

AC 27/2/13
Item no. 4.38

UNIVERSITY OF MUMBAI



Syllabus for Sem V & VI

Program: B.Sc.

Course: Zoology

(Credit Based Semester and Grading System with
effect from the academic year 2013–2014)

UNIVERSITY OF MUMBAI

T.Y.B.Sc. Zoology

Credit Based Semester and Grading System
to be implemented from the Academic Year 2013-2014.

PREAMBLE

BoS in Zoology during its meeting constituted a pyramid committee, to revise the syllabi in Zoology, with Dr. M. K. Pejaver as the Chairperson and Senior Teachers from affiliated Colleges as Jt. Chairperson, one each for UG and PG programmes. The class-wise syllabus committees were constituted in accordance with inclusive policy of the BoS with an aim to provide youngsters hands on training and exposure to work on syllabus committees which will go a long way in taking our subject ahead in future when these youngsters would shape the subject after a decade. With the introduction of Credit Based Semester and Grading System and continuous evaluation consisting of components of internal assessment and external assessment by the esteemed University, the syllabus in Zoology was revised for F.Y. and S.Y. classes to be implemented with effect from 2010-2011 and 2011-12 respectively, after approval by concerned authorities of the University.

Vide University Circular No. APD/Misc.-01/407/of 2011 dated 12/12/2011, contents of letter from K. P. Singh, Joint Secretary, UGC No. D.O.F1-1/2009-(CPP-II) dated 29/11/2011 were notified to the faculty in Zoology. As per the letter an expert committee was constituted by the UGC to look into the issue of discontinuation of dissection of live animals in the laboratory experiments in Zoology/ Life Sciences at UG and PG levels. The guidelines prepared by the expert committee and approved by UGC were notified with a viewpoint to ensure compliance of the guidelines.

A special meeting of Heads of Zoology Departments of all the Colleges affiliated to the University was convened on 17th August 2012 for deliberation on recommendation of expert committee appointed by the UGC regarding the discontinuation of dissection of live animals in laboratory experiments in Zoology / Life Sciences at UG and PG level.

In accordance with the deliberations in the above meeting, draft syllabus for T.Y.B.Sc. Zoology, suitably revised, to be implemented in the Credit Based Semester and Grading System was prepared by the committee under the guidance of pyramid committee. The draft was circulated among the heads and senior teachers of the Department of Zoology of various colleges for approval and suggestions.

In meeting of the BOS held on 12th December, the draft was approved and it was resolved to implement the revised syllabus of T.Y.B.Sc. Zoology and make it effective from the Academic Year 2013-2014 after approval from concerned authorities of the University.

Chairman
Board of Studies in Zoology
University of Mumbai.

T.Y.B.Sc.**Zoology Syllabus.**

Credit Based Semester and Grading System.

(To Be Implemented from the Academic Year 2013-2014)

Semester -V

| Theory | | | | |
|-------------------|------|--|-----------|-----------|
| Course | Unit | TOPIC | Credits | L / Week |
| USZO501 | I | Type Study: Invertebrate- Sepia | 2.5 | 1 |
| | II | Comparative Chordate Anatomy - I | | 1 |
| | III | Developmental Biology – I | | 1 |
| | IV | Histology and Endocrinology-I | | 1 |
| USZO502 | I | Physiology-I | 2.5 | 1 |
| | II | Physiology-II | | 1 |
| | III | Homeostasis and Regulation-I | | 1 |
| | IV | Homeostasis and Regulation-II | | 1 |
| USZO503 | I | Molecular Biology-I | 2.5 | 1 |
| | II | Molecular Biology-II | | 1 |
| | III | Toxicology-I | | 1 |
| | IV | Toxicology-II | | 1 |
| USZO504 | I | Environmental Science-I | 2.5 | 1 |
| | II | Environmental Biology-I | | 1 |
| | III | Epidemiology-I | | 1 |
| | IV | Biostatistics-I | | 1 |
| | | | 10 | 16 |
| Practicals | | | | |
| USZOP05 | | Practicals of Course USZO501 and Practicals of Course USZO502 | 3 | 8 |
| USZOP06 | | Practicals of Course USZO503 and Practicals of Course USZO504 | 3 | 8 |
| | | | 06 | 16 |
| Total | | | 16 | 32 |

