

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046

M. Sc. ZOOLOGY (CBCS PATTERN)

(For the students admitted during the academic year 2011-2012 batch and onwards)

Duration of the course: 2 years

Eligibility Condition:

B.Sc. Zoology

B.Sc. Advanced Zoology

B.Sc. Applied Zoology

B.Sc. Animal Science and Biotechnology

B.Sc. Advanced Zoology and Biotechnology

B.Sc. Life Sciences

Scheme of Examination

Semester	Core/Elective /Supportive Paper	Subject Code 10ZOOA	Title of the Paper	Instructional Hours/week	Internal	External	Total Marks	Total Credits
I	Core-I	13A	Biochemistry and Biophysics	4	25	75	100	4
	Core-II	13B	Molecular Cell Biology	4	25	75	100	4
	Core-III	13C	Microbiology	4	25	75	100	4
	Core-IV	13D	Human Cytogenetics	4	25	75	100	4
	Core Practical- I	13P	Practical (Biochemistry and Biophysics, Molecular Cell Biology, Microbiology and Human Cytogenetics)	6	25	75	100	4
	Elective-I	1EA	Crustacean Aquaculture and Technology	4	25	75	100	4
	*Supportive-I	---	Offered to other Department	4	12	38	50	2

II	Core-V	23A	Animal Physiology	4	25	75	100	4
	Core-VI	23B	Wildlife Biology	4	25	75	100	4
	Core-VII	23C	Experimental Embryology	4	25	75	100	4
	Core-VIII	23D	Economic Zoology	4	25	75	100	4
	Core Practical-II	23P	Practical (Animal Physiology, Wildlife Biology, Experimental Embryology and Economic Zoology)	6	25	75	100	4
	Elective-II	2EA	Global Warming – Animal Migration and Behaviour	4	25	75	100	4
	*Supportive-II	---	Offered to other Department	4	12	38	50	2
III	Core-IX	33A	Molecular Genetics	4	25	75	100	4
	Core-X	33B	Immunology	4	25	75	100	4
	Core-XI	33C	Environmental Biology and Toxicology	4	25	75	100	4
	Core-XII	33D	Conservation Biology	4	25	75	100	4
	Core-XIII	33E	Bioethics and Biosafety	4	25	75	100	4
	Core Practical-III	33P	Practical (Molecular Genetics, Immunology, Environmental Biology and Toxicology, Conservation Biology and Bioethics and Biosafety)	6	25	75	100	4
	Elective-III	3EA	Aquaculture and Fisheries	4	25	75	100	4
*Supportive-III	----	Offered to other Department	4	12	38	50	2	
IV	Project and Viva	47V	Project Work				100	4
			Viva-voce Examination				50	2
			Field Trip* (Visiting Educational Institution, Research Labs. and industries etc.)				25	1
			Skill Development* (Communication skills, Personality development, Summer training programme, Hands on training, On the job training programme etc.,				25	1
Total							2250	90

* To be submitted along with Project Work.

Practical Components:

The M.Sc. Zoology Core Practical Examination having the following Marks:

Internal Marks: 25

Time: 1.30 minutes

Major Practical		10 Marks
Minor Practical		5 Marks
Spotters (A, B, C & D)	4x21/2	= 10 Marks

Total	=	25 Marks

External Marks: 75

Major Practical		20 Marks
Minor Practical		15 Marks
Minor Practical		10 Marks
Spotters (A, B, C & D)	4x5 =	20 Marks
Record		10 Marks

Total	=	75 Marks

Theory Components:

The M.Sc. Zoology Core and Elective theory Examination having the following Marks:

Core and Elective Papers: Maximum Marks – 100

Internal Marks: 25

Test	-	15 Marks
Assignment	-	5 Marks
Seminar	-	5 Marks

External Marks: 75

Section A - 10x1=10 Marks (Question No. 1 to 10)

Choose the best Answer type. Answer all questions. All questions carry equal marks.

Section B – 5x5 = 25 Marks (Either or type – Question No. 11 to 15)

Answer all questions. All question carry equal marks. Each answer should not exceed 2 pages.

Section C – 5x8 = 40 Marks (Either or type – Question No. 16 to 20)

Answer all questions. All Question carry equal marks. Each answer should not exceed 4 pages.

Supportive Papers: Maximum Marks - 50

Internal Marks: 12

Test - 6 Marks
Assignment - 3 Marks
Seminar - 3 Marks

External Marks: 38

Section A – 5x1=5 Marks (Question No. 1 to 5)

Choose the best Answer type. Answer all questions. All questions carry equal marks.

Section B – 3x3 = 9 Marks (Either or type – Question No. 6 to 8)

Answer all questions. All Question carry equal marks. Each answer should not exceed 1 page.

Section C – 4x6 = 24 Marks (Either or type – Question No. 9 to 12)

Answer all questions. All Question carry equal marks. Each answer should not exceed 2 pages.

Core - I - 13A

BIOCHEMISTRY AND BIOPHYSICS

The objective of the course is to provide a concise and unifying approach to physical chemistry, biochemistry and biophysics. It also provides the structure, function and interactions of bio molecules, how biological processes occur at the molecular level and to understand these processes with strong backgrounds in chemistry, biology, and physics.

Unit – I

Structure of atom, molecules, ionic bonds, covalent bonds, hydrogen bond, Vander Vaal's forces, Intermolecular forces, electrolytes, pH and buffer capacity in the cell environment.

Unit – II

Amino acids: Structure, classification, properties, isoelectric point and zwitter ions. **Proteins:** Classification based on chemical structure, function and solubility; properties, primary, secondary and tertiary, Helix, principles of isolation and purification, Synthesis of polypeptides.

Enzymes: Classification, Kinetics, Co-factors, Enzyme inhibition, Enzyme substrate compounds.

Unit – III

Nucleic acids: DNA structure and properties, DNA as a genetic material, DNA synthesis – mechanism of replication (semi conservative and reverse transcription), nucleotides. **Different types of RNA:** mRNA and rRNA.

Lipids: Classification, properties – saturated and unsaturated fatty acids – plant waxes, steroids, cholesterol and lecithin.

Carbohydrates: Classification, structure and properties of functional groups.

