

BHARATHIAR UNIVERSITY: COIMBATORE

M.Sc., ZOOLOGY DEGREE COURSE (COLLEGES - CBCS PATTERN)

SCHEME OF EXAMINATION

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

Semester	Subject and Papers		Ins. Hrs/ week	University Examinations				Credits
				Dur. Hrs.	CIA	EXT	Total	
I	Paper I	Animal Physiology & Endocrinology	6	3	25	75	100	4
	Paper II	Cell & Molecular Biology	6	3	25	75	100	4
	Paper III	Animal Biodiversity	6	3	25	75	100	4
	Paper IV	Genetics	6	3	25	75	100	4
	Practical I	(Comprises of Papers I,II, & III)	2	-	-	-	-	-
	Practical II	(Comprises of Papers IV,V, & VI)	2	-	-	-	-	-
	Practical III	(Comprises of Papers VII & VIII)	2	-	-	-	-	-
II	PaperV	Biochemistry & Bioinformatics	6	3	25	75	100	4
	PaperVI	Biophysics & Biostatistics	6	3	25	75	100	4
	Paper VII	Ecology	6	3	25	75	100	4
	Paper VIII	Developmental Biology & Immunology	6	3	25	75	100	4
	Practical I	(Comprises of Papers I,II, & III)	2	4	40	60	100	4
	Practical II	(Comprises of Papers IV,V, & VI)	2	4	40	60	100	4
	Practical III	(Comprises of Papers VII & VIII)	2	4	40	60	100	4
III	Paper IX	Microbiology	6	3	25	75	100	4
	Paper X	Animal Behavior	6	3	25	75	100	4
		Elective I – Paper I	5	3	25	75	100	4
		Elective II – Paper I	5	3	25	75	100	4
	Practical IV	(Comprises of Papers IX & X)	2	-	-	-	-	-
	Practical V	(Comprises of Papers XI & XII)	2	-	-	-	-	-
		Elective I Practical	2	-	-	-	-	-
	Elective II Practical	2	-	-	-	-	-	
IV	Paper XI	Biotechnology & Genetic Engineering	6	3	25	75	100	4
	Paper XII	Bioinstrumentation & Biological Techniques	6	3	25	75	100	4
		Elective I – Paper II	2	3	25	75	100	4
		Elective II – Paper II	2	3	25	75	100	4
	Practical IV	(Comprises of Papers IX & X)	2	4	20	55	75	3
	Practical V	(Comprises of Papers XI & XII)	2	4	20	55	75	3
		Elective I Practical	2	4	40	60	100	4
	Elective II Practical	2	4	40	60	100	4	
		Total					2250	90

List of Elective papers(opted by the colleges)		
Elective – I	A	Environmental Biology Paper I – III Sem. Environmental Biology Paper II – IV Sem.
	B	Toxicology Paper I – III Sem. Toxicology Paper II – IV Sem.
Elective – II	A	Entomology Paper I – III Sem. Entomology Paper II – IV Sem.

SEMESTER – I

PAPER – I ANIMAL PHYSIOLOGY & ENDOCRINOLOGY

UNIT- I: Nutrition and Digestion:

Nutritive Requirements – Carbohydrates, proteins, lipids, Vitamins and minerals. Physiology of Digestion- role of salivary glands, liver, pancreas and intestinal glands in digestion. Absorption and Assimilation- hormonal control of digestion.

UNIT-II: Respiration and Circulation:

Respiratory organs-integument, gills and lungs. Respiratory pigments. Transport of gases- Bohr's effect, Chloride shift, Structure of mammalian heart. Heart beat- mechanism of circulation -origin and conduction of heart beat - Blood coagulation.

UNIT- III: Excretion and Osmoregulations: Structure of mammalian kidney- urine formation- acid-base regulation-Role of hormones in excretion -osmotic and ionic regulation in freshwater, marine and terrestrial organisms. Thermoregulations

UNIT- IV: Muscle and Nerve Physiology: Ultra Structure of skeletal muscle. Mechanism of muscle contraction- theories. Physico-chemical changes during muscle contraction. Structure of neuron – Origin and conduction of nerve impulse. Synaptic transmission - neuromuscular junction. Biological Clocks.

UNIT- V: Endocrine regulation and reproduction: Structure and functions of different endocrine glands of man- pituitary, Thyroid, Parathyroid, Adrenal and pancreas. Structure and functions of reproductive organs in man. Hormonal regulation of reproduction.

REFERENCE :

1. **Ganong, H**, Review of Medical Physiology, 1989. 14th edition, *Appleton & Lange publisher*, New York
2. **Fleur, and Strand, (1978)**. Physiology: A regulatory system approach, *Macmillan Publishing Company, New York; Collier Macmillan Publishers*, London.
3. **Shier, D., Butler, J. and Lewis, R., Hole's, 2003**. Human Anatomy and Physiology, (10th edition) *WCB/McGraw Hill*, Boston. 2003.
4. **EcKert, R and W.H. Freeman. 2002**. Animal Physiology, (5th edition).

5. **Williams S. Hoar (1991)** General and Comparative Physiology 3rd edition. *Prentice Hall of India*- New Delhi.
6. **Neilson, K.S., 1997.** Animal Physiology, *Cambridge University Press*, Pergamon Press, Oxford.
7. **Knut Schmidt – Nielsen, 2005,** Animal Physiology, 5th Edition, *Cambridge University Press*.
8. **Barrington, E.J.W. (1975):** An Introduction to General & Comparative endocrinology 2nd ed., *Clarendon press*, Oxford.
9. **Williams, R H. 1981.** Text book of Endocrinology, Ed. 6th W. B. Saunders Company, Philadelphia, London.
10. **De Groot. 1979.** Endocrinology, Vol. 1-3, Grune and Stratton, New York.
11. **Astwood, E. B. 1968.** Clinical Endocrinology, Grune and Stratton, New York.
12. **Bondy P.K. and Rosenberg L.E. 1974.** Duncan's disease of Metabolism – Genetics, Metabolism and Endocrinology. W. B. Saunders Co., Philadelphia, London.