Semester -VI

| Theory | | | | |
|-------------------|------|--|---------|----------|
| Course | Unit | TOPIC | Credits | L / Week |
| USZO601 | I | Type Study: Vertebrate- Shark | 2.5 | 1 |
| | II | Comparative Chordate Anatomy - II | | 1 |
| | III | Developmental Biology – II | | 1 |
| | IV | Histology and Endocrinology-II | | 1 |
| USZO602 | I | Hematology-I | 2.5 | 1 |
| | II | Hematology-II | | 1 |
| | III | Immunology-I | | 1 |
| | IV | Immunology-II | | 1 |
| USZO603 | I | Biotechnology-I | 2.5 | 1 |
| | II | Biotechnology-II | | 1 |
| | III | Genetics | | 1 |
| | IV | Genetics and Evolution | | 1 |
| USZO604 | I | Environmental Science-II | 2.5 | 1 |
| | II | Environmental Biology-II | | 1 |
| | III | Epidemiology-II | | 1 |
| | IV | Biostatistics-II | | 1 |
| | | | 10 | 16 |
| Practicals | | | | |
| USZOP07 | | Practicals of Course USZO601 and Practicals of Course USZO602 | 3 | 8 |
| USZOP08 | | Practicals of Course USZO603 and Practicals of Course USZO604 | 3 | 8 |

Course Code: USZO501

Study of Animal Types-I, Comparative Chordate Anatomy, Developmental Biology, Histology and Endocrinology.

Unit I: Study of Animal Types-I

15 Lectures

1.1: Invertebrates: Sepia

Systematic position, habit & habitat, external features, shell, locomotion, digestive system, ink sac, respiratory system, circulatory system, excretory system, reproductive system, nervous system and sense organs, economic importance.

Unit II: Comparative Chordate Anatomy: I

15 Lectures

2.1: Structure of integument and its derivatives:

Scales - epidermal & dermal, feathers, hair, beaks, claws, nails, hoofs, horns, antlers, glands.

2.2: Digestive system:

Digestive tube and its evolution, primary divisions of the tube.

Tooth structure & position, teeth in lower vertebrates, mammalian dentition.

2.3: Circulatory System:

Evolution of heart, aortic arches, venous, portal and lymphatic systems in vertebrates.

Unit III: Developmental Biology: I

15 Lectures

3.1: Chick Embryology:

Development up to 72 hours of age, extra-embryonic membranes.

3.2: Types of placentae:

Extra embryonic membranes in mammal, classification of placentae on the basis of external morphology and histology.

Unit IV: Histology and Endocrinology I

15 Lectures

4.1: Mammalian Endocrinology:

Histology, hormones, functions of hormones and hormonal disorders of the following endocrine glands: pituitary, adrenal, thyroid, parathyroid & pancreas.

USZ0502

Physiology and Homeostasis and regulation

Unit I: Physiology-I

15 Lectures

Enzyme and Enzyme kinetics

Enzyme as Biocatalyst: Concept of activation energy, chemical structure of enzymes, nomenclature and classification with numerical code, Brief study of oxidoreductases, transferases, hydrolases, lyases, isomerases and ligases, Co-enzymes, Enzyme specificity, mechanism of enzyme action.

Basic principle of chemical kinetics: (Derivation of Michaelis-Menten equation), Derivation of Lineweaver-Burk equation, plot and its significance, significance of V_{max} Factors affecting/regulating enzyme activity: temperature, pH, substrate concentration, Enzyme activation, Enzyme inhibition and kinetics, Regulation of enzymes: allosteric and covalently modulated enzymes, Isoenzymes and their significance.

Unit II: Physiology-II

15 Lectures

Chemical Messengers: Introduction, concept and classification; Neurotransmitters and Neurosecretory substance, Acetyl catecholamine, Gama-amino butyric acid (GABA), Aspartic acid, Purine ATP, Mode of working of transmitters; Neurosecretory substances and a brief account of Neurosecretory system.

Unit III: Homeostasis and Regulation-I

15 Lectures

3.1 Homeostasis: External and internal environment; Control systems in Biology: Feedback mechanism; control of blood glucose level as an example.

3.2. Thermoregulation: temperature balance; Heat production; Shivering and non shivering thermogenesis, brown fat- special thermogenic tissues in mammals and heat loss; Acclimaion and acclimatization; Adaptive response to temperature; Daily torpor, Hibernation, Aestivation.

3.3. Osmotic and Ionic regulation: Mantaining water and electrolyte balance: ionic regulation in iso-osmotic environment; living in hypo-osmotic and hyper-osmotic environment, Problems of living in terrestrial environment: water absorption, salt water ingestion and salt excretion, metabolic water and behavioral adaptations.

Unit IV: Homeostasis and Regulation-II

15 Lectures

4.1 Regulation of blood circulation:

Vascular pumps: Suction pump in open circulation and pressure pump in closed circulation, Heart size (Heart mass-Hm) in vertebrates, heart rate frequency in vertebrates and invertebrates, Cardiac outpu, Pace maker, neurogenic and Myogenic hearts; Electrical activity in heart muscles: Electrocardiogram; chemical and nervous regulation of heart.

4.2. Regulation of breeding cycle: Endocrine regulation of male reproductive system, Endocrine regulation of female reproductive system, Types of female reproductive cycles (estrous and menstrual), Endocrine regulation of pregnancy, parturition and lactation in mammals.

