UNIVERSITY OF MUMBAI

No.UG/ 343 of 2004

CIRCULAR:

A reference is invited to the scheme of papers at the B.Sc. degree course under revised pattern vide pamphlet No.141 and to this office Circular No.UG/7 dated 7th January, 1998 and Principals of the affiliated colleges in the faculty of Science are hereby informed that the recommendation made by the Board of Studies in Zoology at its meeting held on 29th December, 2003 has been accepted by the Academic Council at its meeting held on 2nd April, 2004 vide item No.4.49 and that in accordance therewith the revised syllabus in the subject of zoology at the T.Y.B.Sc. examination is as per Appendix and that the same has been brought into force with effect from the academic year 2004-2005.

Mumbai 400 032,
16th August, 2004.

for I/c. REGISTRAR.

To,

The Principals of the affiliated colleges in the faculty of Science

A.C. No.4.49/02.04.2004

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No.UG/ 343-A of 2004 16th August, 2004.

Copy forwarded with Compliment to for information:-

1) The Dean, Faculty of Science.
2) The Chairman, Board of Studies in Zoology.

for I/c REGISTRAR.

Copy to :

The Director, Board of College and University Development, the Controller of Examinations/the Deputy Registrar (Eligibility & Migration Section), the Director of Students Welfare, the Personal Assistants to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-centre, Ratnagiri, for informations.

The Controller of Examinations (10 copies), F. & A. O., (Accounts Section) Fort, (2 copies), Record Section (5 copies), Publication Section (5 copies), D.R., (Enrollment, Eligibility & Migration Section - 3 copies), D.R., (Statistical Unit) (2 copies), D. R., (Accounts Section), Vidyanagari, (2 copies), D. R. (Affiliation Section) (2 copies), The Director, U.C.C., I.D.E. Bldg., Vidyanagari, A. R., A. A. Unit (2 copies) He is requested to treat this as Action taken report on the concerned resolution adopted by the Academic Council/Management Council, referred to in the above Circular; and that no separate A.T.R. will be sent in this connection., A. R., CONCOL (2 copies), BUCTU (1 copy), Dy. Acct. (Unit V) (1 copy), In-charge, Central Computing Facility (1 copy), Receptionist (1 copy), Telephone Operator (1 copy), In this connection, the Assistant Registrar [illegible]), Superintendent

A. C. Item No. 4.49 dt. 2/4/2004.

UNIVERSITY OF MUMBAI

Revised Syllabus

for

T.Y.B.Sc. (Zoology)

(with effect from the academic year 2004-2005)

Revised Syllabus of T. Y. B. Sc. Zoology
Effective from the Academic Year 2004-2005

PAPER – I :

Unit 1: Animal types: Type study	**30 Lectures**
a) Invertebrate: Earthworm	
b) Vertebrate: Frog	
Unit 2: Comparative Chordate Anatomy	**30 Lectures**
Unit 3: Developmental Biology	**30 Lectures**
Unit 4: Histology and Endocrinology	**30 Lectures**

PAPER – II :

Unit 1: Physiology	**30 Lectures**
Unit 2: Homeostasis and Regulation	**30 Lectures**
Unit 3: Haematology	**30 Lectures**
Unit 4: Immunology	**30 Lectures**

PAPER – III :

Unit 1: Molecular Biology	**30 Lectures**
Unit 2: Biotechnology	**30 Lectures**
Unit 3: Genetics and Evolution	**30 Lectures**
Unit 4: Toxicology	**30 Lectures**

PAPER – IV :

Unit 1: Environmental Science	**30 Lectures**
Unit 2: Environmental Biology	**30 Lectures**
Unit 3: Epidemiology	**30 Lectures**
Unit 4: Biostatistics	**30 Lectures**

Note:

1. Theory paper I and II and Practical I and II are to be studied by the students opting for 3 units and for 6 units students all the four papers and practicals are compulsory.
2. Two short and one long excursions for habitat studies/visits to institutes of educational interest are compulsory.
3. Fieldwork of not less than eight hours duration is equivalent to one period per week for a batch of 15 students.

PAPER – I

Unit 1: Study of Animal types (30)

1.1: Invertebrates: Earthworm [*Pheretima posthuma*]

External characters, body wall, locomotion, coelom, digestive system, blood vascular system, excretory system, nervous system, reproductive system, copulation and cocoon formation.

1.2: Vertebrates: Frog [*Rana tigrina*]

External characters, skeletal system (axial & appendicular) digestive system, circulatory system, structure of heart and course of circulation, respiratory, excretory, reproductive and nervous systems, sense organs (eye and ear).

Unit 2: Comparative Chordate Anatomy: (30)

2.1: Digestive system:

Digestive tube and its evolution.
Primary divisions of the tube.
Tooth structure & position, teeth in lower vertebrates and mammalian dentition.