PAPER II - CELL AND MOLECULAR BIOLOGY

Unit – I

Prokaryotic and eukaryotic cells. Plasma membrane – models and functions. Nucleus: ultra structure and Function. Cell division: mitosis and meiosis.

Unit - II

Ultra structure, types and functions of Ribosomes, Endoplasmic reticulum, Golgi complex, Mitochondria and Lysosome.

Unit - III

Chromosomes – structure and types. **DNA** - Watson and Crick model of double helix, different forms of double helix – A, B & Z forms. **DNA replication:** types, enzymology and mechanism of semi-conservative mode of replication.

Unit-IV

RNA structure and functions of rRNA, tRNA, and mRNA. Protein synthesis - Transcription, translation and post translation modifications.

Unit-V

Regulation of the Eukaryotic cell cycle, Cell birth, Lineage and cell death. Biology of aging. Cancer/ oncogenes, Cell markers, Cellular morphology, Kinetics of cell growth, Stem cell culture, embryonic stem cells and their applications.

REFERENCE:

1. De Robertis ED P *et al* 1987 Cell and Molecular Biology
2. Alberts B *et al* 1986 The molecular biology of the cell
3. Watson J D *et al* 1987 Molecular Biology of the Gene

PAPER III – ANIMAL BIODIVERSITY

UNIT I

Biodiversity and species concept

Components of Biodiversity – Ecosystem, Genetic and Species diversity
Species Concept – Biogeography and Speciation; Principles of Taxonomy

Animal Diversity

Animal – Distribution, Population inventory, Species richness (Dominance)
Biodiversity Hot spots – Mammals, Birds, Reptiles, Amphibians, Fishes and Invertebrates of Western GHAT region
Indo – Burma regions
Domestic Animals of India –cattle, birds, carnivores like dogs and cat

UNIT II

Loss of animal Diversity (Extinctions)

Past rate of Extinctions – Geological
Island biogeography and extinction rates of islands – Island Fauna
Human induced extinctions – Habitat loss, Degradation, Fragmentation, Population reduction, Threats

Status of Species

Isolated species – Rate, Endemic and Threatened towards extinctions
Wild species – Measurement, IUCN Red list of Indian wild life

UNIT III

Conservation Biology

Case Studies – In situ and Ex situ conservation of Indian animals
Population management – Project Tiger and Elephants;
Communities and Conservation – People participation; Success and failures of conservation action.

Tools in Conservation

Wild life data (Statistics) and methods of interpretation
Wild life maps
Remote sensing in wild life and study of Landscape
Human demography – PVA, CAMP

UNIT IV

Animal Laws and Policies in India

Protected area network Programme
Forest Policy
SPCA Act

Economics of Bioconservation

Convention on biodiversity: Objectives, principles, use of terms in situ and ex situ conservation, sustainable use of components
Convention on International Trade in endangered species – principles, regulation, exemption, signatories
Negative list of exports – Animals only
Zoo policy

Economics of biodiversity conservation

UNIT V

Conservation Education

Wild life / Animal Magazines

Writing of Popular and Scientific articles on conservation

Information on wild life – Mass media

Conservation awareness

Wild life celebration days – Games on the conservation of Wild life global programmes on Nature and Environment

Biotechnology in conservation

REFERENCES:

1. Glimpses of Biodiversity- B.Blosetti.
2. Environmental biodiversity- P.R.Yadav
3. Biodiversity of microbial life- Stanely Reysenbach
4. Ecology & Env. Biology Sathyanarayana Books & Allied (P) Ltd

PAPER IV - GENETICS

Unit:I

Mendalism

Biography of Mendel and his experiments with pea plant

Law of Segregation :Monohybrid cross, back and test cross, Dominance and Recessive, Co-dominance and Incomplete dominance.

Law of Independent Assortment

Dihybrid crosses in *Drosophila*, back and test cross.

Unit II

Sex determination

Chromosomal theory of sex determination, Environment and Sex determination. Hormonal control of sex determination (free martin) Gynandromorphs / Intersexes, Supersexes in *Drosophila*. Sex differentiation and dosage compensation.

Gene Mutation

Definition , Types of mutations, Physical & Chemical Mutagens, Measurement of mutation rate in Bacteria, *Drosophila* and Human. Types of gene mutations.

Reverse mutation in bacteria, insects and human.

Unit III

Inheritance

Gene concepts classical theory – Modern theory

Multiple alleles – blood group inheritance

Extra chromosomal inheritance.

Genetic recombination

Types of recombination, molecular events during recombination

Genetic recombination in Bacteria (Transformation, conjugation, transduction, episomes and plasmids.)

Unit IV

Mapping of chromosomes

Eukaryotic, Bacterial, Viral, Bar loci, Complex locus and complementation mapping.

Gene Regulation

Operon concept – The repressor, operator and promoter genes. Developmental genes – control of gene expression and sequential gene expression in eukaryotes.

Unit V

Chromosomal aberrations

Numerical and Structural aberrations. Evolutionary significance of chromosomal aberrations.

Extra Chromosomal Inheritance / Cytoplasmic Inheritance.