Unit – IV

Bioenergetics: Laws of thermodynamics, concept of free energy, oxidation reduction (redox) reactions. Energy coupling reactions, energy rich compounds, ATP cycle, standard free energy, membrane potentials, and negative entropy changes in living systems, enzyme catalysis.

Unit – V

Analytical techniques: Principle and application of Chromatography (Paper, thin-layer, column and GLC), Centrifugation (RPM and G, Ultra centrifugation), Spectroscopic techniques (UV, visible spectroscopy, X-ray crystallography, NMR, IR, fluorescence & atomic absorption), Isotopes and their importance (GM counters & Scintillation counting).

Reference Books:

1. Biochemistry, by D.Voet and J.G. Voet, 2004. John Wiley & Sons, USA
2. Biochemistry, by R.H. Garrett and C.M. Grisham, (3rd Edition) 2007. Saunders College Publishers.
3. Principles of Biochemistry by A.L. Lehninger. 1984. CBS Publishers and Distributors, New Delhi.

4. Physical Biochemistry by D. Friefelder, (2nd edition) 1982. W.H. Freeman & Company.
5. The Physical Basis of Biochemistry, by Peter R. Bergethon, Springer-Verlag, 1998.
6. Biophysics-An Introduction, by C. Sybesma, 1989, Kluwer Academic Publisher.
7. Cellular Biophysics I and II, by Thomas F. Weiss, 1995, MIT Press.
8. Basic Biophysics for Biology, by E. K. Yeagers, 1992, CRC press.
9. Principles of Biochemistry by Albert L. Lehninger (4th edition) 2004. CBS Publishers & Distributors, New Delhi.
10. Biochemistry by Lubert stryer (4th edition) 2000. Freeman International Edition.
11. Biochemistry by Keshav Trehan, 1990. Wiley Eastern Publications.
12. Fundamentals of Biochemistry by J.L.Jain et. al. (4th edition) 1994. S.Chand and Company.
13. Textbook of Organic Chemistry (A Modern Approach) Ist edition) 2002. McGraw Hill.
14. The Biochemistry of Nucleic acid – Tenth Edition-Roger L.P.Adams, John T. Knowler and David P.Leader, 1992. Chapman and Hall Publications.
15. Essentials of Biophysics by Narayanan, P (2000), New Age Int. Pub. New Delhi.
16. A Text Book of Biophysics by Roy R.N. (1999), New Central Book Agency.
17. Biochemistry. S. C. Rastogi, 2nd edition. 2003. Tata McGraw Hill Publishing Company Ltd., N. Delhi.

Core - II – 13B

MOLECULAR CELL BIOLOGY

Unit – I

Cell organization, Sub-cellular structures of prokaryotic and eukaryotic cells. Synthesis and sorting of plasma membrane. Chromatin structure and nucleosome concept, Organization and function of genetic material, Gene paradox, Repetitive DNA, Satellite DNA, Overlapping genes, Split genes, Pseudogenes. Chromatin, nuclear and mitochondrial genome organization, Structures of DNA and RNA, Stereochemistry of bases and secondary structures. Genetic structure analyses of eukaryotic genomes.

Unit-II

Evidence of basic targets, Enzymes, Mechanisms of DNA replication in eukaryotes. t-RNA, m-RNA, r-RNA and hn-RNA structures and folding, Mechanisms in eukaryotes RNA splicing. Ribosomes, Genetic code, General control of DNA, RNA and protein synthesis, Post-translational modifications, Protein targeting.

Unit-III

Gene regulation in eukaryotes, Gene clustering, Mechanism of positive and negative control of gene expression. Translational and transcriptional control of regulatory mechanism of gene expression, Environmental effects on gene regulation.

Unit-IV

Signaling at the cell surface, Types of signaling pathways that control gene activity, Integration of signals and gene controls. Moving proteins into membranes and organelles, Vascular traffic, secretion and endocytosis, Metabolism and movement of lipids.

Unit-V

Regulation of the Eukaryotic cell cycle, Cell birth, Lineage and cell death. Cancer/ oncogenes, Cell markers, Cellular morphology, Primary and established cell lines, Kinetics of cell growth, Genetics of cultured cells. Stem cell culture, embryonic stem cells and their applications. Cell culture based vaccines. Somatic cell genetics.

List of Suggested Reference Books:

1. Cell and Molecular Biology, (8th edn.), De Robertis, E.D.P. and De Robertis, E. M.F. 1995, B.I.Waverly Pvt. Ltd., New Delhi.
2. Essential Cell Biology, B. Albert et al., 1998. Garland Publishing, Inc. New York.
3. Principles of Cell and Molecular Biology. (2nd edn.), Kleinsmith, L. J. & Kish, V.M. 1995.
4. Molecular Biology of the Cell. (3rd edn.), Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. (eds.) 1994. Garland Publishing, Inc., New York.
5. Molecular Cell Biology (5th Edn.), H. Lodish et al., 2004. W.H. Freeman and Company, NY
6. Molecular Biology of the gene, J.D. Watson. 1977. (3rd Edn.) W.A. Benjamin Inc. London.
7. An Introduction to Genetic Analysis (7th Edn.), A.J.F. Griffiths et al., 2000. W.H. Freeman & Co.
8. Principles of Biochemistry, A.L. Lehninger. 1984. CBS Publishers, New Delhi.
9. Principles of Genetics (6th Edn.), R.H. Tamarin, 1996. McGraw-Hill, New Delhi.

Core - III - 13C

MICROBIOLOGY

Unit – I

Introduction– Scope and History of microbiology –Classification of bacteria, fungi, yeast and virus. Structure and functions of bacteria and virus. Reproduction in bacteria – Transformation, conjugation, transduction. Mapping in bacterial genomes.

Unit – II

Cultivation and control of microorganism – Methods of collection of sample – methods of estimation of microorganism in soil, water and air – Isolation and identification of bacteria. Methods of sterilization and disinfection – Microbial control – Physical and chemical – techniques of pure culture – Method of cultivation of bacteria – Phases of growth .

Unit – III

Microbial Ecology: Distribution of microorganism in soil, water and air – Environmental factors influencing the distribution of microorganism – Role of microorganisms in the cycling of nutrients – Carbon, nitrogen, phosphorous and sulphur cycle.