2.2: Respiratory system:

Cutaneous respiration (Frog).
Gills of cartilaginous & bony fish,
lungs, air sacs in birds.

2.3: Circulatory System:

Evolution of hearts in vertebrates,
Modifications of aortic arches in vertebrates.
Venous, portal and lymphatic Systems.

2.4: Nervous system:

Early development and differentiation of primary brain vesicles and their cavities, flexures of brain,
Evolution of cerebral hemispheres & cerebellum,
Brains of Shark, Frog (Covered in type study), Lizard, Pigeon & Rabbit.

2.5: Urinogenital System:

Ontogeny of kidney ducts. archinephros, pronephros, mesonephros, metanephros; urinary bladder in vertebrates, structure of glomerulus and uriniferous tubules.
Gonads and their ducts.

2.6: Structure of integument and its derivatives:
Structure of scales, feathers, hair, beaks, claws, nails, hoofs, horns, antlers & glands.

Unit 3: Developmental Biology: (30)

3.1: Frog embryology:
Gametogenesis, structures of egg and sperm, fertilization, development in embryonic phase and post embryonic phase.

3.2: Chick Embryology:

3.2.1. Development up to 72 hours of age.
3.2.2. Extra embryonic membranes.

3.3: Types of placentae:

3.3.1. Classification of placentae on the basis of external morphology and histology.

3.4: Morphogenesis:

3.4.1. Differential cell affinity, cell adhesion, morphogenetic movements.
3.4.2. Development of tetrapod limb:
a) Formation of Limb Bud
[The limb fields, role of Hox genes and retinoic acid. Induction of apical ectodermal ridge]
b) Generation of proximal-distal axis of limb
[The apical ectodermal ridge: The ectodermal component, role of Hox genes]
c) Specification of the anterior-posterior limb axis.
[The zone of polarizing activity]
d) The generation of dorsal ventral axis.

Unit 4: Histology and Endocrinology: (30)

4.1: Histology:

4.1.1. Histological structures of the following frog organs::
Liver, pancreas, T.S. of stomach, T.S. of intestine. T.S.of testis and T.S. of ovary.
4.1.2. Histological structures of the following mammalian organs: Liver, Kidney, Testis and Ovary.

4.2:Endocrinology:

4.2.1. Endocrine glands and hormones, classification of hormones and their mode of action.

4.2.2. Histology, hormones, functions of hormones and hormonal disorders of the following endocrine glands: Pituitary, Adrenal, Thyroid, & Pancreas.

PAPER – II

Unit 1: PHYSIOLOGY (30)

1.1. Enzyme and enzyme kinetics:

1.1.1 Enzyme as biocatalyst
1.1.2. Concept of activation energy
1.1.3. Chemical structure of enzymes
1.1.4. Nomenclature and classification with numerical code
1.1.5. Brief study of oxidoreductases, transferases, hydrolases, lyases, isomerases and ligases.
1.1.6. Co-enzymes
1.1.7. Enzyme specificity
1.1.8. Mechanism of enzyme action
1.1.9. Basic principles of chemical kinetics (Derivation of Michaelis-Menten Equation).
1.1.10. Derivation of Lineweaver-Burk equation, plot and its significance.
1.1.11. Significance of V_{max}
1.1.12. Significance of K_m
1.1.13. Factors affecting/regulating enzyme activity: temperature, pH, substrate concentration.
1.1.14. Enzyme activation
1.1.15. Enzyme inhibition and its kinetics
1.1.16. Regulatory enzymes: Allosteric and covalently modulated enzymes
1.1.17. Isozymes and their significance.

1.2. Chemical messengers:

1.2.1. Introduction, concept and classification.
1.2.2. Neurotransmitters:
(a) Acetylcholine, catecholamine, Gama-amino butyric acid (GABA), Aspartic acid, Purines-ATP.
(b) Mode of working of transmitters.
1.2.3. Neurosecretory substances:
(a) Neurosecretory substances and a brief account of neurosecretory system.
(b) Neurohormones of neurohypophysis
(c) X and Y organs of crustaceans.
1.2.4. Hormones:
(a) Hormones of adenohypophysis
(b) Adenohypophysis in relation to thyroid and adrenal

Unit 2: HOMEOSTASIS AND REGULATION (30)

2.1. Homeostasis:

2.1.1. External and Internal environment

2.1.2. Control systems in biology

(a) Negative feed back

(b) Positive feed back

(c) More complex mechanism

(d) Control of blood glucose level as an example

2.2. Temperature regulation:

2.2.1. Relation between temperature and biological activities.

2.2.2. Temperature balance:

(a) Heat production: Shivering and non-shivering thermogenesis, Brown fat – a special thermogenic tissue in mammals

(b) Heat loss

2.2.3. Compensation through acclimation and acclimatization.

2.2.4. Adaptive response to temperature:

(a) Daily torpor

(b) Hibernation

(c) Aestivation

2.3. Osmotic and ionic regulation:

2.3.1. Maintaining water and electrolyte balance

(a) Ionic regulation in iso-osmotic environment

(b) Living in hypo-osmotic and hyper-osmotic environment

(c) Problems of living in terrestrial environment: Integumentary, respiratory and urinary water loss, tissue water, water absorption, salt water ingestion and salt excretion, metabolic water and behavioural adaptations.