Cancer Genetics

Regulation of mitotic cell cycle in eukaryotes and intercellular communication in multi cellular eukaryotes. Properties of cancer cells. Proto oncogenes, Oncogenes, Cellular oncogenes, Tumor suppressor genes, Viral oncogenes.

REFERENCES:

1. Mitra Sardhya 1994 Genetics
2. Stickberger 1974 Genetics
3. Gardiner E J *et al* 1984 Principles of Genetics
4. Sarin C 1985 Genetics
5. Dobzhansky Th 1969 Genetics and Origin of species
6. Hart D L Population Genetics

SEMESTER - II
PAPER V - BIOCHEMISTRY AND BIOINFORMATICS

Unit I Classification, structure and metabolism

Carbohydrates: Glycolysis, Glycogenesis, Glycogenolysis, Glyconeogenesis, TCA cycle, Cori cycle.

Proteins: Deamination, Transamination, Amino acid synthesis.

Lipids: Lipolysis, Beta oxidation, Steroidogenesis

Unit II Nucleic acids

Structure and Synthesis. Degradation of Purines and Pyrimidines.

Enzymes, Isoenzymes and co-enzymes

Classification

Mechanism of action

Significance

Unit – III Vitamins

Fat soluble and water soluble vitamins-structure and function. Coenzymes and their structures. **Antibiotics**-Structure and functions of Pencillin, Streptomycin and Chloromycetin

Unit IV Bioinformatics

Introduction to Bioinformatics: Overview, Internet and bioinformatics, Applications.

Databases: Various biological databases, Protein and Nucleotide sequence data bases. Protein sequence, structure and Classification of databases.

Unit V Gene prediction

Gene prediction methods: Signal sites Predictions.

Protein Computational Biology - Structural classification of proteins.

Protein structure prediction, Active site prediction, Protein modeling and drug design.

REFERENCE:

Biochemistry

1. Stryar.L. 1988 Biochemistry
2. Lehnigar. A.L. 1982 The Principles of Biochemistry
3. Abraham Mazur. 1966 Text Book of biochemistry.
4. Voet.D & Voet.J.G. 1997 Biochemistry
5. Hawk 1996 Practical Physiological Chemistry
6. Garrett.R.H. *et al* 1996 Biochemistry

Bioinformatics

1. Yaswant Khanitkar 1992 Computer Languages
2. Christopher Cavanaugh 2001 Computer Hints & Tips
3. Bipin C Desai *et al* 1999 Database Management
4. Mani.K & Vijayaraj.N. 2001 Bioinformatics.

PAPER VI - BIOPHYSICS AND BIO STATISTICS

Unit I Bioelectricity

Membrane, Resting and action potential. Ionic distribution and membrane potential, Recording of action potential.

Radiation

Electromagnetic radiation. Laws of light absorption - Beer Lamberts law, Biological applications of X-rays, infra red rays, Ultra violet rays.

Unit –II Bioenergetics

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

Unit – III Biological data

Source, Collection – Classification – Tabulation, Diagrammatic representation. Frequency curves, Frequency Polygon, Ogive.

Measurements and variables

Central tendency, Arithmetic mean – Median – Mode
Dispersions, Deviations, Co – efficient of variance.
Standard Deviations and standard Error.

Unit IV Test of Samples

Sampling, distribution of samples and sampling errors.
Student “t” test, Chi – square test, f test, ANOVA one way and two way.

Unit V Correlation & Regression

Types, Karl Pearson’s co – efficient
Calculation of regression co – efficient and Significance test.

Probability

Definition, Types, Additional and Multiplication theorems.

REFERENCE:

Biophysics

1. Giese. A.C. 1969 Cell Physiology
2. Casey. 1993 Biophysics
3. Deb.A.C. 1983 Fundamentals of biochemistry.

Biostatistics:

1. Gupta S P Statistical Methods Chand & Co, Delhi.
2. Sokal R R & Rohlf F J Biostatistics Freeman, San Francisco
3. Snedecor G W & et al Statistical Methods East-West Press, Delhi.
4. Zar J H Biostatistical Analysis Prentice Hall, London.
5. Shiv Kumar Practical Statistics Chand & Sons, Delhi.
6. Rama Krishnan P Biostatistics Saras Pub., Nagarcoil.

PAPER VII - ECOLOGY

Unit I

Ecosystems and Habitat Ecology

Aquatic – Fresh water, Marine, inter tidal, Rocky, Muddy sandy – deep sea – Estuary – Terrestrial – grass land, desert & forest. Energy flow in an ecosystem Remote sensing techniques.

Unit II

Community Ecology

Organization, Stratification – Community stability. Food chain, Food Web, Ecological pyramids, Ecological Succession, Eutrophication, ecological niche, ecotone, biological magnification.

Unit III

Population Ecology

Population measurements, Growth, Fluctuations, Cycle and Equilibrium. Intraspecific and interspecific relationships.

Factoral Ecology

Physico – chemical factors – Light, Temperature, Salinity and Oxygen. Biogeochemical cycles – Water, Nitrogen, Carbon, Sulphur and Phosphorus.

Unit IV

Natural resources

Types of resources – Mineral, Forest, Agriculture, Wild life and Fishery resources. Principles of conservation, Management of natural resources, Afforestation, Wild life Management, Fresh water fish culture.

Unit V

Pollution Ecology

Sources, effects and control of Air, Noise, Water, Land, Thermal and radioactive pollutions.