Unit – IV

Food Microbiology: Sources, types incidence of microorganism in vegetables, meats, poultry, seafood, milk and diary products – spoilage of food, fruits, vegetables, cereals, meat, poultry egg, seafood, caned products – Factors influencing spoilage – Methods of detection of spoilage, principles of food preservation and prevention of food spoilage.

Unit – V

Microbial Technology: Genetic engineering of food and additives – Single Cell Protein (SCP) production – Production of organic acids (acetic acid), ethanol – Antibiotics – Microbial toxins – methanogenesis — Fermentation products.

References:

1. Burden, K.L. and R.P. Williams (6th Ed.) 1968. Microbiology. The Macmillan Co., London P. 818.
2. Dawes, E.A. (Ed.) 1986. Energy conservation in bacterial photosynthesis. In: Microbial energetics. Blackie & Son Ltd., Glasgon, 133-144pp.
3. Doelle, H.W. (Ed.) 1969. Fermentation acetic acid bacteria and lactic acid bacteria. In: Bacterial metabolism. Academic Press. New York, London. 256 – 351 pp.
4. Hay, J.M. (Ed.) 1986. Modern Food Microbiology. CBS publishers, Delhi. 622 pp.
5. Reed, G. (4th Ed.) 1983. Prescott & Dunn's Industrial Microbiology. AVI Publishing Co., Inc. Connecticut, 883. pp.
6. Roberts, T.A. and F.A. Skinner (Eds.) 1983. Food Microbiology: Advances and Prospects, Academic Press, Inc. London, 393 pp.
7. Selle, A.J. (Ed.) 1967. Fundamental Principles of Bacteriology. Tata McGra – Hill Publishing Company Ltd., New Delhi, 822 pp.

Core – IV - 13D

HUMAN CYTOGENETICS

Unit - I

History of Human Chromosome Research - Denver Conference (1940) - Chicago Conference (1966) - Paris Conference (1971) - Nomenclature of Human Chromosome.

Unit - II

Identification of Human diploid chromosome - peripheral blood cultures - banding techniques - G-band; Q-band; C-band; R-band - Identification of 23 pairs of Human chromosomes by band position.

Unit - III

Chromosomal syndromes: Autosomal syndromes - Sex chromosomal syndromes - Structural chromosomal syndromes.

Unit - IV

Prenatal diagnosis: Chorionic villi sampling - Foetoscopy, Ultrascopy - Amniocentesis. b) Postnatal diagnosis: Peripheral blood leucocyte culture - Sister Chromatid Exchange - Fragile site - Mitotic index. c) Genetic Counseling.

Unit - V

Hereditary forms of Cancer - Oncogenes and Cancer - Chromosomes and Cancer - Cancer and the environment.

Reference books

1. Human Heredity Principles and issues -- by Michael R. Cumming's. 3rd Edition.
2. Genetics Medicine - by Karl. H. Muench Elsevier Pb. London
3. Human Genetics by Elof Axel Carlson, TATA Mc Graw-Hill Pb. New Delhi.
4. Attwood, T.K. and Parry Smith, D.J. 1999, Introduction to Bioinformatics, Longman Publications, Pearson Education Ltd., New Delhi.
5. Baxevanis, A.D. and Francis Ouellette, B.P., 1998, Bioinformatics, A Practical Guide to the Analysis of Genes and Proteins, Wiley – Interscience Publication, New York.
6. Bishop, M.J. and Ramlings, C.J., 1987, Nucleic Acid and Protein Sequence Analysis, A Practical Approach, IRL Press, Oxford.
7. Brown, T.A., Genomes, 1999, John Wiley and Sons Inc., New York.
8. Zhang, W.E.I. and Shmulevich, I.Y.A. 2002, Computational and Statistical Approaches to Genomics, Kluwer Academic Publishers, London.

**Core Practical – I - 13P BIOCHEMISTRY AND BIOPHYSICS, MOLECULAR CELL
BIOLOGY, MICROBIOLOGY AND HUMAN
CYTOGENETICS**

Biochemistry and Biophysics

1. pH: Structure and operation of pH meter
2. Preparation of buffers: Phosphate buffer and citrate buffer.
3. Colorimetric/Spectrophotometric estimation of the following biomolecules.
 - a. Total free amino acids (Ninhydrin reagent method)
 - b. Protein (Lowry et al., 1951 method)
 - c. Total soluble carbohydrates (Anthrone reagent method)
 - d. Total cholesterol (Zlatkis et. al. method)

Molecular Cell Biology

1. Principles of microscopy and optics.
2. Cell size determination
3. Microtomy and photography.
4. Mounting of polytene chromosomes.
5. Preparation of mitosis in Onion root tip.
6. SDS - PAGE of protein from animals.

Microbiology

1. General rules of microbiology laboratory.
2. Preparation of Non-selective and selective culture media.
3. Estimation of bacteria from soil and water using plate count method.
4. Observation of morphological characters of bacteria (temporary wet mount technique).
5. Staining methods: Preparation of smears for staining - simple staining, negative staining, gram staining.

Human Cytogenetics

1. Problems related to Mendelian laws.
2. Pedigree analysis
3. Peripheral blood leukocyte culture for chromosomal studies
4. Mitotic indices
5. Sister chromatid exchange -determination
6. Micronucleus test
7. Chromosomal disorders-Numerical, Structural

Elective - I - 1EA CRUSTACEAN AQUACULTURE AND TECHNOLOGY

Unit-I

Importance of fisheries and aquaculture - Current issues regarding sustainability of aquaculture - Ecological and social aspects of aquaculture development - Nutritional value of crustaceans as food.

Unit-II

Taxonomy of crustaceans - Live feeds: micro algae, micro-invertebrates (Rotifers, *Artemia*, Copepods etc.) – Plant and animal nutrients - Balanced diet (iso-nitrous and iso-caloric) - Artificial feed formulation – Low cost feed formulation.

Unit-III

Hormonal control of crustacean reproduction - Brooding (selective breeding, “specific pathogen free”) - The hatchery technology and freshwater prawn seed production.