2.3.2. Role of hormones in the regulation of water and electrolyte balance

2.4. Regulation of blood circulation:

2.4.1. Vascular pumps: Suction pump in open circulation and pressure pump in closed circulation

2.4.2. Heart size (heart mass – H_m) in vertebrates

2.4.3. Heart rate/frequency (H_f) in vertebrates and invertebrates

2.4.4. Cardiac output

2.4.5. Pace maker: Neurogenic and Myogenic hearts

2.4.6. Electrical activity in heart muscles: Electrocardiogram

2.4.7. Chemical and nervous regulation of heart

2.5. Regulation of breeding cycle:

2.5.1. Endocrine regulation of male reproductive cycle

2.5.2. Endocrine regulation of female reproductive cycle

2.5.3. Types of female reproductive cycles (estrous and menstrual)

2.5.4. Endocrine regulation of pregnancy, parturition, and lactation in mammals

Unit 3: HAEMATOLOGY (30)

3.1. Composition of blood:

3.1.1. Plasma proteins
3.1.2. Inorganic constituents
3.1.3. Organic constituents other than proteins
3.1.4. Respiratory gases
3.1.5. Internal secretions, antibodies and enzymes

3.2. Volume of blood:

3.2.1. Total quantity and regulation
3.2.2. Haemorrhage
3.2.3. Blood transfusion with whole blood and other materials (saline, gumacacia and isinglass)

3.3. Erythrocytes:

3.3.1. Total count and ESR
3.3.2. Variation in number
3.3.3. Abnormalities in form and structure of erythrocytes
3.3.4. Haemoglobin-structure, function, formation and degradation
3.3.5. Haemolysis (Fragility test)
3.3.6. Erythropoiesis
3.3.7. Anaemia

3.4. Leucocytes:

3.4.1. Total count and volume
3.4.2. Differential count
3.4.3. Variation in number
3.4.4. Types of leucocytes and functions
3.4.5. Leucopoiesis
3.4.6. Leukemia

3.5. Haematopoietic organs and haematopoiesis:

3.5.1. Haematopoietic growth factors
3.5.2. Regulation of haematopoiesis:
(a) Programmed cell death
3.5.3. Enrichment of haematopoietic stem cells
3.5.4. Immune system cells:
(a) Lymphoid cells: B lymphocytes, T lymphocytes, Null cells
(b) Activities of mononuclear cells: Phagocytosis, Antimicrobial and cytotoxic activities, secretion of factors.
(b) Mast cells
(c) Dendritic cells
3.5.5. Organs of the immune system:
(a) Primary lymphoid organs: Thymus, bone marrow
(b) Lymphatic system
(c) Secondary lymphoid organs: Lymph nodes, Spleen, Gut associated lymphoid tissue (GALT)
(d) Cutaneous associated lymphoid tissue

3.6. Accessory organs of blood system:

3.6.1. Reticulo-endothelial system

3.6.2. Formation of blood platelets

3.7. Blood coagulation and lymph:

3.7.1. Clotting mechanism

3.7.2. Bleeding and clotting time

3.7.3. Anticoagulants

3.7.4. Failure of clotting mechanism

Unit 4: IMMUNOLOGY (30)

4.1. Definition and scope

4.2. Innate (Nonspecific) Immunity:

4.2.1. Definition and characteristics

4.2.2. Innate immunity at species, race, family and individual levels

4.2.3. Factors influencing the level of innate immunity in an individual: age, hormone and nutrition.

4.2.4. Mechanism:

(a) First line of defence

(b) Second line of defence

(c) Third line of defence

4.3. Acquired (Specific) Immunity:

4.3.1. Definition and characteristics

4.3.2. Important features:

(a) Immune memory

(b) Immune specificity

(c) Recognition of non-self

4.3.3. Passive acquired immunity:

(a) Natural (b) Artificial

4.3.4. Active acquired immunity:

(a) Natural (b) Artificial

4.4. Antigens:

4.4.1. Complete antigens and haptens

4.4.2. Determinants of antigenicity: foreignness, molecular size, chemical composition and heterogeneity, susceptibility to tissue enzymes, antigen specificity, species specificity, isospecificity, organ specificity, auto-specificity, heterogenic specificity.