Course Code: USZO503

Title: Molecular Biology and Toxicology

UNIT- I: MOLECULAR BIOLOGY-I

15 Lectures

1.1: The nature & properties of the genetic material.

1.2: DNA as genetic material: Griffith's transformation experiment., Avery McCleat & McCarty experiments, Hershey-Chase experiments.

1.3: RNA as genetic material: Singer & Conrat expt. on TMV.

1.4: DNA Replication: Semiconservative nature of DNA replication , Meselson & Stahl experiment , procaryotic & eucaryotic replication, semi-discontinuous replication preming, bidirectional & unidirectional replication, θ mode of replication in bacteriophages, enzymes involved in DNA replication.

1.5 DNA damage-repair mechanisms: Photoreactivation, excision repair, recombination repair and SOS repair.

UNIT- II: MOLECULAR BIOLOGY-II

15 Lectures

2.1 Gene regulation: a) Control of gene expression in prokaryotes; Lac Operon, Trp Operon. b) Control of gene expression in eukaryotes; heterochromatin, euchromatin, transcriptional level control (transcription factors other than those involved in formation of initial complex; DNA binding domains, Helix turn helix, Zinc fingers, Leucine zipper, HLH (Helix – Loop – Helix) motif), Role of DNA methylation.

2.2 Mutations & mutagenic agents: Point mutations due to deletion, insertion & substitution (Missense, non-sense, frameshift & silent mutations), Tautomerism of bases, transition & transversion, mutagenesis; effect of ionizing radiations, UV radiation (formation of pyrimidine dimers), chemical mutagens, base analogue, alkylating agents, deaminating agents, intercalating agents.

UNIT-III: TOXICOLOGY-I

15 Lectures

3.1: Introduction to toxicology, definition, scope, relationship to other sciences, history of toxicology.

3.2: Sources of toxic compounds; food additives, chemicals in work place (lead & mercury). Drugs of abuse, therapeutic drugs, pesticides, solvents, polycyclic aromatic hydrocarbons and cosmetics.

3.3: Naturally occurring toxins: mycotoxins, microbial toxins, plant toxins (caffeine & nicotine), animal toxins (honey bee sting, venoms of coelenterates, scorpion, snake & fish).

3.4: Dose response relationship: Measurement of dose response relationship, dose response curves, LC₅₀ and LD₅₀, acute and chronic toxicity; margin and safety & therapeutic index; threshold dose and no observed effect level (NOEL); TDH, TDL.

UNIT-IV: TOXICOLOGY-II

15 Lectures

4.1: Mechanism of absorption through membranes, rates of penetration, routes of absorption in mammals, dermal, gastrointestinal and respiratory; distribution & accumulation.

4.2: Metabolism of toxicants: Phase I reactions, Phase II reactions, metabolism of carbon tetra chloride (CCl₄) and paracetamol.

4.3: Target organ toxicity – hepatotoxicity; susceptibility of liver, types of liver injury, examples of hepatotoxicants, nephrotoxicity, susceptibility of kidney, examples of nephrotoxicants, neurotoxicity, vulnerability of nervous system, examples of neurotoxicants.

Course Code: USZO504

Environmental Science-I, Environmental Biology, Epidemiology and Biostatistics

Unit-I: Environmental Science-I15 lectures

1.1: **Types of resources:** Conventional and non-conventional; exhaustible and inexhaustible; renewable and non-renewable.

1.2: **Resources utilization and impact of technology:** After industrial revolution and world wars; sustainable development.

1.3: **Energy:** Firewood, fossil fuel, solar, thermal, hydel, wind, tidal, geo-thermal, biofuels.

1.4: **Environmental education:** Goals and objectives; role of environmental organization and agencies.

Unit-II: Environmental Biology-I15 lectures

2.1: **Zoogeography:** Continuous and discontinuous distribution; dispersal-means and barriers; zoogeographic realms-geographical limits, climates, topography, vegetation and fauna of palaerctic, nearctic, neotropical, Ethiopian, oriental, Australian and Antarctic realms.

2.2: **Animal behavior;** Habitat selection, food selection, dispersal, homing, territoriality, aggression.

2.3: Social behavior: Schooling in fishes, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.

Unit-III: Epidemiology-I15 lectures

3.1: Scope of epidemiology:: Perspective of epidemiology; descriptive and analytical epidemiology; epidemiological triad; stages of diseases, screening for diseases.

3.2: Epidemiology of communicable diseases : definition of common terms.

3.2: Dynamics of disease transmission : Reservoir, route of transmission, incubation.

Unit-IV: Biostatistics-I.....15 lectures

4.1: Scope of biostatistics – Definition and limitations.

4.2: Sampling techniques: Simple random sampling- lottery method, with and without replacement, use of table of random numbers; stratified random sampling.

4.3: Classification of data- Primary, secondary, qualitative (concept of attributes), quantitative (concept of variate- discrete and continuous).