REFERENCE:

1. Odum, E. Fundamentals of Ecology W.B. Saunders, London.
2. Clarke, S. Ecology
3. Krebs, C.J. Ecology
4. Pielon, E.C. Population and Community Ecology
5. Knight, F. Concept of Ecology. Kings Pub. Co. Victoria.
6. Dash.M.C. Fundamentals of Ecology.
7. Batschelet E Introduction to mathematics for life Scientists Springer-Verlag, Berlin
8. Sokal R R & Rohlf F J Biometry Freeman, San Francisco
9. Jorgenson S E Fundamentals of Ecological Modeling Elsevier, New York.

PAPER VIII – DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

UNIT I

Fertilization

Theories of fertilization,
Process and significance of fertilization
Artificial insemination
Collection and cryopreservation of gametes & embryos
Embryo transfer technology
Invitro fertilization
Induced ovulation
Teratology – causes types & events

UNIT II

Embryonic nutrition

Yolk utilization
Types of placenta, Placental hormones
Physiology of placenta
Hormonal control of pregnancy and lactation

Induction and Organizer

Nature of induction and organizer
Physiology of induction
Experiments on inductions
Nucleoplasmic interactions

UNIT III

Outlines of Immunology

Basics of immunity – Types of immunity – Lymphoid organs – Structure and types of Immune system.
Immunoglobulin – Structure, biological properties and functions

UNIT IV

Cells, tissues and organs of immune system

Primary and secondary lymphoid organs structure and their functions.
Cells of Immune system: Their maturation, activation, differentiation and functions.

Types of Immunity:

- a. Innate immunity
- b. Humoral immunity: Antigen their types; adjuvananes, epitopes as antigenic determinants; Process of antigenicity.
Antibodies (Immunoglobulins) classes and structure, Antigen and Antibody interations.
Theories of antibody formation.
- c. Cellular immunity: Major and minor histocompatibility (MHC) complexes: HLA system; clinical significance of MHC & HLA

UNIT V

Immunoresponse and its regulation

Primary and secondary immunoresponse.

Immunocompetence of embryo

Hypersensitivity I, II, III & IV types with suitable examples.

Transplantation immunity – skin graft rejection

Immunoresponse to tumour antigens

Immunodiagnostic assays – ELISA, RIA; Vidal tests and their applications.

Vaccines: Types; preparation; Active and passive immunization

REFERENCE:

Development biology and Experimental Embryology

1. Balinsky B L 1970 An Introduction to Embryology
2. Reven Ch P 1858 Morphogenesis
3. Barth L G 1959 Embryology
4. Reven Ch P 1959 An outline of developmental Physiology
5. Rugh R 1952 Experimental Embryology
6. Robert *et al* 1957 Experimental in developmental biology

Immunology

1. Pawar *et al* 1984 General Microbiology
2. Roitt I 1986 Essential Immunology
3. Boyd W C 1981 Fundamental of Immunology
4. Wieser R S *et al* 1971 Fundamentals of Immunology

PRACTICAL – I

Animal Physiology & Endocrinology :

1. Determination of the rate of activity of salivary amylase (Human saliva) activity by titration method.

Ptyalin Activity in relation to temperature and calculation of Q10.

Ptyalin activity in relation Ph and calculation of Q10.

Recording of diastolic and systolic pressure during, standing, sitting & lying posture.

2. Biological responses of animals to various osmotic concentrations and their effects.

a. Change in weight of Earthworm in heterosmotic media.

b. Pattern of osmotic responses of crab in heterosmotic media.

c. Active uptake of Na⁺ and Cl⁻ of a fish from the environmental water and change in salinity.

3. Determination of the specific gravity of the blood of a vertebrate animal-by copper sulphate method.

4. Effect of temperature on the Oxygen consumption of fish and calculation on Q10.

Molecular Cell Biology:

1. Mounting of Polytene chromosome from the salivary gland of Chironomous Larva.

2. Squash preparation of testis of grasshopper to study the stage of Meiosis.

3. Isolation of DNA and RNA from an animal tissue (Demonstration only)
4. Study of different cells from the vertebrate animal. (Brain, Liver, Gonad, Kidney and Muscle)

Animal Biodiversity

1. Fossils Characteristics and identification of,
 - a) A Coelenterate
 - b) A Molluscan
 - c) An Echinoderm and
 - d) A Vertebrate.
2. Measurement of Biodiversity in a Terrestrial and an Aquatic Ecosystem.

Visit to Zoological parks, wildlife sanctuaries and biosphere reserves.

PRACTICAL – II

Genetics:

1. Genetic characteristics of a class room sample. Finger print, ear lobe, tongue rolling, mid digital hairs, widow's peak, inward bending of little finger.
2. Culture of Drosophila and identification of mutant characters. (from the given sample).
3. Blood Grouping of man to study multiple allelism and inheritance.

Biochemistry :

1. Qualitative and quantitative estimation of Carbohydrates, Proteins and Lipids from the given samples.
2. Preparation of Haemin crystals.
3. Quantitative estimation of Haemoglobin.
4. Separation of plasma, Serum and cells from blood.
5. Colorimetric estimation of glucose from blood

Bioinformatics:

1. Use of excel sheet for data processing.
2. Acid and protein sequence databases.

Biostatistics:

1. Construction of (a) Frequency polygon (b) Histograms from the Data given (The basic data may be from any material available around)
2. Calculation of (a) Standard deviation and (b) Correlation and (c) Student's test from the given data.

Biophysics:

1. Determination of viscosity of the given liquid (Ostwald's Method)
2. Determination of Glucose content of a given sample. (Calorimeter method)

PRACTICAL – III

Ecology:

1. Water analysis and estimation of the following parameters:
a. Calcium b. Magnesium c. Phosphate d. Silicate e. Nitrate
2. Quantitative analysis of Planktons (Fresh water / Marine)
3. Identification of Marine and Freshwater Plankton from the slides.
4. Effect of salinity on oxygen consumption of fish.