4.5. Immunoglobulins (antibodies):

4.5.1. Basic structure of immunoglobulin

4.5.2. Immunoglobulin classes: IgG, IgM, IgA, IgD and IgE, structure and properties.

4.6. Immune response:

4.6.1. Antigen presentation and processing, mechanism of lymphocyte activation.

4.6.2. Humoral immune response:

(a) Pattern of antibody production
(b) Primary and secondary responses
(c) Fate of antigens in tissues
(d) Production of antibodies
(e) Factors affecting antibody production: age, nutritional status, Route of administration, size and number of doses, multiple antigens, adjuvants, immunosuppressive agents.

4.6.3. Cellular immune response (Cell mediated immunity)

(a) Scope of CMI (cell mediated immune response)
(b) Cell types involved in CMI and their role
(c) Lymphokines
(d) Detection of CMI
(e) Transfer factor

4.6.4. A brief account of immunological tolerance

4.7. Antigen antibody interactions:

4.7.1. General features of antigen antibody interactions

4.7.2. Precipitation reactions:

(a) Definition, characteristics and mechanisms
(b) In fluids (tube test) and in gels (slide test)-Radial immunodiffusion (Mancini method), Double immunodiffusion (Ouchterlony method) Immunoelectrophoresis.

4.7.3. Agglutination reactions:

(a) Definition, characteristics and mechanism
(b) Haemagglutination (slide and micro-tray agglutination), Bacterial agglutination (tube agglutination), Passive agglutination, Coomb's test and Agglutination inhibition.

4.7.4. Complement fixation test
4.7.5. Radioimmunoassay
4.7.6. Immunofluorescence
4.7.7. Enzyme linked immunosorbent assay (ELISA)

4.8. Complement system:

4.8.1. Complement components
4.8.2. Classical and alternative pathways
4.8.3. Significance of complement

4.9. Hypersensitivity:

4.10.1. Type I (Anaphylaxis and atopy)
4.10.2. Type II (Cytotoxic)
4.10.3. Type III (Immune complex mediated)
4.10.4. Type IV (Cell mediated or delayed type)
4.10.5. Type V (Stimulatory)
(Type II, III, IV & V in brief.)

4.10. Transplantation immunology:

4.11.1. Classification of grafts

4.11.2. Immunologic basis of graft rejection:

(a) First and second set rejection reaction

(b) Immune mechanism in graft rejection

(c) Precautions against graft rejection

(d) Graft versus host disease (GVH)

4.11.3. Tissue and organ transplantation:
Corneal graft, Kidney transplant, Heart transplant, Liver transplant, Bone marrow transplants.

4.11. Immunology of tumors

4.12.1. Clinical evidence of immune response in malignancy

4.12.2. Tumor antigens

4.12.3. Immune response to tumor antigens

4.12.4. Immunological surveillance

4.12.5. Immunotherapy of cancer.

PAPER – III

Unit 1. MOLECULAR BIOLOGY (30)

1.1. The Nature and properties of the Genetic material:

1.2. DNA as genetic material:

1.2.1. Griffith's transformation experiment

1.2.2. Avery, Macleod and McCarthy experiment

1.2.3. Hershey-Chase experiment

1.3. RNA as genetic material:

1.3.1. Singer and Conrat experiment on TMV

1.4. DNA replication:

1.4.1. Meselson and Stahl experiment:
Semi conservative nature of DNA replication.

1.4.2. Prokaryotic & eukaryotic DNA replication
Semi discontinuous replication.
Priming , Bi-directional and unidirectional replication,
Theta mode of replication in E.coli,
Rolling circle replication in bacteriophages,
Enzymes involved in DNA replication.

1.5. Gene Regulation:

1.5.1. Control of gene expression in prokaryotes:

Bacterial operon (Lac operon and Trp operon)

1.5.2. Control of gene expression in Eukaryotes

a). Chromatin : Heterochromatin & euchromatin
b). Selective amplification of DNA templates
c). Transcriptional level control
d). The role of DNA methylation
e). Translational level control

1.6. Mutations and mutagenic agents:

1.6.1. Mutations :

a). Point mutations due to Deletion, Insertion & substitution [Missence, nonsense, frameshift and silent mutations]
b). Tautomerism of bases, Transition and Transversion

1.6.2. Mutagenesis

a). Effect of ionizing radiations
b). Effect of UV radiation : formation of pyrimidine dimers
c). Chemical mutagens: Base analogue, alkylating agents, deaminating agents, intercalating agents.

1.7. DNA damage repair mechanisms:

Photoreactivation, Excision repair, Recombination repair & SOS repair.

Unit 2: BIOTECHNOLOGY: (30)

2.1. Animal Cell and tissue culture:

2.1.1. Introduction:

Primary and established cell lines [ref to mammalian cell lines and their characteristics], mass culture & clonal cell culture, density dependent regulation of growth,growth factors.