4.4: Presentation of data: tabulation-simple tables (one way and two way), complex tables, frequency distribution tables, diagrammatic presentation-frequency polygon, frequency curves, bar diagram, (simple, multiple, segmented), pie diagrams.

4.5: Measure of central tendency and dispersion: Mode, median, mean, variance, standard deviation.

**SEMESTER V
PRACTICAL- USZ0P05
Based on USZO501 and USZO502**

| | Course USZOP05 | Topic | Credits 3 |
|--|---------------------------|---|----------------------|
| | 1 | Sepia Dissections: Digestive, Nervous and Reproductive Systems | |
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| | 2 | Mountings: jaws, radula, chromatophores, spermatophores, statocyst. | |

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| 3 | Chick Embryology Observations: Permanent slides of whole-mounts of chick embryo at 18 hrs, 22-24 hrs, 36 hrs, 48 hrs & 72 hrs of incubation. |
| 4 | Permanent preparation of Chick Embryo - up to 48 hrs of incubation. |
| 5 | Study of placentae [observation - specimen and/or slide] Shark yolk sac placenta, different types of mammalian placentae. |
| 6 | Observation of permanent slides: Mammalian tissues: pituitary, adrenal, thyroid and pancreas |
| 7 | Study of acid phosphatase activity a. Effect of substrate concentration b. Effect of pH variation c. Effect of enzyme concentration d. Effect of inhibitor |
| 8 | Determine specific activity of Acid phosphatase |
| 9 | Separation of LDH isozyme by electrophoresis on agarose/PAGE |
| 10 | Study of vaginal smear to identify stages of Oestrous cycle |
| 11 | Study of human ECG: Normal, Sinus tachycardia, Sinus bradycardia, Ventricular fibrillation |
| 12 | Mounting of nerve cells and neurosecretory cells from cockroach |

Practical: USZOPO6

Based on USZO503 and USZO504

| Course USZOP06 | Topic | Credits 3 |
|--------------------------|--|---------------------|
| 1 | Estimation of RNA by Orcinol method. | |
| 2 | Estimation of DNA by Diphenylamine method. | |
| 3 | Isolation of <u>E. coli</u> genomic DNA and checking its purity by horizontal gel electrophoresis. | |

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| 4 | Determination of LC ₅₀ for a suitable pollutant (any one salt of a heavy metal dissolved in water) on Daphnia, Probit analysis. |
| 5 | Effect of salt of a heavy metal on the heart beat of Daphnia. |
| 6 | Effect of CCl ₄ on the level of enzyme activity in liver or serum acid and alkaline phosphatase, aspartate and alanine amino transferase. |
| 7 | Rapid field test for sulfate and nitrate content as well as base deficiency of soil samples |
| 8 | Determination of carbonates in soil by rapid titration |
| 9 | Analysis of community by working out ecological indices (frequency/importance probability, rarity, fidelity, constancy, species diversity and Shannon-Weiner Indices) |
| 9.1 | Using transect method |
| 9.2 | Using quadrat method |
| 10 | Study of interaction between organism: Social organization in : Honey bee, Termite, Hanuman langur, Asian elephant |
| | Study of fauna of different zoogeographic regions : Palearctic –Giant panda, Japanese snow Monkey Nearctic- Virginia opossum, sea otter, raccoon Neotropical- South American lung fish, low land tapir/ Brazilian tapir, llama Oriental- flying frog, gharial, flying lizard, Asian elephant, Indian porcupine, Great Indian one- horned rhino Ethiopian- African lung fish, ostrich, African elephant Australasian-duck- billed platypus, spiny ant eater, Australian lung fish, red kangaroo Antarctic-penguins |
| 11 | Temporary preparation of head and mouth parts of mosquito |
| 12 | From the given data, make frequency distribution table |
| 13 | From the given data, plot frequency polygon/histogram |
| 14 | From the given data, derive mean and standard deviation |
| 15 | From the given data, plot bar diagram/pie diagram |

Semester-VI – USZ0601

Theory

Unit I Study of Animal types-II

15 Lectures

1.1: Vertebrates: Shark

Systematic position, habit & habitat, distribution, external characters, skin, exoskeleton, endoskeleton, digestive system, respiratory system, blood vascular system, nervous system, receptor organs, urinogenital system, copulation, fertilization and development, economic importance.

Unit II: Comparative Chordate Anatomy: II

15 Lectures

2.1: Respiratory system:

Skin, gills of cartilaginous & bony fish, lungs in vertebrates.

2.2: Nervous system:

Development and differentiation of primary brain vesicles and their cavities, flexures of brain, evolution of cerebral hemispheres & cerebellum with reference to shark, frog, lizard, pigeon & rabbit.

2.3: Urinogenital System:

Archinephros, pronephros, mesonephros, metanephros, structure of nephron, urinogenital ducts, urinary bladder in vertebrates.