Unit-IV

Site selection and preparation of culture ponds – Culture and Grow-out technology (semi-intensive, intensive, hyper-intensive etc.) for commercially important crustaceans: freshwater prawns, marine shrimps, freshwater crayfish, lobsters, and crabs.

Unit-V

Nutritional requirement and feeding strategies - Water quality management and maintenance of sanitation – Methods for the microbiological examination of water and foods - Prawn diseases - Pathology and quarantine - Post-harvest handling and marketing – Predators and Parasites in aquaculture. Value addition to aquaculture produces.

Reference Books

1. Palaemonid Prawns, K.V. Jayachandran, Science Publishers, Inc., USA, UK.
2. A Text Book of Fish, Fisheries and Technology, K.P. Biswas. M.Sc., Ph.D., F.Sc. (Bombay) E.F. (West Germany), published by Smt. Manju Biswas, Neral Main Road Goria, Calcutta.
3. Fish & Fisheries of India, V.G. Jhingran, Director, Central Inland Fisheries Research - institute, Barrackpore (W.B.) Published by Hindustan Publishing Corporation (India) 6 UB, Jawahar Nagar, Delhi.
4. Biotechnology and Genetics in Fisheries and Aquaculture by A.R. Beaumont and K. Hoare, Blackwell Science (2003).
5. Production of Meal, Oil and Protein-Vitamin Preparation in Fishing Industries Kuli Key, Oxford & IBH.
6. Prawn Culture by C.V. Kurian and M.J. Sebastian.
7. Prawn and Prawn Fisheries of India by Kurian and Sebastian.
8. Limnological Methods by Adoni et al.
9. Manual for the culture of freshwater prawn, FAO Technical paper series.

10. Manual for Culture of Freshwater Prawns - FAO Technical Paper Services.
11. Freshwater Aquaculture in India - Srivastava.
12. A Manual of Freshwater Aquaculture - Santhanam et al.
13. Marine Fishes in India - D. V. Bal & K. Birabhadra Rao, Tata McGraw Hill Publishing Company Ltd. New Delhi.
14. Aquaculture Training Manual - Donald & Swift. Fishing News Books Ltd., London.
15. Tropical Fish Farming - D.K. Belsare, Environment Publications, Karad-415 110, India.
16. C.R.C. Handbook of Mariculture, 2nd Edition, Vol. II Finfish Aquaculture-Ed. James, P' McVey. CRC Press, Boca Raton, Ann Arbon, London.
17. The Marine and Freshwater Plankton - Charles, C. David, Michigan State University Press.

Core - V - 23A

ANIMAL PHYSIOLOGY

This study helps in understanding how the body functions adapts with respect to its external and internal environment, related to nervous integration, sensation, metabolism and reproduction.

Unit –I

Locomotion and Nutrition: Types of muscles – Ultra-structure – Mechanism of contraction of skeletal muscles – Nervous control of muscles. Nutritive requirements – General. Organization of alimentary canal – Role of salivary glands, liver, pancreas and intestinal glands in digestion.

Unit – II

Digestion and Excretion: Absorption of digested food-hormonal control of digestion - Introduction to intermediate metabolism –Structure of mammalian kidney – Urine formation – acid base regulatory mechanisms; endocrine regulation of water and mineral balance.

Unit – III

Circulation and Respiration: Composition of blood, blood groups in man, coagulation – Structure of mammalian heart, open and closed system of circulation, blood pressure and its regulation.

Unit – IV

Nervous integration and sense Organs: Organization of Nervous system – nerve conduction – synapse – neurotransmitters – nervous co-ordination – coding information to sensory organs – Chemoreceptor – Mechanoreceptor – Thermoreceptor – Photoreceptor.

Unit – V

Reproduction: Functional morphology of reproductive organs, gametogenesis, parthenogenesis, reproductive cycles – Pheromones.

References:

1. Ganong, H, Review of Medical Physiology, 1989. 14th edition, Appleton & Lange publisher, New York
2. Physiology: A regulatory system approach, Fleur, and Strand, (1978). Macmillan Publishing Company, New York; Collier Macmillan Publishers, London.
3. Shier, D., Butler, J. and Lewis, R., Hole's Human Anatomy and Physiology, (10th edition) 2003. WCB/McGraw Hill, Boston. 2003.
4. Animal Physiology, Eckert, R (5th edition), 2002. W.H.Freeman.
5. Williams S. Hoar (1991) General and Comparative Physiology 3rd edition. Prentice Hall of India- New Delhi.
6. Neilson, K.S. Animal Physiology, 1997. Cambridge University Press, Pergamon Press, Oxford.
7. Prosser, C.L. and Brown-Jr. F.A.: Comparative Animal Physiology, 1961. W.B. Saunders, Philadelphia.

Core - VI – 23B

WILDLIFE BIOLOGY

Unit – I

Biogeography of India and patterns and distribution of ecosystems, ecological succession, biotic and abiotic factors of an ecosystem. Taxonomy of common Indian wild animals of reptilia, aves and mammalia.

Unit – II

Natural history of wild life; resting behaviour; Food and feeding: nutritional and reproductive strategies of common wild animals such as the calotes, poisonous and non-poisonous land and water snakes; crocodiles, birds of prey and other insectivorous, frugivorous, nectivorous and seed feeding birds, wild mammals of India.

Unit – III

Population ecology and growth; population patterns, habits, habitats, habitat selection; prey-predator relationship.

Unit – IV

Social behaviour such as aggregation, sexual behaviour, migration and territorial behaviour in birds and mammals; means of dispersal and barriers of dispersal, group size and spacing carrying capacity.

Unit – V

Wild life management; Tropic structure of wildlife, common diseases of wildlife; wild life sanitation, management of wildlife, Zoo planning and management and tourism development in wild life sanctuaries.

Recommended Readings:

Dasmann, R.F. 1982. : **WildLife Biology**, Wiley eastern Ltd. New Delhi.

Krishnan, M: **India's WildLife**, 1972. Bombay Natural His. Soc.

Mani, M.S. : **Ecology and Biogeography of India**, 1974. Junk. Publ. The Hague.

Giler, R.F. : **WildLife Management and Techniques**, 1971. WildLife Soc.