2.1.2. Media for cultivation of mammalian cells:

[media containing naturally occurring ingredients : blood plasma, blood serum, tissue extract, complex media]

2.1.3. Methodology:

Preparation of cells / organs for culture, coverslip culture, flask & tube culture, large scale cultivation of mammalian cells.

2.1.4. Applications of animal cell culture

2.2. Hybridoma technology:

Somatic cell fusion, somatic cell genetics, production of monoclonal antibodies.

2.3. DNA finger printing:

2.3.1. Tools: PCR, Southern blotting, RFLP

2.3.2. Applications: in forensic science, parenthood testing etc.

2.4. Gene manipulation:

a). Restriction enzymes: Types, characteristics and nomenclature.

b). Overview of various cloning strategies and characteristics of cloning vehicles.

c). Insertional inactivation in pBR 322, and in pUC series plasmids.

d). Bacteriophage λ as a vector : insertional and replacement vectors

e). Reverse transcription, preparation of desired gene using reverse transcriptase.

f). Expressed Sequence Tags for genome study. c-DNA microarrays.

2.5. Bioinformatics:

DNA databases and protein databases.

Primary and secondary databases.

Broad idea of the services available on the 'NET'

a). Sequence search tools: FASTA & BLAST [Basic Local Alignment Search Tool]

b). Data retrieval system : Entrez, SRS (sequence retrieval System)

c). Literature database : PubMed (Public MEDLINE)

d). Human genetics : OMIM [Online Mendelian Inheritance in Man]

Unit 3: GENETICS AND EVOLUTION 30

3.1. GENETICS:

3.1.1. Normal human karyotype :

a). Karyotype preparation and chromosome banding techniques, band numbering scheme.

b). Human genome sequencing and human genome project.

3.1.2. Chromosome non-disjunction:

a). Process of non-disjunction and its genetic implications.

b). Non disjunction of autosomes:
Trisomy 21, Trisomy 18 & Trisomy 13 syndromes.

c). Non disjunction of sex chromosomes:
Turner's and Klinefelter's syndromes, XYY males.

3.1.3. Other chromosomal anomalies:

a). Deletions and Duplications with examples.

b). Microdeletions and microduplications with examples

c). Translocations: Down's syndrome and other translocations

d). Other abnormalities : Inversions, ring chromosomes, polyploidy.

3.1.4. Inborn errors of metabolism:

a). The concept of inherited metabolic disease
b). Genetics of human metabolic diseases
  i). Phenylketonuria, alkaptonuria and albinism, maternal PKU.
  ii). G6PD deficiency & variants of G6PD.
c). Complex trait in families: Diabetes mellitus

3.2. EVOLUTION:

3.2.1. Molecular evolution:

a). Amino acid sequence divergence in proteins
b). Nucleotide sequence divergence in DNA
c). Molecular evolutionary clock
d). Large scale DNA sequence comparisons
  Molecular marker analysis, DNA hybridization,
e). Gene organization,
f). Maintenance of gene diversity
g). Phylogenetic analysis, Construction of a phylogenetic tree, Comparison of data from different sources in phylogentic analysis.

Unit 4: TOXICOLOGY (30)

4.1. Introduction to toxicology:

Definition and scope, Relationship to other sciences, History of toxicology

4.2. Sources of toxic compounds:

Food additives, Chemicals in work place (lead and mercury), Drugs of abuse, Therapeutic drugs, Pesticides, Solvents, Polycyclic aromatic hydrocarbons and cosmetics.

4.3. Naturally occurring toxins:

Mycotoxins, Microbial toxins, Plant toxins (caffeine and Nicotine) Animal toxins (Honey bee sting, venoms of coelenterates, scorpion, snake and fish).

4.4. Dose response relationship:

4.4.1. Measurement of dose response relationship, dose response curves, LC_{50} and LD_{50}
4.4.2. Acute and chronic toxicity
4.4.3. Margin of safety and therapeutic index
4.4.4. Threshold dose and no observed effect level (NOEL)
4.4.5. Selectivity: TDH, TDL, HNTD, HRTC

4.5. Absorption, distribution and accumulation of toxicants:

4.5.1. Membranes
4.5.2. Mechanism of absorption
4.5.3. Rates of penetration
4.5.4. Routes of absorption in mammals: Dermal, Gastrointestinal and Respiratory
4.5.5. Distribution and accumulation

4.6. Metabolism of Toxicants:

4.6.1. Phase I reactions
4.6.2. Phase II reactions
4.6.3. Metabolism of Carbontetrachloride and Acetaminophen.

4.7. Target organ toxicity:

4.7.1. Hepatotoxicity: Susceptibility of the liver, types of liver injury and examples of hepatotoxicants.
4.7.2. Nephrotoxicity: Susceptibility of kidney, Examples of nephrotoxicants
4.7.3. Neurotoxicity: Vulnerability of nervous system, Examples of neurotoxicants.