Developmental biology:

1. Induced Ovulation in Frog (Demonstration only)
2. Effect of Thyroxin on the growth of tadpoles. (Demonstration only)
3. Study of Embryonic developmental stages (Frog and Chick)

Immunology:

1. Study of Antigen and Antibody reaction through the study of Blood grouping.
2. Study of Rh factor through the study of Blood grouping.

A study tour to various places of ecological importance is essential. A tour report should be submitted along with the record.

SEMESTER - III

PAPER IX - 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.

PAPER X - ANIMAL BEHAVIOUR

UNIT: 1

Introduction and causes of behavior

1. Adaptive value of behaviour
2. Habituation and conditioning
3. Instinct versus learning
4. Circadian and circannual rhythms

UNIT: II

Communication and Programmed Behaviour

1. Visual communication – Dance language of honey bee; Mating dance of birds.
2. Auditory (Sound/Vocal) communication – songs of birds and sounds of mammals.
3. Chemical communication – Pheromones of insects; Pheromones of mammals
4. Migration of fishes and birds; Navigation, animal orientation and echolocation.

UNIT: III

Introduction to Sociobiology

1. Social behaviour – habitat selection; dominance hierarchy
2. Territoriality; Aggregation; Social competition; Aggression and cannibalism
3. Social training – Schooling in fishes; flocking in birds; societies in primates.

UNIT: IV

Reproduction Behaviour

1. Mating – Selection and mate choice
2. Dance, courtship and natal behaviour in mammals
3. Parental care – in fishes; in birds and in mammals.

UNIT: V

1. Hormonal control of animal behaviour
2. Human behaviour – Neuronal control; mania; excitement and depression; schizophrenia; Alzheimer disease.
3. Genetic and environmental components of behaviour;

REFERENCES

1. Alcock, J. 1984; Animal behaviour: An evolutionary approach. Sinaeur Associates Inc. Publ.
2. Sunderland, Messa. USA.
3. Bradbury, J.W., and S.L. Vehrencamp. Principles of animal communication SinaeurAssociates Inc. Publ. Mass. USA.
4. Drickamer and Vessey. Animal behaviour concepts, processes and methods. Wardworth Publ.
5. Eibl-Eibesfeldt, I. 1970. Ethology: The biology of behaviour; Holdt, Reinhardt and Winston, New York.
6. Gould, J.L. 1982. Ethology: The mechanism and evolution of animal behaviour. W.W. Norton and Company, NY., London.
7. Chandrasekaran, M.K., G. Fleissner and G. Neuweiller, 1987. Animal Behaviour; Bask
8. experiments in Neurophysiology, Macmillan, India.
9. Eckert, R.D. Randall and G. Augustine. 1988. Animal Physiology; Mechanisms and adaptations. III. Eds. W.H. Freeman and Company, N.Y.
10. Hauser, M. The evolution of communication. MIT Press, Cambridge, Massachusetts, USA.
11. Hinde, R.A. Animal behaviour; A synthesis of Ethology and comparative psychology. Mc Graw-Hill, New York.
12. Krebs, J.R. and N.B. Davis. 1987. An introduction to behavioural ecology; Blackwell Scientific Publications, Oxford.
13. McFarland, D. 1985. Animal behaviour; Psychobiology. Ethology and Evolution, Pitman Publ. Ltd., London.
14. Mekeon, B.A. 1984. Fish migration, Chapman and Hall, London.
15. Strickberger, H.W. 1985. Genetics. III Ed. Macmillan, New York.
16. Wilson, E.O. 1978. Sociobiology: The new synthesis: President and Fellows of Harvard college, USA.
17. Wittenberg J.F. 1981. Animal social behaviour. Duxbury Press, Boston.

ELECTIVE I – ENVIRONMENTAL BIOLOGY – I

UNIT I

Atmosphere

Composition

Structure

Climatic factors

Interaction of ecological factors

Temperature and Plant distribution

Atmospheric pressure

Winds and air masses

Humidity and rain fall

UNIT II

Hydrosphere

Realms of water

Hydrological cycle

Physico-chemical aspects – rivers, estuaries, mangroves and seas

Freshwater (soft and hard)

Ecological groups of organisms and their adaptations

(Xerophytes and Xerocoles; Mesophytes and mesocoles; Hydrophytes and hydrocoles)

UNIT III

Lithosphere

Land forms

Soil formation

Components of soil

Physico-chemical properties of soil

Major soil types of India

Soil erosion (degradation)

UNIT IV

Natural resources

Types of resources – Mineral, Forest, Agriculture, Wild life and Fishery

Principles of conservation

Management of natural resources

Afforestation

Wild life management

Fresh water fish culture

UNIT V

Energy and Environment

Concept of energy

Types and sources of energy

Energy in the environment

Productivity in the environment

Measurement of Primary Production
Uses of Primary production to Man

REFERENCE::

1. Odum E 1969 Fundamentals of Ecology
2. Prosser E L 1978 Environmental and Metabolic Animal Physiology

ELECTIVE I – TOXICOLOGY I

Unit- I INTRODUCTION AND SCOPE

Introduction – Scope of Toxicology. Disciplines of Toxicology. Goals of Toxicology.

Unit II TOXICOLOGICAL TESTING METHODS

Acute and chronic , Risk and Hazard, Bioassays. Determination of LC50.

Unit III CLASSIFICATION OF TOXICANTS

Pesticides- Types – Uses – Contamination to Environment. Heavy metals. Radioactive substances.