Stracey, P.D. : **WildLife in India – Conservation and Control**, 1963. Ministry of Agriculture Govt. India.

Hind, R.A.: **Animal Behaviour**, 1966. McGraw Hill, New York.

Stillwell, F.: **The wards of WildLife**, 2004. W.W.F.

Seber, G.A.F.: **The estimation of animal abundance and related parameters**, 1973. Chapman and Hall.

Gee, E.P. : **The WildLife of India**, 1964. Colling London.

Core - VII - 23C

EXPERIMENTAL EMBRYOLOGY

Experimental embryology is an experimental science, which provides understanding of the processes of early embryonic development, to analyze the mechanisms of development by experimental manipulation of developing embryos and to review current methodologies for conducting research in the field of embryology. It also emphasizes on current experimental approaches utilized in research of normal and abnormal development of the mammalian embryo.

Unit –I

Introduction and scope – Gametogenesis: Spermatogenesis: Origin of Primordial germ cells – Differentiation of spermatozoa – structure and motility of sperm – egg activation – acrosomal reaction. **Oogenesis:** Development of Oocytes – types of eggs – Biochemical changes during Oogenesis.

Unit – II

Fertilization process: Activation of sperm and egg– interaction of sperm and egg – Sequence of events in sperm entry – Egg surface changes. **Post–fertilization changes:** changes in the organisation of the egg cytoplasm caused by fertilization.

Unit – III

Cleavage: Cell division and chemical changes during cleavage – pattern of cleavage – Distribution of cytoplasmic substances in the egg – role of egg cortex - morphogenetic gradient in the egg cytoplasm. **Gastrulation:** Principles and patterns of gastrulation – Fate map.

Unit – IV

Organizer: Spemann's primary organizer – analysis of nature and mechanism of induction; **Organogenesis:** Cellular interaction – differentiation and organogeny. **Embryonic adaptation:** Extra embryonic membrane structure in Reptiles and Birds. **Placenta:** Classification, structure and physiology.

Unit – V

Post embryonic developmental events: Metamorphosis (Insects and amphibians); Regeneration in various animals. Asexual reproduction: Occurrence and forms of asexual reproduction. Cryo-preservation of gametes and embryos – in-vitro fertilization and embryo transfer – sperm banking – Fertility control and regulation.

Recommended Readings:

- Berril, N.T. : Developmental Biology, 1971. McGraw Hill Co., New York.
Berril, N.T., Karp, G. : Development, 1988. Tata McGraw Hill Co., New York
Patten's Foundation of Embryology, Bruce M Carlson . Tata McGraw Hill Co., New York
Waddington, G.H. : Fundamentals of Embryology, 1949. George Allen and Unwin.
Huxley De Beer: The Elements of Experimental Embryology, 1934. Cambridge Univ. Press,
Cambridge, Hafher Publishing Co.
Rover, C.P. : An Outline of Developmental Physiology (1968). Pergamon Press.
Austin, C.R. : Fertilization (1966). Prentice Hall.
Austin, C.R. : Ultrastructure of Fertilization (1967). Holt Reinhart and Winston.
Hay, E.D. : Regeneration (1970). Holt Reinhart and Winston.
Nelson, G.F. : The Comparative Embryology of Vertebrates (1979). Blackinton and Co.
Balinsky, B.I. : An Introduction to Embryology (1960). W. B. Saunders Co., Philadelphia
Bodemer, C. : Modern Embryology (1968). Hold, Rinehart and Winstorn, Inc, New York.
Trampush, HAL and Kiotsis, V. : Regeneration and Related Problems (1972). North
Holland Publishing Co.,
Vorontsova, M.A. and Liosner, L.D. : Asexual Propagation and Regeneration (1960).
Pergaman Press.
Monray, A. Chemistry and Physiology of Fertilization (1978). Halt Reinhart and Winston.

Core – VIII – 23D

ECONOMIC ZOOLOGY

Unit- I. Agricultural Zoology

Beneficial insects – Spider, Mantis, Ladybugs, Damsel bug, Mealybug destroyer, Soldier beetle, Green lacewing, Syrphid fly, Tachinid fly, Ichneumon wasp and Trichogramma wasp. Harmful insects – Migratory locust, Colorado potato beetle, Boll weevil, Rhinoceros beetle, Aphids, Mosquitoes and Cockroach. Pests of major crops, their injuries and control – Paddy, Sugarcane and Groundnut. Economic importance of Rodents, Snakes, Owls and Bats. Apiculture - Sericulture - Lac culture – Vermiculture.

Unit- II. Medical Zoology

Infectious/ communicable diseases – small pox, hepatitis, AIDS, influenza, tuberculosis, plague, cholera, amoebiasis, malaria, trypanosomiasis, elephantiasis. Diseases caused by aberrant chromosomes/ genes in man - genetic counseling - DNA and forensic investigation.

Unit- III. Veterinary Zoology

Important livestock – goat, sheep, cattle, dog, deer and rabbit. Livestock diseases – tetanus and anthrax. Livestock parasites – helminthes, flies, ticks, lice and mites. Dairy and Poultry industries - Animal breeding - Establishment of Zoo and its importance.

Unit –IV. Aquaculture

Aquaculture in India – an overview. Fish culture: carp culture, marine fish culture and ornamental fishes. Prawn culture: Freshwater prawns and marine shrimps. Fattening of marine crabs. Crayfish and Lobster cultures. Molluscs: Mussels, clams, chanks and oysters. Pearl culture – Planktons – Algae - Aquatic weeds.

Unit-V. Food Processing

Freshness criteria and quality assessment of fish and prawn - Spoilage - Methods of preservation: Canning, Freezing, Drying, Salting, Smoking and Curing - Quality control of processed fish and prawn- Fish and prawn processing industries in India - Composition and nutritional value of poultry meat and eggs - Processing of poultry meat and eggs - Spoilage and control - Byproduct utilization - Important microorganisms and the factors affecting their growth and survival in foods.

