BHARATHIAR UNIVERSITY, COIMBATORE: 641 046

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

MODIFIED SCHEME OF EXAMINATION

(For the students admitted during the academic year 2017 – 2018 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 & Environmental Nanotechnology	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 & Evolution	6	3	25	75	100	4
		Elective I – Entomology Paper I	5	3	25	75	100	4
		Elective II – Paper I **(or)** *Elective II-C Research Methodology	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 **(or)** *Elective II-C Project work	2	-	-	-	-	-
IV	Paper XI	Biotechnology & Genetic Engineering	6	3	25	75	100	4
	Paper XII	Bioinstrumentation & Biological Techniques	6	3	25	75	100	4
	Practical IV	(Comprises of Papers IX & X)	2	4	30	45	75	3
	Practical V	(Comprises of Papers XI & XII)	2	4	30	45	75	3
		Elective I – Entomology Paper II	5	3	25	75	100	4
		Elective I – Entomology Practical	2	4	40	60	100	4
		Elective II Paper II and	5	3	25	75	100	4
		Elective II – Practical **(or)**	2	4	40	60	100	4
		*Elective II-C Project work	7	-	-	-	*200	8
		Total					**2250**	**90**

List of Elective papers (opted by the colleges)		
Elective – II Choose A or B or C	**A**	Paper I - Environmental Biology Paper I – III Sem. Paper II - Environmental Biology Paper II – IV Sem. Practical Exam-IV Sem.
	B	Paper I - Toxicology Paper I – III Sem. Paper II - Toxicology Paper II – IV Sem. Practical Exam-IV Sem.
	***C**	*Theory Paper - Research Methodology – III Sem. *Research Project for 200 marks – IV Sem.

* For Elective II, if *C is opted,
*Theory Paper – Research Methodology will carry100 marks and
*For Project 200 marks (Project work =160 marks and Viva-voce =40 marks).

Project Guidelines:

1. Internal and external examiners will evaluate the project work and award marks out of 160.
2. Internal and external examiners will conduct viva-voce examination and award marks out of 40.

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SEMESTER – I

PAPER – I ANIMAL PHYSIOLOGY & ENDOCRINOLOGY

UNIT- I: <u>Nutrition and Digestion</u>:

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: <u>Respiration and Circulation</u>:

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: <u>Excretion and Osmoregulation</u>: 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: <u>Muscle and Nerve Physiology</u>: 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: <u>Endocrine regulation and reproduction</u>: 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 Medial 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 Genera& 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. Significance of crossing over - Chromosomal movement during cell division.

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

Cell signaling-Cell receptors and cell signaling molecules. Cell birth, Lineage and cell death. Apoptosis and its pathways. Biology of aging. Kinetics of cell growth, Stem cells-types,significance and 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

- Biodiversity - components, types, and significance.
- Species concept, speciation, species richness.
- Biodiversity hot spots in India – significance of Western-Ghats & Indo-Burma region.

Unit II: Indian biodiversity and Loss of animal biodiversity

- Endemic terrestrial biodiversity of India.
- Marine biodiversity of India.
- Agro biodiversity of India.
- Past rate of Extinction - Geological.
- Human induced extinction.
- Isolation of species
- Endemic and Endangered species.

Unit III: Conservation biology

- In-situ and Ex-situ conservation.
- Project Tiger, project Elephant.
- Biotechnology in conservation.
- IUCN – Red list category.
- Success and failures of conservation.
- Protected area network programme.

Unit IV: Legal aspects in biodiversity conservation

- Forest policy.
- Zoo policy.
- SPCA act.
- Legal instruments relevant to biological diversity in India.
- Animal ethics, ethical committee.
- Discontinuation of dissections in educational institutions.
- CITES.
- Convention on biodiversity.

Unit V: Future strategies for India

- Research impetus – Thrust areas in environmental research
- Strategies, opportunities and options of animal biodiversity
- Future strategy for conservation of biological diversity – Environmental awareness programmes – wild life week and days of environmental importance
- Genetically modified organisms (GMOs) - promise and danger for biodiversity.
- Institutional mechanism and modalities.