Unit IV ROUTE OF EXPOSURE

Absorption – Distribution – Excretion . Factors affecting toxicity of Xenobiotic chemicals.

Unit V PERSISTENCE OF TOXICANTS

Fate of Pesticideresidues. Fate of heavy metals. Fate of toxicants in the atmosphere.

ELECTIVE II – ENTOMOLOGY I

UNIT I

Class Insecta

Classification up to order with example for each order

Identification of insects using keys

Insect Collection

Methods

Preservation

Significance

UNIT II

Comparative Morphology

Head

Thorax

Abdomen
Appendages
Functional Morphology
Mouthparts
Genitalia (male, female)

UNIT III

Structure and Physiology

Digestive system
Respiratory system
Circulatory system
Excretory system
Nervous system
Sense organs
Reproductive system

UNIT IV

Integument

Structure
Chemistry
Synthesis of chitin
Sclerotisation
Tanning

Growth

Insect growth
Metamorphosis and its control

UNIT V

Insect Endocrines

Endocrine Glands
Hormones and Neurohormones – their functions

Insect adaptations

Adaptations to environmental stress
Diapauses
Pheromones
Insect flight

Reference

1. Imms 1986 Textbook of Entomology
2. Snodgrass 1983 Insect Morphology
3. Chapman 1973 Insect Structure and Morphology
4. Wigglesworth 1969 Insect Physiology
5. Alka Prakash 1996 Applied Entomology
6. Ramakrishan Iyer 1989 South Indian Insects
7. Vasantharaj David 1983 Economic Entomology
8. Dennis 1986 Entomology

SEMESTER – IV

PAPER XI – BIOTECHNOLOGY & GENETIC ENGINEERING

Unit I

Gene Transfer Methods and Transgenic Organisms

Gene Transfer Methods in Animals – Transgenic animals. Application and Perspectives – Ethical issues. Molecular probes and their applications in diagnosis of human diseases. Somatic cell hybridization – mechanism and applications.

Unit II

Recombinant DNA Technology

Recombinant DNA – cloning and PCR.

Restriction enzymes for Cloning – Techniques used in Recombinant DNA technology – Cloning Vectors for Rdna – Construction of Chimeric DNA – other Cloning Approaches – Molecular probes – Construction and Screening of Genomic Libraries.

Unit III

Isolation, Syntheses and Sequencing of Genes

Isolation of genes – using DNA and RNA Probes; Synthesis of genes – Non PCR Methods of Sequencing of genes

Gene Therapy: Types of Gene Therapy- *Exvivo* and *In vivo*.

Unit IV

Industrial Biotechnology

Designing of Bioreactors – Formulation of medium – Isolation of Microorganisms – Selection of Microorganisms

Fermentation Products – Production of amino acids, alcohol, organic acids, antibiotics and alcoholic beverages.

Unit V

Environmental biotechnology

Biotechnological methods of pollution control- biological treatment of waste water- biotechnology for solid waste treatment-microbial bioremediation of polluted environment- bioleaching and biomining for recovery of resources.

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1. Bellanti, J. 1985. Immunology. W.B. Saunders., W.B. Saunders, Co. Philadelphia
2. Coggle, J.E. 1983. Biological effects of radiation. II Ed. Taylor and Francis Ltd.,
3. Dubey, R.C. 2002. A text book of biotechnology. S. Chand and Company Ltd., New Delhi.
4. Gabriel Melchias, 2001. Biodiversity and conservation, Oxford IBH Publ. Co. Pvt. Ltd, New Delhi, Calcutta.
5. Glazer, A.N. and Hiroshi Nikaido, 1995. Microbial biotechnology: Fundamentals of Applied
7. Biotechnology, W.H. Freeman and Company, New York.

8. Gupta, P.K. 2003. Elements of Biotechnology, Rastogi Publ. Meerut.
9. Rao, C.V. 2002. An introduction to immunology, Narosa publishing House, New Delhi.
10. Leisinger, T. Cook, D.M.J. Meusch and Hutter, 1981. Microbial degradation of xenobiotics
11. and Recalcitrant compounds, Academic Press, London.
12. Maniatis, T.E., J. Fritsch and J. Sambrook. 1989. Molecular cloning II Ed. Cold Spring
13. Harbor, New York.
14. Marx, J.L. 1989. A revolution in Biotechnology, Cambridge Univ. Press., Cambridge.
15. Rigby, P.W.J., 1987. Genetic Engineering, Academic Press, London.
16. Stewart-Tull, D.E.S. and M. Sussman. 1992. The release of genetically modified and
17. microorganisms REGEMM, Plenum Press, N.Y.
18. Susoman, M.C.H. Collins and F.A. Skinner. 1988. The release of genetically engineered
19. microorganisms, Academic Press, London.
20. Swaminathan, M.S. and Jana. 1992. Biodiversity: Implications for global food security,
21. Macmillan, Madras.
22. Tizzard, I.R. 1995. An introduction to immunology. IV Ed. Saunders College Publ. New York, Tokyo.
23. Upadhyay, A.K. Upadhyay and Niramalendu Nath., 2004. Biophysical chemistry; Principles
24. and Techniques, Himalaya Publ. Mumbai, Delhi.
25. Wiseman, A. 1983. Principles of Biotechnology, Chapman & Hall, New York.

PAPER XII – BIOINSTRUMENTATION & BIOLOGICAL TECHNIQUES

UNIT I

Microscopy – Light microscope, Interference microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope (TEM & SEM).

Centrifugation – Bench top centrifuge, refrigerated centrifuge and ultra centrifuge.