Unit III: Developmental Biology II:

15

Lectures

3.1: Frog embryology:

Gametogenesis, Structures of Egg and Sperm, Fertilization, Development in embryonic and post-embryonic phases.

3.2: Morphogenesis:

Fate maps, cell differentiation, embryonic stem cells, differential cell affinity, cell adhesion, morphogenetic movements.

Unit IV: Histology and Endocrinology II:

15

Lectures

4.1: Histology

Histological structures of the following mammalian organs: stomach, intestine, liver, kidney, testes and ovary.

Course – USZ0602
Hematology and Immunology

Unit I: Hematology-I

15 Lectures

1.1: Composition of blood: plasma proteins, Inorganic constituents, respiratory gases, Organic constituents other than proteins (include Internal Secretions, antibodies and enzymes)

1.2. Volume of blood: Total quantity and regulation, Haemorrhage, blood transfusion with whole blood and other materials (saline, gum acacia, isinglass).

1.3. Erythrocytes: Total count, variation in number and ESR, Abnormalities in form and structure of Erythrocytes, Haemoglobin structure, function, formation and degradation; Haemolysis (Fragility test) Erythropoiesis, Anaemia.

Unit-II: Hematology-II

15 Lectures

2.1. Leukocytes: Total count, differential count and variation in number, types of leukocytes and function, Differential count, Leucopoiesis and Leukemia.

2.2. Blood coagulation and lymph: Formation of blood platelets (Thrombopoiesis), clotting mechanism, Bleeding and clotting time, anticoagulants, failure of clotting mechanism.

Unit III: Immunology-I

15 Lectures

3.1. Innate (Nonspecific) Immunity: Definition and characteristics, Innate immunity at species, race, family and individual levels; Factors influencing the levels of innate immunity in an individual: age, hormone and nutrition; Mechanism: First line of defence, Second line of defence, Third line of defence.

3.2. Acquired (Specific) Immunity: Definition and characteristics, Important features: immune memory, Immune specificity & recognition of non-self; Passive acquired immunity: Natural and artificial; Active acquired immunity: Natural and artificial, Immune system cells: Lymphoid cells: B lymphocytes, T lymphocytes, Null cells & Activities of mononuclear cells: phagocytosis, Antimicrobial and cytotoxic activities, secretion of factors, Mast cells, Dendritic cells.

3.3. Organs of immune system: Primary lymphoid organs: Thymus, bone marrow, Lymphatic system; Secondary lymphoid organs: Lymph nodes, Spleen, Gut associated lymphoid tissue (GALT), & Cutaneous associated lymphoid tissue.

Unit IV: Immunology-II

15 Lectures

4.1 Antigens: Complete antigens and haptens, Determination of antigenicity: foreignness, molecular size, chemical composition and heterogeneity, susceptibility to tissue enzymes, antigen specificity, species specificity, iso-specificity, organ specificity, auto specificity, heterogenic specificity.

4.2. Immunoglobulin (antibodies); Basic structure of immunoglobulin, Immunoglobulin classes: IgG, IgM, IgA, IgD and IgE, structure and properties.

4.3. Antigen antibody interactions: General feature of antigen antibody interactions; Precipitation reaction: Definition, characteristics and mechanisms, in fluids (tube test) and in gels (slide test)- Radial immunodiffusion (Mancini method), Double immunodiffusion (Ouchterlony method), Immunoelectrophoresis, Agglutination reaction: definition, characteristics and mechanism, Haemagglutination (slide and micro-tray agglutination), Bacterial agglutination (tube agglutination), passive agglutination, Coomb's test and agglutination inhibition; complement fixation.

Course Code: USZO603

Title: Biotechnology, Genetics and Evolution

UNIT- I: BIOTECHNOLOGY-I

15 Lectures

1.1: Animal cell and tissue culture: Primary and established mammalian cell line and their characteristics, mass culture and clonal cell culture, density dependent regulation of growth, growth factors; media for cultivation of mammalian cells (media containing naturally occurring ingredients; blood plasma, blood serum, tissue extracts, complex media); Methodology: preparation of cells/organs for culture, coverslip culture, flask and tube culture, applications of animal cell culture.

1.2: Hybridoma technology: Somatic cell fusion, somatic cell genetics, production & applications of monoclonal antibodies

UNIT- II: BIOTECHNOLOGY-II

15 Lectures

2.1: DNA finger printing: PCR, Southern blotting, RFLP; application in forensic sciences, parenthood testing etc.

2.2: Gene manipulation: Restriction enzymes, types, characteristics & nomenclature; overview of various clonal strategies & characteristics of clonal vehicles; insertional inactivation in pBR 322 and pUC series plasmids, bacteriophage λ as a vector: insertional & replacement vectors; reverse transcription, preparation of designed gene (cDNA) using reverse transcriptase.