References

1. Economic Zoology, G.S. Shukla, V.B. Upadhyay (2006)
2. Text Book of Applied Zoology, Pradip. V Jabde (2005)
3. Textbook of Animal Diseases, Ashok Kumar (2009)
4. Medical Zoology, R.C. Sobti (1991)
5. Modern Textbook of Zoology, R. L. Kotpal (2000)
6. Processed Meats, AM. Pearson & TA Gillett (1996)
7. Egg and poultry meat processing, W.J. Stadelman, V.M. Olson, GA. Shemwell & S. Pasch S (1988)
8. Fish as Food, Vol 1 & 2, HA. Bremner (2002)

**Core Practical – II – 23P ANIMAL PHYSIOLOGY, WILDLIFE BIOLOGY,
EXPERIMENTAL EMBRYOLOGY AND
ECONOMIC ZOOLOGY**

Animal Physiology

1. Influence of pH on salivary amylase activity.
2. Biochemical analysis (Qualitative) – carbohydrate, proteins and fats.
3. Estimation of haemoglobin (Sahli's method), RBC and WBC.
4. Estimation of glucose (O-toludine method)
5. **Models:** Stomach, Eye, Ear, Liver, Brain, Heart and Kidney.

Wildlife Biology

1. Inventories/Surveys.
2. Field Techniques.
3. Identification and use of keys – Reference specimen.
4. Collection and preservation.
5. Introduction to computerized techniques – Remote sensing CAMP and GIS and their modules for conservation.
6. IUCN Red List Exercise and PVA modeling.
7. Statistical analysis/interpretation.
8. Technical writing and reporting of field studies.
9. Public presentation.
10. Field Project/ Report – Visit to Zoological parks, wildlife sanctuaries and biosphere reserves.

Experimental Embryology

1. **Spotters** :
 - a) Oogenesis, Spermatogenesis
 - b) **Frog:** Four cell stage, Late cleavage, Blastula, Gastrula, Gastrula yolk plug stage,
 - c) **Chick:** 36 Hours stage, 48 Hours stage, 56 Hours stage, 72 Hours stage, 96 Hours stage.
2. Serial sections of chick embryo.
3. Mounting of chick Blastoderm.

Economic Zoology

1. Parasitic protozoa – Amoeba, Plasmodium and Trypanosoma
2. Helminthes worms – Liver fluke, Tape worm and Filarial worm
3. Insect Pests – Trips, Nematode, Caterpillar and Rhinoceros beetle
4. Value added products of dairy, poultry and fishery
5. Methods for the microbiological examination of water and foods.

Elective - II – 2EA GLOBAL WARMING – ANIMAL MIGRATION AND BEHAVIOUR

Unit - I

Introduction to global warming: Basics of Green house gases — Climatic change and its Significance and Causes - Impact of global warming on eco- system - Fossil fuel in Global warming- present and future trends.

Unit - II

Climatic change: Acid rain-ozone depletion-Green house effect –forest fire-GIS, RS and its application.

Unit - III

Impact on Biodiversity: Behavioral Adaptation - Threats to biodiversity – IPCC and migration of species –biodiversity of land, aquatic and polar ecosystem – Climate change Human Health.

Unit – IV

Green house gases – impact behavior impact behavior: Transgenic Plants and behavior of insects – Prey Predator and parasitoid system – Climate change and Vector prevalence – Vector Borne diseases - Carbon sequestration.

Unit – V

Conservation and management: Threatened and Endangered Species - wild animals and plants – Global conservation organizations - Deforestation and Defaunation - integrated conservation strategies.

Reference:

Ecology (Individuals, population and Communities) by Michael Begon, John L. Harper Colin R. Townsend.

Environmental politics and policy by Walter A. Rocenbaun

The text book of Animal behaviour by Hoshang S. Gunderia and Hare Govind Shingh.

Environmental planning and management by John H. Balduim

Environmental protection and the law by K. Khitoliyan

Animal Behaviour by John Alcolh

Development and Animal Behaviour by Dr. Amila Sarhan.

Core - IX - 33A

MOLECULAR GENETICS

Unit – I

Fundamentals of genes and chromosomes – DNA structure and function – Chromosome structure and function – Gene in pedigree.

Unit – II

Fundamentals of DNA cloning and molecular hybridization: Cell based BNA cloning – DNA hybridization assays – PCR based DNA cloning and DNA analyses.

Unit – III

Features of the human Genome: Organization and expression of the human genome – Human multigene families and repetitive DNA – Footprints of evolution – Mutation and instability of human DNA.

Unit – IV

Mapping of the human genome: Physical mapping - Genetic mapping – The human genome project.

Unit – V

Dissecting and manipulating genes: Studying human gene structure and function and creating animal models of disease – Gene therapy and other molecular genetic based therapeutic approaches.

Reference Books:

1. Tom Strachan and Andrew. P. Read – Human Molecular Genetics – ‘Bios’ Scientific Pub UK. (1996).
2. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J. and Weinter, A.M. – Molecular Biology of Genes (4th edition) 1987. The Benjamin/Cummings publishing Company inc., Joky.
3. Lewin, B. Genes VI (1997). Oxford University Press, Oxford, New York, Tokyo.
4. Darvell, J. **et. al.**, Molecular Cell Biology (7th edition) 2002. Garland Publishing iwc., New York.

Core - X- 33B

IMMUNOLOGY

Unit - I

Outlines of Immunology: Basics of Immunity – Types of Immunity - Structure and Types of Immune system - Lymphoid organs.

Unit – II

Antigens, Antibiotics and Complements: Antigens – Antibody reaction – Immunoglobulin-structure of Immunoglobulin - Structure, function and biological properties of Immunoglobulin classes - Salient features and Biosynthesis of Complement.

Unit - III

Immunopathology: Hypersensitivity - Types of hypersensitivity - Major Histocompatibility Complex (MHC) and its significance.

Unit - IV

Immunological disorders: Immunodeficiency diseases – Transplantation immunology - Types of graft - Mechanism of allograft rejection.

Unit - V: Immunotechnology

Active immunization - Passive immunization – Principles and Methods of vaccine preparation – Immunological techniques - RIA, ELISA, Immunocytochemistry and Immunoblotting.