Electrochemical techniques – Principles of electrochemical techniques, redox reactions, Ph meter. Spectrophotometry - visible and UV spectrophotometry. Atomic Absorption Spectrophotometer.

UNIT II

Chromatographic techniques – Principles of chromatography,

Ion exchange and affinity chromatography. High performance liquid chromatography (HPLC), Gas liquid chromatography (GLC), Thin layer chromatography (TLC), Paper chromatography.

Electrophoresis - General principles, Electrophoresis of proteins: SDS-PAGE , Isoelectric focusing, cellulose acetate electrophoresis, immunoelectrophoresis

UNIT III

Southern blotting, Western Blotting, DNA finger printing techniques.

Biosensors and Biochips – Principle and application.

Hybridoma technology – production and applications of monoclonal antibodies.

UNIT IV

Radio isotope techniques – The nature of radioactivity, detection and measurement of radioactivity: detection based on gas ionization- Geiger Muller counter- principles and applications. Liquid Scintillation counter-principle and applications. Applications of radio isotopes in biological sciences. Autoradiography.

UNIT V

Flowcytometry, Cell separation techniques.

Cell culture techniques and cell proliferation measurements.

ELISA, RIA, Vidal and their applications.

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1. Bellanti, J. 1985. Immunology. W.B. Saunders., W.B. Saunders, Co. Phiedelphia
2. Coggle, J.E. 1983. Biological effects of radiation. II Ed. Taylor and Francis Ltd.,
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13. Marx, J.L. 1989. A revolution in Biotechnology, Cambridge Univ. Press., Cambridge.
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15. Stewart-Tull, D.E.S. and M. Sussman. 1992. The release of genetically modified and
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23. York, Tokyo.
24. Upadhyay, A.K. Upadhyay and Niramalendu Nath., 2004. Biophysical chemistry; Principles and Techniques, Himalaya Publ. Mumbai, Delhi.
25. and Techniques, Himalaya Publ. Mumbai, Delhi.
26. Wiseman, A. 1983. Principles of Biotechnology, Chapman & Hall, New York.

ELECTIVE II –ENVIRONMENTAL BIOLOGY II

UNIT I

Air Pollution

Air pollutants

Chemistry of air pollutants

Sources

Effects on the environment – Acid rain, Green house effect

Effects on the living organisms including man

Control methods of air pollution

UNIT II

Water pollution

Water pollutants

Types of water pollutants

Sources

Effects on the environment

Effects on the living organisms including man

Riverine pollution

Marine pollution

Control methods of water pollution

UNIT III

Soil, Noise, Thermal and Radioactive Pollution

Solid waste pollution – their effects on the environment, organisms including man

Solid waste management

Sources of noise – their effects on the environment, organisms including man

Thermal and radioactive pollution – their effects on the environment, organisms including man

UNIT IV

Toxicology

Classification

Scope and significance

Toxicants and toxicity

Toxicological testing methods

UNIT V

Environment quality, awareness and management
Ecoindicators and the environment
Bioindicators and the environment
Environmental Education and Awareness
Environmental monitoring and impact assessment

REFERENCE:

1. Odum E 1969 Fundamentals of Ecology
2. Prosser E L 1978 Environmental and Metabolic Animal Physiology

ELECTIVE I – TOXICOLOGY II

Unit I ENVIRONMENTAL TOXICOLOGY

Toxicants in the Environment – Atmosphere- Ozone Depletion- Photochemical smog, Acid rain, Global warming- Hydrosphere- Eutrophication- Lithosphere- Biodegradable wastes.

Unit II EFFECT OF XENOBIOTICS

Mechanism of action of Toxicants. Bioaccumulation. Biotransformation and Biomagnification.

Unit III SPECIFIC TOXICITY TESTS

Teretogenesis and Teretogenecity evaluation. Mutagens and Mutagenecity evaluation. Carcinogens and Carcinogenecity evaluation.

Unit IV BIOMONITORING OF TOXIC CHEMICALS

Biological monitoring programme. Bioindicators- microbialsystem, plants, animals and human systems.

Unit V SAFETY EVALUATION OF TOXICANTS

Risk management- Risk assessment- Creteria for Safety Evaluation. Upper and lower confidence limits – Cumulative toxicity. Calculation of safe level.

ELECTIVE II - ENTOMOLOGY II

UNIT I

Interaction of Insects

Social Insects – Termite, Honey and Ant

Social americana on

Caste differentiation

Social behaviour

Insect – Plant interaction

Insect vector – Host

Bionomics and control measures

a. Locusta migratoria – Polyphagus grasshopper

b. Odontotermis obesus – Polyphagus termite

c. Heliothis armigera

d. Spodoptera litura – Polyphagus caterpillar

e. Oryctus rhinocerus – Coconut beetle

UNIT II

Biology and Control measures of Insect pests

Cash crops – Cotton and sugarcane

Storage grains – Paddy, Wheat and Flour

Insect control measures

Chemical

Physical

Mechanical

Cultural

Biological

UNIT III

Insect Vectors

Systematics, Biology and Control measures of Insect vectors of Human diseases

Flies – Anopheles, Culex and Aedes; Musca domestica

Roaches and bugs – Periplaneta americana and Cimex indicus

Insects of Commercial Importance

Honey Bee – types and the differences in nest building, social behaviour and production of Honey.

Silk Moth – types and the differences in life cycles and production of silk

Lac Insect – Indian type only

UNIT IV

Insect Toxicology

Principles and Scope

Chemistry and mode of action of the Insecticides

Inorganic compounds

Organochloride compounds

Organ phosphorus compounds

Carbomates
Botanical Insecticides

UNIT V

Insects and Modern chemicals

Growth regulatory compounds

Microbial insecticides

Pheromones and pest control

Insecticides

Formulation

Application technology

Mechanism of Insecticide resistance – Genetical, Physiological and Biochemical.