2.3: Bioinformatics: DNA data bases and protein data bases, primary & secondary data bases, broad idea of services available on the net viz. sequence search tools, FASTA & BLAST (Basic Local Allignment Search Tool), data retrieval system Entrez, SRS (Sequence Retrieval System); Literature data base: PubMed (Public Medline); Human genetics: OMIM (Online Mendelian Inheritance in Man).

UNIT-III: GENETICS

15 Lectures

3.1 Normal human karyotype: Karyotype preparation & banding techniques, band numbering scheme, human genome sequencing & human genome project.

3.2 Chromosome non-disjunction: Process of non-disjunction & its genetic implications, non-disjunction of autosomes; Trisomy 21, Trisomy 18, & Trisomy 13 syndrome; non-disjunction of sex chromosomes: Turner's & Klinefelter's syndromes, XXY males; other chromosomal anomalies: Deletions & duplications with examples; microdeletion & microduplication with examples, translocation, Down's syndrome & other translocation; other abnormalities: Inversions, ring chromosomes, polyploidy.

UNIT-IV: GENETICS & EVOLUTION

15 Lectures

4.1 Inborn errors of metabolism: The concept of inherited metabolic diseases, genetics of human metabolic diseases: Phenylketonuria, alkaptonuria & albinism, maternal PKU, G6PD deficiency and variants of G6PD; complex traits in families: Diabetes mellitus.

4.2: Evolution:

Molecular evolution: Amino acid sequence, divergence in proteins, nucleotide sequence, divergence in DNA, molecular evolutionary clock, large scale DNA sequence comparison, molecular marker analysis, DNA hybridization, gene organization, maintenance of gene diversity, phylogenetic analysis, construction of a phylogenetic tree, comparison of data from different sources in phylogenetic analysis.

Course Code: USZO604

(2.5 Credits)

Unit-I: Environmental Science-II.....15 lectures

1.1: **Air:** Components of air and their significance; common air pollutants, their sources, effects and management; greenhouse gases and global climate change, carbon audit (carbon credits and foot-print).

- 1.2: **Water:** Distribution of water; potable water resources –reasons for shift from rivers to impoundments and ground water resources; recharging ground water; common water pollutants, their sources, effect and management.
- 1.3: **Land:** Land use pattern and optimization; metal and non-metal resources, mining and its effect; geological hazard (earthquake, volcano, flood and erosion); soil as resource; agricultural practices and their polluting effects; types of solid wastes , strategies of waste management.
- 1.4: **Environmental management** – EIA studies; role of pollution control boards- central and Maharashtra.

Unit-II: Environmental Biology-II15 lectures

- 2.1:**Biodeversity and conservation:** Forest resources; National forest policy, forestry and wildlife-research education and training in india; India biodiversity; rare and endangered animals of India: wildlife conservation projects; important national parks, sanctuaries and tiger projects in India(Sanjay Gandhi, Tadoba, Gir, Ranthambhore, Dachigam, Jim Corbett, Bharatpur, Kaziranga, Sunderbans, Kanha, Bandipur-mudumalai, Silent Valley; Ecotourism.
- 2.2 **Wildlife management:** Definition, causes of wildlife depletion, importance of wildlife, management in India with emphasis on Western Ghat.

Unit-III: Epidemiology-II.....15 lectures

- 3.1: **Prevention and control of communicable diseases-** Notification, isolation, quarantine, disinfection; concurrent, terminal, precurent/ prophylactic methods of disinfection: natural, physical, chemical, immunization; general measures, health education in India.
- 3.2: **Epidemiology of communicable diseases:** Diagnosis, transmission, prevention, control measures and treatment of-
- a) **Diseases of viral origin-** Rabies, dengue, swine flue
 - b) **Diseases of bacterial origin-** TB, national TB control programme, leprosy, leptospirosis
 - c) **Diseases of protozoan origin-** Malaria, national malaria control programme
 - d) **Diseases of helminthes origin-** Ascariasis, dracunculosis, filariasis

Unit-IV: Biostatistics-II.....15 lectures

- 4.1: **Probability**- Addition and multiplication rules and their applications.
- 4.2: **Normal distribution**: Properties of normal distribution, Z- transformation, p-value.
- 4.3: **Parametric test of significance**- Two tailed Z test and t-test.
- 4.4: **chi-square test** and its applications.
- 4.5: **Correlation**: Correlation coefficient and testing significance of correlation coefficient.
- 4.6: **Use of computers in biostatistics**

