Uniformly spaced. C) Clumped. D) All are equally common.
9. Which of the following populations is most likely to go extinct?
A) A very small population in an unstable environment. B) A moderate-sized population
C) A large population with lots of genetic variability D) All would be equally likely to go extinct
10. Which of the following factors will affect population growth rates?
A) Net emigration B) net immigration C) birth rate D) all of the above

SECTION – B (5 × 7 =35)

Answer ALL questions, choose either (a) or (b).

10. a) What is ecosystem? Briefly discuss about pond ecosystem?
(OR)
b) Explain the structure and classification of Ecosystem?
12. a) Explain the productivity? Describe the concept of productivity?
(OR)
b) Give an account on “Renewable resources”.
13. a) Explain about the fossil fuels and Nuclear fuels
(OR)
b) Write short notes on “Endangered Species”.
14. a) Write the principles and advantages of conservation
(OR)
b) Write a detailed account on “Population growth”

15. a) Give an account on “R & K Selection Theory
(OR)
b) Describe population fluctuations

SECTION – C (3 x 10 =30)

Answer any THREE questions.

16. Give detailed account on “Biodiversity conservation”
17. Write an essay on Non renewable resources.
18. Describe about the Population distribution with suitable example.
19. What is a Biogeo-chemical cycle? Explain a detail account on Nitrogen cycle?
20. Write about the energy based classification of the ecosystem with suitable example.

LAB IN GENETICS AND ECOLOGY

TIME: 3 Hours

MARKS: 60

1. Measure the length and width of the leaves provided (20 nos). Tabulate your data and calculate the correlation coefficient. Write the procedure and discuss your results
... **20 Marks**

- 2 Estimate the rate of Primary productivity of Aquatic macrophyte using Light and Dark bottle method. Write the principle and procedure and interpret the results critically.
... **20 Marks**

3. Identify and Comment on A and B. (5×2) ... **10 Marks**

4. Record Note ... **10 Marks**

Total **60 Marks**

KEY: I

Procedure -8, Tabulation- 4, Calculation- 4, Interpretation -4 ... **20 Marks**

KEY: II

Procedure – 10, Calculation– 5, Results -5 ... **20 Marks**

KEY: III

Spotters ... **10 Marks**

1. Klinefelters syndrome
2. Pond Ecosystem