References:

1. Textbook of Biodiversity - K V Krishnamurthy, by Science Publishers.
2. Glimpses of Biodiversity- B.Blosetti.
3. Environmental biodiversity- P.R.Yadav
4. Biodiversity of microbial life- Stanely Reysenbach.
5. Ecology & Env. Biology - Sathyanarayana Books & Allied (P) Ltd.,
6. Biodiversity: An Introduction, 2nd Edition- Kevin J. Gaston, John I. Spicer, Wiley-Blackwell.
7. Agrobiodiversity - David Wood, Jillian M. Lenné, CABI Pub., Nature

PAPER IV - GENETICS

Unit:I

Mendelism

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.

Sex determination

Chromosomal theory of sex determination, Environmental sex determination, Hormonal control of sex determination (free martin), Gynandromorphs / Intersexes, Super sexes in Drosophila. Sex differentiation and dosage compensation.

Unit II

Mutation

Definition and types of gene mutations,
Physical & Chemical Mutagens,
Measurement of mutation rate in Bacteria, Drosophila and Human
Reverse mutation in bacteria, insects and human
Numerical and structural chromosomal aberrations and their evolutionary significance

Inheritance

Gene concepts classical theory – Modern theory
Multiple alleles – blood group inheritance
Extra Chromosomal inheritance/Cytoplasmic inheritance

Unit III

Genetic recombination

Types of recombination, molecular events during recombination

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

Mapping of chromosomes

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

Unit IV

Gene Regulation

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

Human genome project

Cancer Genetics

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

Unit V

Population Genetics and Speciation

Mendelian population, gene pool, gene frequency

Hardy-Weinberg law of Genetic Equilibrium

Patterns of isolating mechanism

Models of speciation (Allopatric, Sympatric & Parapatric)

REFERENCE:

1. Mitra Sardhya 1994 Genetics
2. Stickberger 1974 Genetics
3. Gardiner E J *et al* 1984 Principles of Genetic
4. Sarin C 1985 Genetics
5. Dobzhansky Th 1969 Genetics and Origin of species
6. Hart D L Population Genetics
7. Klug and Cummins. Concepts in Genetics
8. Pielon, E.C. Population and Community Ecology

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SEMESTER - II
PAPER V - BIOCHEMISTRY AND BIOINFORMATICS

Biochemistry

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 Penicillin, Streptomycin and Chloromycin

Bioinformatics

Unit IV

History and scope of Bioinformatics
Internet browsers and search engines
Biological Databases
- NCBI, EMBI, DDBJ, PDB and Genbank

BLAST and FASTA format
Sequence analysis – DNA, RNA and proteins.

Unit V

Gene prediction methods
- Sequence similarity search method
- Ab initio gene prediction method

Molecular docking and drug designing
Computational DNA sequencing techniques
- Sanger radio labeling method
- Dye terminator sequencing method

Human Genome Project
- History, techniques and applications

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

Biophysics

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, and 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.

Biostatistics

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.
Chi – square test, Student “t” test, f test, ANOVA one way and two way.

Unit V
Correlation & Regression
Types, methods of studying correlation- Karl Pearson's co – efficient
Calculation of regression co – efficient and Significance.
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 & ENVIRONMENTAL NANOTECHNOLOGY

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. Ecological pyramids, Ecological Succession, Eutrophication, ecological niche, ecotone, biological magnification.
Population ecology

Unit III
Pollution Ecology
Sources, effects and control of Air, Noise, Water, Land, Thermal and Radioactive pollutions.