SEMESTER VI
PRACTICAL - USZ0P07

| Course USZ0P07 | Topic | Credits 3 |
|---------------------------|---|----------------------|
| 1 | In suitable fish Dissections: Digestive, Circulatory, Urinogenital, Cranial nerves Mountings: scrollvalve, muscles, nervefiber, cartilage. Skeleton | |
| 2 | Temporary mountings: Placoid, cycloid and ctenoid scales of fish. | |
| 3 | Brain: Comparative study of brains of shark, frog, lizard, bird (pigeon /fowl) & rat. | |
| 4 | Observation of Permanent slides: Mammalian Tissues- liver, kidney, testis, ovary, stomach and intestine. | |
| 5 | Colorometric estimation of total plasma proteins. | |
| 6 | Separation of plasma proteins by electrophoresis on agarose/PAGE | |
| 7 | Estimation of blood glucose by O-toluidine method | |
| 8 | Estimation of serum/plasma total cholesterol by FeCl ₃ method. | |

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| 9 | Estimation of serum/plasma total triglycerides by Phosphovanillin method. |
| 10 | Enumeration of erythrocyte-total count. |
| 11 | Enumeration of leucocytes –total and differential count. |
| 12 | Estimation of haemoglobin by Sahlis acid haematin method. |
| 13 | Study of Lymphoid organs: Lymph node, Thymus and Spleen. |
| 14 | Study of Leukemic cells for permanent slide. |
| 15 | Observation of bone marrow cells. |
| 16 | Students are expected to know the preparation of blood report. |
| 17 | Latex agglutination test [any available/ Rheumatoid Arthritis] |
| 18 | Determination of blood group and Rh factor-RA test serum. |

Semester VI
Practical – USZOP08

| Course USZOP08 | Topic | Credits 3 |
|---------------------------|--|----------------------|
| 1 | Use of autoclave for sterilization of equipments for tissue culture. | |
| 2 | To prepare cells for culture from mammalian kidney, spleen or chick embryo using trypsin. | |
| 3 | Problems in Biotechnology & Bioinformatics. | |
| 4 | Karyotype analysis for the following syndromes with comments on numerical & structural variations in chromosomes: Turner's, Klinefelter's, Down's, Cri-du-chat, D-G translocation, Edward's & Patau's syndromes. | |

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| 5 | Physical properties of water |
| 5.1 | Turbidity |
| 5.2 | Conductivity |
| 6 | Chemical properties of water |
| 6.1 | Total acidity |
| 6.2 | Total alkalinity |
| 6.3 | COD |
| 6.4 | Heavy metal-Copper |
| 6.5 | Nitrate and nitrite nitrogen |
| 7 | Study of present status, distribution, habitats and reasons for decline in India of the following animals Gaur, Hangul, Rhino, Musk Deer, Wild Ass, Brow-antlered Deer, Blackbuck, Elephant, Tiger, Lion, Snow Leopard, Red Panda, Reticulate Python, Pink-Headed Duck, White – winged Wood Duck, Mountain Quail, Great Indian Bustard |
| 8 | Identification of permanent slides/ specimens of <i>Paramecium</i> , <i>Ascaris</i> , <i>Wuchereria</i> |
| 9 | Application of Z-test |
| 10 | Application of t-test |
| 11 | Application of chi-square test of significance |
| 11.1 | To test goodness of fit of observed and expected proportions |
| 11.2 | To test association between two events |
| 12 | Use of spreadsheet program in biostatistics |

Reference Books for Courses USZO501 & USZO 601

Invertebrates / Vertebrates and Comparative anatomy

1. Vertebrate comparative anatomy, Function, Evolution: K. V. Kardong, 3rd Ed. Tata McGraw Hill publication.
2. The life of Vertebrates: J. Z. Young, ELBS-Oxford Univ. Press.
3. A Text Book of Zoology: T. J. Parker and W. A. Haswell, McMillan.
4. Chordate zoology: E. L. Jordan and P. S. Verma, S. Chand & Co.
5. Invertebrate Zoology: E. L. Jordan and P. S. Verma, S. Chand & Co.

Developmental biology / Embryology

6. Developmental Biology: 5th Ed, Scott F. Gilbert, Sinauer Associates Inc. *
7. Developmental Biology: T. Subramoniam, Narosa Publishers.
8. Chick embryology: Bradley M. Patten

Histology / Endocrinology

9. Bailey's Text Book of Histology, 6th Ed: Scientific book Agency
10. General Endocrinology 3rd Ed,: Turner and Bagnara, Saunders.

Reference Books for Courses USZO502 & USZO602

Physiology, Homeostasis and regulation, Haematology and Immunology

1. Comparative animal Physiology: P. C. Withers. Thomson Publishing Co.
2. Comparative animal Physiology: Prosser and Brown
3. Comparative animal Physiology: Knut Schmidt-Nielson, Cambridge
4. General and Comparative animal Physiology: William Hoar, Princitice Hall.
5. Biochemistry: S. C. Rastogi, Tata McGraw Hill
6. Biochemistry: Lehninger, Nelson and Cox, Worth Publication.
7. Human Physiology, Vol I: Chhatterjee, Central Book Agency.
8. Immunology, 4th Ed. Janis Kuby, W. H. Freeman & Co.
9. Immunology, 6th Ed. Ivan M. Roitt
10. Immunology, Tizzard, Thomson Publishing Co.
11. Text Book of Microbiology, R. Ananthanarayan, Orient Longman.