PAPER – IV

Unit 1. Environmental Science: (30)

1.1. Anthropogenic perspective:

Impact of development of science & technology on environment.

1.2. Environmental resources, utilization and effect on environment:

1.2.1. Types of resources :

[renewable/ non renewable; Natural/ anthropogenic]

1.2.2. Energy Sources :

[renewable/ non renewable; conventional/non-conventional]
Thermal power, firewood, fossil fuels, hydropower, nuclear power, solar, wind, tidal, geothermal, biomass based.
Conservation of energy.

1.2.3. Water resources:

Major water compartments: [Oceans, ground water, rivers, lakes, wet land, dams, reservoirs canals]
Freshwater shortage, ground water depletion - Indian scenario.
Conservation of water as a resource.

1.2.4. Geological resources:

Minerals and rocks, metal and non-metal resources, soil as a resource.
Degradation of geological resources: resource extraction [mining]
And geological hazards [earthquake, volcano, flood & erosion]

1.2.5. Food and agricultural resources:

Major food resources: crops, meat, milk and seafood.
Use and abuse of other resources required for agriculture [water, fertilizer, energy, pesticides], sustainable agricultural practices, Agroforestry in India

1.3. Quality of environment:

1.3.1. Air and climate:

Greenhouse effect and global climate change, Kinds and sources of air pollutants, interaction between climate processes and air pollution, Effects of air pollution [human health, plants, reduced visibility, acid deposition, damage to forest, buildings and monuments].
Pollution control, Activity of Pollution Control Boards in India

1.3.2. Water pollution:

Point and non point sources, categories of water pollution (Biological, inorganic, ground water pollution, marine pollution, fresh water pollution] Indian perspective – Pollution control in rivers Yamuna and Ganga.

1.3.3. Solid waste pollution:

Waste disposal methods and environmental problems.
Solution: reuse, recycling, composting, hazardous and toxic waste, options for hazardous waste management.

1.3.4. Noise pollution

1.3.5. Radioactive pollution

1.4. Sustainability and resources:

Concept of sustainable development - Global and Indian perspective. Environmental education in India, Environmental challenges and efforts in India's development.

Unit 2: Environmental Biology: (30)

2.1. Animal behaviour:

2.1.1. Biological Communication :

a). Chemical, Visual, Light and Audio signals
b). Species specificity of songs.
c). Evolution of language.

2.1.2. Ecological Aspects of Behaviour:

a). Habitat selection, food selection
b). Aggression, homing, territoriality and dispersal
c). Host-parasite relations

2.1.3. Social Behaviour:

a). Aggregations – Schooling in fishes, flocking in birds, herding in mammals

b). Group selection, kin selection, altruism, reciprocal altruism and inclusive fitness.

c). Social organization in insects and primates.

2.2. Wildlife conservation:

2.2.1. Forest resources, National forest policy and conservation

2.2.2. Forest research, education and training in India

2.2.3. India's biodiversity and uses of green belt

2.2.4. National parks and important wildlife sanctuaries of India:
[Sanjay Gandhi, Tadoba, Dachigam, Jim Corbett, Bharatpur, Gir, Ranthambor, Kanha, Bandipur-Mudumalai, Sunderbans, Kaziranga]

2.2.5. Rare and endangered species of India

2.2.6. Project tiger

2.3. Zoogeography:

2.3.1. Continuous and discontinuous distribution

2.3.2. Barriers to dispersal.

2.3.3. Means of dispersal

2.3.4. Zoogeographic realms:
[Physical features and typical fauna of the following regions : Nearctic, Neotropical, Palaearctic, Ethiopian, Oriental, Australian and Antarctic]

Unit 3: Epidemiology: (30)

3.1.1. Definition

3.1.2. Descriptive epidemiology: Time, Place and Person

3.1.3. Analytical epidemiology

3.1.4. Screening for diseases

3.2. Epidemiology of communicable diseases

3.2.1. Infectious disease epidemiology: Selected definitions

3.3. Dynamics of disease transmission:

3.3.1. Reservoir

3.3.2. Routes of transmission

3.3.3. Incubation

3.4. Prevention and control of communicable diseases:

3.4.1. Notification
3.4.2. Isolation
3.4.3. Quarantine
3.4.4. Disinfection-concurent, terminal, precurrent or prophylactic Disinfection methods: Natural, Physical and Chemical
3.4.5. Immunization
3.4.6. General measures
3.4.7. Health education

3.5. Epidemiology of communicable diseases: Diagnosis, Transmission, Prevention, Control measures and Treatment of:

3.5.1. Diseases of Bacterial origin:
Tuberculosis - National tuberculosis control programme,
Typhoid, Cholera - National diarrhoea disease control programme,
Leprosy and Leptospirosis.