Unit IV
Zoogeography and paleontology
Major terrestrial biomes
Theory of Islands
Zoogeography and Biogeographical zones in India
Dating, fossils and geological time scale

Unit V
Nanotechnology for environment
Nanomaterials for soil and ground water remediation
Uses of nanomaterials
- Nanosensors, Nanobioreactor, Nanofilters and Nanoporous materials

Environmental risks of nanotechnology
- Social justice, health issues and nanoweapons of war

Risks for the health of aquatic organisms and residual problems

REFERENCE:
1. Odum, E. Fundamentals of Ecology *W.B. Saunders,* London.
2. Clarke, S. Ecology
3. Krebs, C.J. Ecology
4. Knight, F. Concept of Ecology. *Kings Pub. Co.* Victoria.
5. Dash. M.C. Fundamentals of Ecology.
6. Batschelet E Introduction to mathematics for life *Scientists Springer*-Verlag, Berling
7. Sokal R R & Rohlf F J Biometry *Freeman,* San Francisco
8. Jorgenson S E Fundamentals of Ecological Modeling *Elsevier,* New York.
9. Mark R.Wiesner and Jean-Yves, Bottero. Environmental Nanotechnology: Applications and impacts of nanomaterials. Mc Graw Hills; New York.

PAPER VIII – DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

Developmental Biology
UNIT I Fertilization
Theories of fertilization,
Process and significance of fertilization
Induced ovulation
Artificial insemination
Collection and cryopreservation of gametes & embryos
Invitro fertilization
Embryo transfer technology
Teratology – causes types & events
Cloning-Application and ethical issues

UNIT II
Embryonic nutrition
Yolk utilization
Types of placenta, Placental hormones
Physiology of placenta
Hormonal control of pregnancy and lactation
Embryonic Induction and Organizer
Nature of embryonic induction and organizer
Physiology of induction
Experiments on induction
Nucleocytoplasmic interactions

UNIT III

Cells, tissues and organs of immune system

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

Immunology

Unit IV

Types of Immunity:

Innate immunity and acquired immunity
Humoral immunity: Antigen their types; adjuvananes, epitopes as antigenic determinants; Process of antigenicity.
Antibodies (Immunoglobulins) classes and structure and functions.
Antigen and Antibody interactions
Theories of antibody formation
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 & V 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. Experiments 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
5.Abdul K Abbas etal. 2014. Basic Immunology Elsevier Prosby Saunders

PRACTICAL – I
(Comprises Theory Papers I, II & III)

Animal Physiology & Endocrinology:
(Use any two cultured species which are not in endangered list)

1. Determination of the rate of activity of salivary amylase (Human saliva) activity.
   Ptyalin Activity in relation to temperature and calculation of Q10.
   Ptyalin activity in relation pH.
   Recording of diastolic and systolic pressure during, standing, sitting & lying posture.

2. Biological responses of animals to various osmotic concentrations and their effects **(any one experiment).**
   a. Change in weight of Earthworm in heteroosmotic media (or)
   b. Pattern of osmotic responses of crab in heterosmotic media (or)
   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 opercular movement of fish and calculation of Q10.

Cell and Molecular Biology:

1. Mounting of Polytene chromosome from the salivary gland of a selected species.
2. Squash preparation of onion root tip to study the stages of Mitosis.
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.

Field trip

Visit to Zoological parks, wildlife sanctuaries and biosphere reserves etc.

PRACTICAL – II
(Comprises Theory Papers IV, V & VI)

Genetics:

1. Genetic characteristics of a class room sample.Dermatoglyphic patterns (Finger print), ear lobe, rolling of tongue, 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. Estimation of allelic Frequency based on ABO Blood Group.

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. Nucleic Acid and protein sequence databases.

Biophysics:

1. Working principles of SEM and TEM.
2. Determination of Glucose content of a given sample. (Calorimeter method)

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 (b) Correlation and (c) Student's test from the given data.