References Books for Courses USZO503 & USZO603

Molecular Biology, Genetics and Evolution, Biotechnology, Bioinformatics

1. Celland molecular biology- Concept and Experiments: Gerald Karp, John Wiley and Sons & Inc.
2. Molecular Biology of the Cell: Bruce Alberts and others: Garland Publishing.
3. Molecular Biology: Peter Pioletta, Tata McGraw Hill.
4. Molecular Biology: David Freifelder, Narosa Publishing House.
5. The Science of Genetics: A.G. Atherly, J.R.Girton, J.F.McDonald, Harcourt College Publishers.
6. Genetics: D.J.Fairbanks, W.R.Anderson, Thomson Publishing Co.
7. Basic Human Genetics: E.J.Mange and A.P.Mange, Rastogi Publications.
8. Advance Genetics: G.S.Miglani, Narosa Publishing House.
9. Principles of Gene Manipulation: Old and Primrose, Blackwell Scientific Publication.

10. Molecular Biotechnology: B.R.Glick and J.J.Pasternak. ASM Press.
11. Biotechnology: Rutledge, Cambridge Publication.
12. Introduction to Bioinformatics: T.K.Atwood and D.J.Parrysmith. Pearson Education
13. Instant Notes-Bioinformatics. D.R.Westhead, J.H.Parish & R.M.Twyman. Viva Books Pvt. Ltd.
14. Introduction to Computational Molecular Biology: J.Setubal & J.Meidanis. International Student Ed. Thomson Books/Cole
15. Sequence Analysis in a nut shell. A guide to common tools and Data Base. S.Markel & D.Leon. O'Reilly, Shroff Publishers & Distributers

References Books for Courses USZO504 & USZO604

Toxicology, Environmental Biology/ Environmental Science, Animal Behaviour, Epidemiology, Biostatistics

1. Casarett & Doull's Toxicology. The Basic Science of Poisons. 5th Ed. McGraw Hill.
2. A Text book of Morden Toxicology: E.Hodgson and P.E.Levi, Tata McGraw Hill.
3. Principles of Environmental Science: W.P.Cunningham & M.A.Cunningham. Tata McGraw Hill.
4. Ecology: N.S.Subramanyam.& AVSS.Sambamurthy, Narosa.
5. Animal Behaviour: David McFarland, Pitman Publishers.
6. An Introdutin to Animal Behaviour, 5th Ed.A.Manning and S.Dawkins, Cambridge
7. Public Health & Sanitation Part I &II: The All India Institute of Local Self Government. Sthanikraj Bhavan, C.D.Barfiwala Marg, Andheri (W), 400058,
8. Park's Textbook of Preventive & Social Medicine, 7th E.d: K.Park, M/S Banarsidas Bhanot Publishers, 1167, Premnagar, Jabalpur, 482001.
9. Methods in Biosatistics: By Dr. B.K.Mahajan, Jaypee Brothers Medical Publishers
10. Introduction to Biostatistics: P.K.Banerjee. S.Chand & Co.

N.B :

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees :

- 1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
- 2) A Dissection Monitoring Committee (DMC)

Composition of DMC shall be as follows :

- i) Head of the Concerned Department (Convener/Chairperson)
- ii) Two Senior Faculty Members of the concerned Department
- iii) One Faculty of related department from the same College
- iv) One or two members of related department from neighboring colleges.

Scheme of Examinations:

Theory Course:

Recommendations for Internal Assessment for 40 marks

One periodical test on class instructions 20 marks

One assignments 10 marks

Active Participation (attentiveness/ability to answer questions) 05 marks

Leadership qualities in organizing or participation in academic or Co-curricular activities /mannerism and articulation etc. 05 marks

External Assessment 60 marks

Semester End Theory Assessment - 60% 60 marks

- i. Duration - These examinations shall be of two and half hours duration.
- ii. Theory question paper pattern :-
 1. There shall be **five** questions each of **12** marks. On each unit there will be one question & fifth one will be based on all the four units.
 2. All questions shall be compulsory with internal choice within the questions. Each question will be of **24** marks with options.
 3. Questions may be sub divided into sub questions a, b, c & d only, each carrying **six** marks **OR** a, b, c, d, e & f only each carrying **four** marks and the allocation of marks depends on the weightage of the topic.

Practical Course: 50 marks external.

Note:

1. Field excursions (with at least one beyond the limits of Mumbai) for habitat studies are compulsory. Field work of not less than eight hours duration is equivalent to one period per week for a batch of fifteen students.

2. A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of TYBSC Botany and the Field Report or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of T Y B Sc Botany as per the minimum requirements. In case of loss of journal a candidate must produce a certificate from the Head of the Department/ Institute that the practicals for the academic year were completed by the student. However such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.