Reference

1. Imms 1986 Textbook of Entomology
2. Snodgrass 1983 Insect Morphology
3. Chapman 1973 Insect Structure and Morphology
4. Wigglesworth 1969 Insect Physiology
5. Alka Prakash 1996 Applied Entomology
6. Ramakrishan Iyer 1989 South Indian Insects
7. Vasantharaj David 1983 Economic Entomology
8. Dennis 1986 Entomology

PRACTICAL – IV

Microbiology:

1. Sterilization – Principles and methods.
2. Media preparation – Liquid and Solid media, Agar deep , slant and plate.
3. Pure culture techniques – Streak plate, pour plate, spread plate.
4. Identification of Gram positive and Gram negative bacterial strains.
5. Enumeration of microorganisms from soil.
6. Water quality analysis – MPN.
7. Isolation of microorganisms from spoiled foods – Meat, milk, Cereals and Bread.
8. Milk quality – Dye reduction test.

Animal Behaviour:

1. To study the geotaxis behaviour of earthworm.

PRACTICAL - V

Biotechnology:

1. Fermentor Design and Working Principle
2. Organic acid Production -- Citric acid (solid state or submerged).
3. Production and assay of extra cellular enzyme – Protease—submerged.
4. Wine Production.
5. Antibacterial sensitivity test.
6. Isolation and estimation of DNA & RNA (Demonstration Only)
7. Preparation of tissue culture medium
8. Preparation of single cell suspension from spleen and thymus.
9. Cell counting and viability

Biological techniques:

1. Microtomy and histochemistry – Preparation of slides and staining technique (Demonstration only).
2. Separation technique of amino acids using paper chromatography. (Demonstration only).
3. Separation of Proteins on gel electrophoresis. (Demonstration only)
4. Study on the Principles of the Instruments and their uses.
 1. pH Meter.
 2. Colorimeter
 3. Spectrophotometer.
 4. Electrophoresis apparatus.

ELECTIVE I PRACTICAL– ENVIRONMENTAL BIOLOGY

I. Analysis of water – Determination of:-

Pond/Pool water, Canal/River water, Sewage water

1. pH
2. Total dissolved solids
3. Turbidity / light penetration
4. CO₂ and O₂
5. Hardness (Temporary and permanent)
6. Sulphates and sulphites
7. BOD and COD (Demonstration only)

II. Analysis of soil – Determination of:-

Clayey soil, Sandy soil, Garden soil / Red soil

1. Soil Moisture
2. Chlorides
3. Sulphates

4. Nitrates
5. Total Phosphates
6. Total organic matter
7. Humous
8. Chlorophylls and Phaeopigments

III. Biological analysis (Spotters)

1. Qualitative analysis of organisms (Pollution indicator) such as diatoms / algae, flagellates, ciliates, planarians, Annelids, Rotifers, Insects and their larvae.
2. Biological analysis of sewage water and industrial effluent

Field study

1. Detailed study of Pond / Pool ecosystems
 - a. Physico-chemical parameter
 - b. Qualitative and Quantitative analysis of plankton
2. Study of an industrial effluent

Field trips

1. Visit to – Drinking water treatment plant; Industrial effluent treatment plant; Pollution control lab.

Submission at the time of Practical Examination

1. Report on the Field study and Field trips
2. A minimum of 5 whole mounts of Planktons
3. Bonafide Record

ELECTIVET I PRACTICAL – TOXICOLOGY

1. Evaluation of Toxicity of a pollutant through LC50 at 96 hours in aquatic organisms.
2. Evaluation of Toxicity of a pollutant through LC50 at 96 hours in terrestrial organisms.
3. Determination of the effect of Temperature in the toxicity of a pollutant.
4. Determination of the effect of pH in the toxicity of a pollutant.
5. Analysis of pesticide residues by finger printing technique.
6. Effect of Toxicant on the total RBC count in the blood of fish.
7. Effect of Toxicant on the total WBC count in the blood of fish.
8. Observation of Histopathological alterations in pollutant treated animals.
9. Effect of Toxicant on the haemoglobin content of the blood of fish.
10. Estimation of Calcium, Magnesium count in the blood of fish.
11. Determination of biochemical parameters of Carbohydrates.
12. Determination of biochemical parameters of Proteins.

Spotters related to Practical.

Submission of 10 slides showing histopathology of fish.

Bonafide Records.

ELECTIVE II PRACTICAL - ENTOMOLOGY

1. Identification of Insects

- a. Key to each order
- b. One insect for each order (South Indian insects only)

2. Dissection – Digestive system, Nervous system and Reproductive system

(Any four)

Cockroach
Gryllotalpa
Nepa
Cybister
Silk moth

3. Mounting – Mouthparts, Salivary gland and Sting apparatus.

Honey bee
Cockroach
House fly
Mosquito

- 4a. Qualitative study of haemocyte in the haemolymph of cockroach
- 4b. Qualitative study of lipids, carbohydrates and proteins in the haemolymph of cockroach.
- 4c. Identification of Insect pests of the following (3 major pests in each)
 - i. Paddy ii. Cotton iii. Sugarcane iv. Vegetables v. Storage products
5. Submission – Insects (preservations)
 - a. Systematics
 - b. Pests
 - c. Medical importance
 - d. Veterinary importance
 - e. Economic importance
 - f. Insect whole mounts – 10 slides
6. Record – A complete record of the works done during the practical hours of the year should be submitted with duly bonafide certificate.