PRACTICAL – III
(Comprises Theory Papers VII&VIII)

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.
5. Construction of ecological pyramid using plastic animal toys

Evolution

1. Study on the Homology of a group of vertebrates on the limb skeleton
2. Study of Mimicry, Colouration among animals

Developmental biology:

1.Regeneration study in Tadpole/Earth-worm
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.
3. Widal Test

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

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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 dairy 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: Genetically modified organisms in food production – 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 & EVOLUTION

UNIT: 1

Introduction to Ethology

1. Adaptive value of behaviour
2. Habituation and conditioning
3. Instinct versus learning
4. Circadian and circannual rhythms and lunar cycles
5. Analysis of behaviour patterns: taxis, kinesis and reflexes

UNIT: II

Communication and Programmed Behaviour

1. Visual communication – Dance language of honey bee; courtship behaviour 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 echolation.

UNIT: III

Sociobiology and reproductive behaviour

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.
4. Mating – Selection and mate choice
5. Dance, courtship and natal behaviour in mammals
6. Parental care in fishes, amphibians, birds and mammals.
7. Role of Hormones in parental care.

UNIT: IV

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

UNIT: IV

Origin of higher categories

Adaptive radiations in mammals
Major trends in the origin of higher categories
Mimicry and colouration
Modern evolution
Evolution in man

REFERENCES

1. Alcock, J. 2013; 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. Norten 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 Harward college, USA.
17. Wittenbergerm J.F. 1981. Animal social behaviour. Duxbury Press, Boston.

ELECTIVE I – 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
Comparative Physiology
Digestive system
Respiratory system
Circulatory system
Excretory system
Nervous system
Reproductive system

UNIT IV
Integument
Structure
Chemistry
Synthesis of chitin
Moulting
Sclerotisation
Tanning
Growth
Insect growth
Metamorphosis: types, significance and hormonal regulations

UNIT V
Insect Endocrines
Endocrine Glands
Hormones and Neurohormones –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

ELECTIVE II- A. 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
3. Verma & Agarval. 2000 Environmental Biology

ELECTIVE II-B. TOXICOLOGY I

Unit- I

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

Unit II

Toxicological Testing Methods-Acute and chronic, Risk and Hazard, Bioassays. Determination of LC_{50}.

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 Pesticide residues. Fate of heavy metals. Fate of toxicants in the atmosphere.

Reference:

Subramaniam M.A Concepts of Toxicology

Elective II – C: Theory Paper - Research Methodology

Unit I

Topic selection - Planning research – defining objectives - Preparation of work plans. Identification of suitable methodology - Preparation of project proposal – Funding agencies – Student project scheme of TNSCST & TANSCHE – Summer Schools – Training in research institutes

Unit II

Collection of literature- News articles – Newsletters – Magazines – Books - Journals. Digital library and search of articles - Key words and search - Internet – Google Scholar – Pub med – Inflibnet – Medline – Agricola – Science direct -Open access Journals - virtual sources - other sources. Short communications –review articles

Unit III

Collection of samples / data – Data analysis – Microsoft Excel – Construction of tables – headings - footer - hypothesis testing – Test of Significance – Tabulation – Presentation of results - Use of SPSS.

Unit IV

Thesis structure –Components - Writing Introduction – review of literature – Materials & Methods – Presentation of results – Discussion of Results based on literature – Arriving conclusions – Briefing of Summary – Arrangement of Bibliography and how to quote reference in thesis - Appendix.

Unit V

Publishing of Articles in newspapers /newsletters - Selection of journals – ISSN Number – Peer reviewed Journals – Science citation index – impact factor and importance. Manuscripts preparation for Journals – components – Submission and Publication – reprints and pdf formats. Paper presentation in Conferences.

Reference

1. Anderson, Durston & Polle 1970: Thesis and assignment, writing Wiley Eastern Limited
2. Fisher R.A, 1950: Statistical methods of research workers.
3. Freumd J E, 1967: Modern elementary statistics, Prentice Hall, Inc. Englewood cliffs, N J.
4. Malter K, 1972: Statistical analysis in Biology, Chapmen Hall, London.
5. Rajendra kumar C 2008 Research Methodology SB Nanja for APHA publishing Corporation New Delhi
6. Kothari CR 2004 Research Methodology New Age International Publishers New Delhi.