Reference:

1. Immunology, S.K. Gupta (1999). Narosa Publishing House, New Delhi.
2. Essential Immunology (8th Edition), Ivan Roitt, 1994. Blackwell Scientific Publication. Immunology W.H. Freeman and Company.
3. Abdul .K. Abbas. Andrew .K. Litchmen and Jordan, 1997, Cellular and Molecular Immunology, 3rd Edn. W.B. Saunder Company.
4. Weir, D.M. and Stewart, J., 1997, Immunology, 8th Edn., Churchill Livingstone, New York.
5. Eryl Liddell and Ian Weeks., 1995, Antibody Technology, BIOS Scientific Publishers.
6. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D. Watson.(Eds.), 1994, Molecular Biology of the cell, 3rd Edn., Garland Publishing Inc., New York.
7. Immunology, George Pinchuk (2004). Tata McGraw-Hill Publishing Company Limited, New Delhi.

Core - XI- 33C ENVIRONMENTAL BIOLOGY AND TOXICOLOGY

Environmental Biology course is designed to provide fundamental ecological principles that provide a in-depth understanding of our natural world, the scientific basis for understanding how environmental systems work, the environmental issues, environmental problems, effects and solutions. This course also provides detailed information about environmental toxicology, which provides a sound basis for understanding and formulating various measures to protect the health and welfare of human population in the world. The course content of this paper is designed to give a basic understanding of various aspects of environmental toxicology.

Unit – I

Ecosystem: Review of the concept of ecosystem – pond and Forest as examples of natural ecosystem. Energetics in an ecosystem – Energy flow, Trophic level and structure in ecosystem, Food chain, Ecological pyramids- Review of Bio-geo Chemical cycles.

Unit – II

Limiting Factors: Concept of Limiting factors - Liebig's law of the minimum – Shelford's law of tolerance. **Population and Community Ecology:** Natality, Mortality, Growth rate as factors determining the population density- Population interactions. Types of community - Structure – Community Succession, Homeostasis.

Unit – III

Habitat Ecology: Freshwater habitat – Marine habitat – Estuarine habitat – Terrestrial habitat.

Unit – IV

Resource Ecology and Management: Concept – classification – Non-Renewable and Renewable resources- Conventional and Non- Conventional source and energy – Conservation and management.

Unit – V

General Principles of Toxicology: Introduction – Definition – Types - Scope of toxicology – Recent developments – Types of environmental pollution and their biological effects – Air, Water, Soil, Noise and Radiation pollution. **Routes of Entry and Testing Procedures:** Introduction - Absorption – distribution – Excretion – Bio-transformation-Bioassay – Acute toxicity - Chronic toxicity. Assessment of safety /risk.

Recommended Readings:

Fundamentals of Ecology by Eugene P. ODUM (1972), W.B. Saunders Company, London.
Environmental Biology by Michael Reiss and Jenny Chapman, 2000. Cambridge Press, UK.
An Introduction to Ecology and Population by Emmel THOMAS, C. (1973), Notron, NY.
Fundamentals of Ecology by DASH, M.C., 1993. Tata McGraw-Hill Publishing Company.
Principles of Ecotoxicology by BUTLER, O.C., 1978. John Wiley & Sons, USA.

Core – XII – 33D

CONSERVATION BIOLOGY

Unit I - BIODIVERSITY; SPECIES CONCEPTS; ANIMAL DIVERSITY

What is Biodiversity? - Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - Species concepts - **Animal diversity:** (Distribution, inventory, species richness) - Biodiversity Hotspots (Western Ghats, Indo-Burma region).

Unit II - LOSS OF ANIMAL DIVERSITY, STATUS OF SPECIES

Extinctions: Past rates of Extinctions - Concepts of Island biogeography and extinction rates on Islands - Human induced, Modern and local extinctions - Population reduction-threats to wildlife (examples)- Habitat loss, degradation and fragmentation. Threats to animal diversity in India - **Status of species:** Rare, endemic and threatened species - Measuring status of species in the wild - IUCN Red list (Assessments and methodologies) - Status of Indian animals.

Unit III - CONSERVATION: TOOLS IN ANIMAL CONSERVATION

What is conservation biology? - *In situ* and *Ex situ* conservation of Indian animals (Case studies) - Population management -Project Tiger and Elephant - Captive breeding programme - peoples participation in conservation - Successes and failures of conservation actions in India (Case study) -**Tools in Conservation:** Interpretation of various data on wildlife - GIS - remote sensing - Landscape model – PVA and CAMP processes.

Unit IV - ANIMAL LAWS AND POLICIES IN INDIA; ECONOMICS OF BIODIVERSITY CONSERVATION

Wildlife (Protection) Act of India (1972) - Protected Area network - forest policy - Prevention of cruelty to Animal Act - Convention on Biological diversity, International Trade in endangered species - Zoo policy- Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves - Economics of biodiversity conservation.

Unit V - CONSERVATION EDUCATION AND AWARENESS

Wildlife / Animal magazines, Journals- How to write popular and Scientific articles - Magazine and Journal information - Wildlife, nature, environment games (examples) – Role of NGO's and Government organizations in wildlife conservation - Wildlife celebration days in India - Biotechnology in conservation.

Selected References:

1. R. B. Primack 1993. Essentials of Conservation Biology, Sinauer Associates, USA
2. G. K. Meffe and C. R. Carroll 1994. Principles of Conservation Biology, Sinauer Associates, USA
3. B. Groom bridge 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
4. R. A. Mittermeier, N. Meyers, P.R. Gil and C. G. Mittermeier 2000. Hotspots: Earth's Biologically richest and most endangered Terrestrial Ecoregions. Cemex/Conservation International, USA

5. M.E. Soule 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
6. M. L. Reaka - Kudla, D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
7. T. W. Clark, R. P. Reading and A.L. Clarke 1994. Endangered Species Recovery: Finding the Lessons, Improving the process. Island Press, Washington, DC.
8. <http://www.redlist.org>
9. W. V. Reid and K.R. Miller 1989. Keeping options Alive. World Resources Institute.
10. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
11. K. J. Gaston 1996. Biodiversity: Biology of numbers and Difference. Blackwell Science, Oxford.