3.5.2. Diseases of viral origin: Hepatitis A, Poliomyelitis and Rabies.

3.5.3. Diseases of Helminth origin: Ascariasis and Dracunculosis.

3.5.4. Arthropod borne diseases:
Malaria - National Malaria control programme and National malaria eradication programme,
Dengue, Japanese Encephalitis, Filariasis.

Unit 4: Biostatistics (30)

4.1. Statistics- Definition, application in biology, limitations of statistics.

4.2. Sampling techniques:

4.2.1. Simple random sampling:
a). Lottery method- Without replacement, With replacement
b). Use of table of random numbers.
4.2.2. Stratified random sampling.

4.3. Classification of data:

a). Primary data
b). Secondary data,
c). Qualitative classification (concept of attributes)
d). Quantitative classification (concept of variate-discrete and continuous)

4.4. Presentation of data:

4.4.1. Tabulation

a). Simple tables-one way and two way tables
b). Complex tables.
c). Frequency distribution table.

4.4.2.Diagrammatic Presentation:

a). Frequency curve, types of frequency Curves-normal symmetrical bell shaped curve, skewness – positive and negative.

b). Frequency polygon.

c). Histogram.

d). Bar diagram-simple, multiple, subdivided or segmented or Proportional bar.

e). Pie diagram

4.5. Probability:

4.5.1. Definition, sample space, subset

4.5.2. Types of events:

a). Mutually exclusive

b). Exhaustive

c). Complementary

d). Compound

e). Independent

f). Dependant

4.5.3. Addition rule of probability and multiplication rule of probability.

4.5.4. Applications of addition and multiplication rules in biology.

4.6.Measures of central tendency:

Mode, median, mean, variance, standard deviation.

4.7. Normal distribution:

Properties of normal distribution, Z- transformation, p- value.

4.8. Parametric tests of significance and their applications:

a). Z-test of significance-one tailed and two tailed

b). t-test of significance-simple and paired t test.

4.9. Non-parametric tests of significance:

Chi-square test and its applications.

4.10.Correlation coefficient and testing significance of correlation coefficient.

PRACTICAL – I

1. Earthworm:

Dissections:	Digestive, Nervous and Reproductive Systems.
Mountings:	Setae, septal nephridium, blood glands, spermatheca, sperms and ovary.

2. Frog:

Dissections:	Digestive, circulatory, urinogenital & sympathetic nervous systems, Brain.
Mountings:	Squamous epithelium, ciliated epithelium, muscle & medullated Nerve Fiber.
Osteology:	Axial and appendicular skeleton.
Embryology:	Egg Spawn, 4 celled stage, 8 celled stage, Blastula, Gastrula, Neurula and Tadpole Stages.

3. Temporary mountings: Placoid, cycloid and ctenoid scales of fish.

4. Dissection: Aortic arches of shark, Cranial nerves

5. Brain: Comparative study of brains of shark, frog, lizard, bird (pigeon /fowl) & rat.

6. Dissection: Brain of shark

7. Chick Embryology:
Observations : permanent slides of whole mounts of chick embryo at 18hrs, 22-24 hrs, 36hrs, 48hrs & 72hrs of incubation.

8. Permanent preparation of Chick Embryo – upto 48 hrs of incubation.

9. Study of placentae [observation – specimen and/or slide]
Shark yolk sac placenta, different types of mammalian placentae.

10. Observation of permanent slides:
Earthworm : T.S. through pharynx, gizzard & intestine [passing through typhlosolar region]
Frog : T.S. of stomach, intestine, liver and pancreas. Blood smear.
Mammalian tissues: liver, kidney, testis, ovary, pituitary, adrenal, thyroid and pancreas

PRACTICAL – II

Hematology:

1. Colorimetric estimation of total plasma proteins.
3. Separation of plasma proteins by electrophoresis on agarose/PAGE.
4. Estimation of blood glucose by O-Toluidine method.
5. Estimation of serum/plasma total cholesterol by $FeCl_3$ method.
6. Estimation of serum/plasma total triglycerides by Phosphovanillin method.
7. Enumeration of erythrocytes-total count
8. Enumeration of leucocytes- total and differential count.
9. Estimation of haemoglobin by Sahlis acid haematin method.
10. Study of Lymphoid organs: Lymph node, Thymus and Spleen.
11. Study of Leukemic cells from permanent slide
12. Observation of bone marrow cells.
    (Students are expected to know the preparation of blood report)

Physiology:

1. Study of Acid phosphatase activity:
    a) Effect of substrate concentration
    b) Effect of pH variation
    c) Effect of enzyme concentration
    d) Effect of inhibitor
2. To determine specific activity of succinate dehydrogenase (SDH)
3. Separation of LDH isozyme by electrophoresis on agarose/PAGE
4. Study vaginal smear to analyse female reproductive cycle.
5. Study of human ECG: Normal, Sinus tachycardia, Sinus bradycardia, Ventricular fibrillation.
6. Mounting of nerve cells and neurosecretory cells from cockroach

Immunology:

1. Latex agglutination test
2. Determination of blood group and Rh factor

PRACTICAL – III

Molecular biology:

1. Estimation of RNA – Orcinol method
2. Estimation of DNA-Diphenylamine method.
3. Isolation of E.coli/tissue genomic DNA and checking its purity by horizontal gel electrophoresis.

Biotechnology:

1. Use of autoclave for sterilization of equipment for tissue culture
2. To prepare cells for culture from mammalian kidney/spleen/chick embryo using trypsin and to determine percentage viability.
3. Problems in Biotechnology and Bioinformatics

Genetics:

1. Karyotype analysis for the following syndromes with comments on numerical and structural variations in chromosomes:
   Turner's, Klinefelter's, Down's, Cri-du-chat, D – G translocation, Edwards, Patau's syndrome.

Toxicology:

1. Determination of LC_{50} for a suitable pollutant (any one salt of heavy metal dissolved in water) on Daphnia, Probit analysis.
2. Effect of salt of heavy metal on the heart beat of Daphnia.
3. Effect of carbon tetrachloride on the level of enzyme activity in liver or serum: (Acid and alkaline phosphatases, Aspartate and alanine amino transferases).

Bioinformatics:

Visit to at least one of the related sites on world wide web and its report*.

*Students will enter a record of their visit to the related web site/s in his/her own handwriting, not exceeding two pages. The report should preferably be supported by printout if possible. The College is expected to provide internet facility for these practicals.

PRACTICAL – IV

Environmental science

1. To perform rapid field test of Sulphate, Nitrate content and base deficiency in different soil samples.
2. To determine the soil carbonates by rapid titration method.
3. To determine Cation Exchange Complex (CEC)
4. To study the vegetation by Line transect method
5. To determine frequency of vegetation.
6. To study the community by quadrat method by determining frequency, density and abundance of different species present in the community.
7. Study of physical properties of water:
   a) Turbidity
   b) Conductivity
8. Study of chemical property of water:
   a) Total acidity
   b) Total alkalinity
   c) Chemical oxygen demand (COD)
   d) Biochemical oxygen demand (BOD) (Polluted water sample to be given)
   e) Heavy metal- Lead
   f) Phosphates-phosphorus
   g) NO_x-nitrogen
   h) Carbonates

Environmental biology

1. Study of interaction between organisms:
   a) Parasitism: Head louse, bed bug, *Ascaris*
   b) Social organization: Honeybee and Termite

2. Study of present status, distribution, habitat and reasons for decline in India of the following animals:
   Gaur, Hangul, Rhino, Musk deer, Wild ass, Brow antlered deer, Black buck.Elephant, Tiger, Lion, Snow leopard, Red panda, Reticulated python, Pink headed duck, White winged wood duck, Mountain quail, The great Indian bustard.

Animal Zoogeography:

1. Study of fauna of different zoogeographical regions:

a) Palaearctic: *Aliuropoda melanoleuca, Macaca fuscata.*

b) Nearctic: *Didelphys virginiana, Enhydrous lutra, Procyon lotor.*

c) Neotropical: *Lepidosiren paradoxa, Tapirus terrestris, Llama guanicoe.*

d) Oriental: *Rhacophorus nigropalmatus, Gavialis gangeticus, Draco volans, Elephas maximus, Hystrix indica, Rhinoceros unicornis.*

e) Ethiopean: *Protopterus aethiopicus, Struthio, Loxodonta africana. Raccoon*

f) Australian: *Ornithorhynchus anatinus, Tachyglossus aculeatus, Neoceratodus foroteri, Macropus rufus.*

g) Antarctic: *Penguin*

With the help of photographs, models or sketches.

Epidemiology:

1. **Mountings:** Temprorary preparation of head and mouthparts of mosquito.

2. **Identification:** Permanent slides or specimens:
   a) Plasmodium (malarial parasite)
   b) Ascaris
   c) Dracunculus
   d) Wuchereria

Bio statistics:

1. From the given data make frequency distribution table, plot frequency polygon, histogram, calculate mean and standard deviation.
2. From the given data plot bar diagram and pie diagram.
3. t-test-simple and paired.
4. Chi-square test of significance:-
   i). To test goodness of fit of observed and expected proportions.
   ii). To test association between two events.
5. Use of spread sheet programmes in Biostatistics.

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