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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.

REFERENCES

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

PAPER XII – BIOINSTRUMENTATION & BIOLOGICAL TECHNIQUES

UNIT I

Microscopy – 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, immuno electrophoresis

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

Instrumentation, principle and application of:

Flowcytometry, Cell separation techniques.
Cell culture techniques and cell proliferation measurements.
ELISA, RIA, Vidal and their applications.

REFERENCES

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 Biotechnology, W.H. Freeman and Company, New York.
6. Gupta, P.K. 2003. Elements of Biotechnology, Rastogi Publ. Meerut.

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

ELECTIVE I - ENTOMOLOGY II

UNIT I

Interaction of Insects

Social Insects – Termite, Honey Bee and Ant
Caste differentiation
Social behaviour
Insect – Plant interaction
Insect vector – Host relationship

Bionomics and control measures

a. *Locusta migratoria* – Polyphagus grasshopper
b. *Odentotermis obesus* – Polyphagus termite
c. *Heliothis armigera*
d. *Spodoptera litura* – Polyphagus caterpillar
e. *Oryctus rhynocerus* – Coconut beetle

UNIT II

Biology and Control measures of Insect pests

Economic crops – Cotton and Sugarcane
Stored grains – Paddy, Wheat and Flour

Insect control methods

Cultural
Physical
Mechanical
Biological
Chemical
Integerated pest management

UNIT III

Insect Vectors

Systematics, Biology and Control measures of Insect vectors of Human diseases
Flies – *Anopheles sp, Culex sp* and *Aedes sp; Musca domestica*
Roaches and bugs – *Periplanita americana* and *Cimex indicus*

Insects of Commercial Importance

Honey Bee – types and the differences in nest building. 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
Organophosphorus 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

ELECTIVE II –A: ENVIRONMENTAL BIOLOGY II

UNIT I

Air Pollution

Air pollutants
Chemistry of air pollutants
Sources
Effects on the environment – Acid rain, Greenhouse 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
3. Verma&Agarval. 2010 Ecology
4.Veerpal Rastogi 2010 Ecology

ELECTIVE II-B: 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

Teretogenisis 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.

Reference

Subramaniam M.A Toxicology

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.(Demonstration only)

PRACTICAL - V

Biotechnology & Genetic Engineering

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
10. Immobilisation of cells(Bacteria/Yeast) by entrapment.

Bioinstrumentation & Biological techniques:

1. Microtomy and histochemistry – Preparation of slides and staining technique-submission of 5 slides
2. Separation technique of amino acids using paper chromatography.
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.

Submission: Microtechnique- 5 slides

ELECTIVE I PRACTICAL - ENTOMOLOGY
(Avoid collecting animals from Wild)

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 two)
Cockroach
Gryllotalpa
Nepa
Cybister
Silk moth

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

(Any two)
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 (only photographic album/chart)**

6. Spotters
a. Systematics
b. Pests
c. Medical importance
d. Veterinary importance
e. Economic importance
f. Insect whole mounts – 10 slides

7. Record – A complete record of the works done during the practical hours of the year should be submitted with bonafide certificate.

ELECTIVE II-A PRACTICAL– ENVIRONMENTAL BIOLOGY

I. Analysis of water

Determination of:

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)

All the above parameters in
a.pond/pool water
b.Canal/River water
c.Sewage water

II. Analysis of soil

Determination of:

1. Soil Moisture
2. Chlorides
3. Sulphates
4. Nitrates
5. Total Phosphates

6. Total organic matter
7. Humous
8. Chlorophylls and Phaeopigments

All the above parameters in

a.Clayey soil,
b.Sandy soil,
c.Garden soil / Red soil

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

ELECTIVE II-B PRACTICAL – TOXICOLOGY

Note: 1.Only limited number of cultured animals should be used
2. Only mild concentration of toxicants allowed

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

Spotters related to Practical.
Submission of 10 slides showing histopathology of fish.
Bonafide Record.