Core – XIII – 33E

BIOETHICS AND BIOSAFETY

Unit – I

Introduction to Bioethics in Biotechnology- Ethics – Bioethics - Biotechnology – Positive effects – Negative effects - Ethics in biotechnology- Biotechnology examples – Rice with Vitamin A - Slow Ripening Fruits- Saving the Banana- Virus Resistant Crops - Building with Silk- Educated Need for Fertilizers- More from the Sun- Toxic Soils- Biological Pest Controls – Fast Growing Trees- Fast Growing fish- The Monarch Butterfly Story- Consumer traits – food safety- Environmental concerns- Economic and Social Concerns.

Unit – II

Biosafety Regulations- National and International Guidelines.

Introduction – Regulation framework in various countries – USA- European Union-Canada- Australia- South Africa- Asian Region- International Guidelines.

Unit –III

CPCSEA Guidelines for Laboratory Animal Facility

Goal- Veterinary care- Animal procurement- Quarantine, Sterilization and separation – Surveillance, diagnosis, treatment and control of disease- Animal care and technical personnel- Personal hygiene- Animal experimentation involving hazardous agent- Multiple surgical procedures on single animal- Duration of experiments- Physical restraint- Physical plant- Physical relationships of animal facilities to laboratories – Functional areas- Physical relationship of animal facilities to laboratories- Functional area- Physical facilities- Environment- Animal husbandry- Activity – Food- Bedding- Water- Sanitation and cleanliness- Assessing the effectiveness of sanitation – Waste disposal- Pest control- Emergency , weekend and holiday care.

Unit – IV

GLP and Bioethics- Introduction – National Good Laboratory Practice (GLP) Programme- The GLP authority functions- Why follow Good Laboratory Practices?- The Aspiration – Who is responsible? – The IT Way- Role of a Sponsor- What are the quality standards for Clinical Trials?- Why is India a favorite destination for Clinical Trials worldwide?

Unit – V

Intellectual Property Rights - An introduction- Origin of the Patent Regime- Early patterns Act & Indian Pharmaceutical Industry – History of Indian Patent System- The Present Scenario – Basis of Patentability –Patent Application Procedure in India- Patent Granted Under Convention Agreement- Who can apply for a patent?- Patent Procedure – Opposition to Grant of Patent- Grant and Sealing- Exclusive Rights – Grant of Exclusive Rights- Special Provision for selling or distribution – Suits relating to infringements – Compulsory License- Termination of Compulsory License – Case study- Compulsory Licenses- Relief under TRIPS agreement.

Reference Books:

1. Bioethics, by Shaleesha A. Stanley (2008). Published by Wisdom Educational Service, Chennai.

Core Practical – III – 33P MOLECULAR GENETICS, IMMUNOLOGY, ENVIRONMENTAL BIOLOGY AND TOXICOLOGY, CONSERVATION BIOLOGY AND BIOETHICS AND BIOSAFETY

Molecular Genetics

1. Buccal smear test.
2. Peripheral blood leucocyte culture for chromosomal.
3. Banding techniques G, C, and Q (Demonstration)
4. Micronucleus test
5. Sister Chromatid exchange.
6. Identification of drumstick chromosomes in human blood.
7. PCR technique - DNA analysis - Demonstration.

Immunology

1. Blood group determination by slide agglutination; Rh factor determination by agglutination reaction.
2. Total count of blood cells and differential counts.
3. Total hemoglobin determination.
4. Ag-Ab reaction (Model) – Raising antibodies of Ag injection (Model).
5. Elisa Technique (Demonstration).
6. Immunoelectrophoresis- Western Blotting (Demonstration).

Environmental Biology and Toxicology

1. Determination of pH, dissolved oxygen, salinity, and free CO₂ in water
2. Determination of carbonates and bicarbonates in water
3. Estimation of chlorides in water
4. Estimation of dissolved solids in water
5. Visit to drinking water treatment plants
6. Visit to Forest ecosystem – Maruthamalai Forest ecosystem
7. Visit to a Pond ecosystem – Kurichi pond – Ukkadam

CONSERVATION BIOLOGY

1. Inventories/Surveys.
2. Field Techniques.
3. Identification and use of keys – Reference specimen.
4. Collection and preservation.
5. Introduction to computerized techniques – Remote sensing CAMP and GIS and their modules for conservation.
6. IUCN Red List Exercise and PVA modeling.
7. Statistical analysis/interpretation.
8. Technical writing and reporting of field studies.
9. Public presentation.
10. Field Project/ Report – Visit to Zoological parks, wildlife sanctuaries and biosphere reserves.

BIOETHICS AND BIOSAFETY

1. Visit to Research institutes holding animal house facility.
2. Visit to pharmaceutical industry and report submission.
3. CPCSEA, GLP, IPR- Group discussion - report submission.

Elective- III - 3EA

AQUACULTURE AND FISHERIES

Unit - I

Introduction, present scenario of aquatic biotechnology-Scope and importance-constraints and recent advances in aquaculture biotechnology.

Unit - II

Aqua farm engineering-selection of site, designing, layout and construction of aqua farms-basic introduction to culture techniques-modern approach of composite fish culture-Integrated fish farming-prawn culture.

Unit - III

Feed formulation and Technology –live feeds-ingredients and their selection- formulation and preparation of feeds-addition of probiotics and probiotics in formulated feeds.

Unit - IV

Hormonal and genetic approach to modern aquaculture-fish genetics- gynogenesis and androgenesis-Induced polyploidy-fish breeding and hybridization-molecular markers and their application in fisheries-Hormones and modern techniques of fish seed production-brief account of Ovaprim, ovotide and induced breeding.

Unit - V

Development of new techniques for aquaculture cryopreservation techniques for sperms-Application of remote sensing in conservation of management of fish faunal diversity-vaccines for aquaculture-Identification of Bacterial and viral pathogen.

References:

1. Fisheries research planning and Management in developing countries- V.R.P.Sinha- International Books and Periodicals services (IBS)-New Delhi.
2. Live feeds in Marine Aquaculture-L.A.McEvoy and J.G.Stottrup-Blackwell publishing company, UK.
3. Aquaculture Principles and Practices-T.V.R.Pillay, Fishing News Books, USA.
4. Fish and fisheries of India-V.G.Jingran-Hindustan publishing Corporation,Delhi.
5. Biology of finfish and shellfish-SCSC publishers-Howrah.
