AC Item No.

UNIVERSITY OF MUMBAI

Program: T. Y. B.Sc.

Course: Zoology

Syllabus for Semester V & VI

(Choice Based Credit Semester and Grading System
with effect from the academic year 2018-19)

CONTENTS

PREFACE

PREAMBLE

PEDAGOGY

The syllabus of paper I is an attempt to make the learners understand the principles of taxonomy, levels of organization, modern classification up to class and the evolutionary significance of various levels of organization like symmetry, coelom, segmentation etc.
The learners will fathom the levels of organization from cellular to the 'organ-system' level as well as Linnaean hierarchy, binomial nomenclature and six kingdom classification.
There are many schools of classification. Different authors claim diverse types and ways of their classification to be accurate. Hence it was a difficult assignment to finalize and introduce it in the university syllabus. We have tried our level best.
The latest and coherent way of classification of animals is selected in the present syllabus after much of the brainstorming together with the teachers, syllabus committee members, industry representatives and students themselves.
Though '5 kingdom classification' is studied in brief by the students in H. S. C. class; now at last year of graduation level in Zoology, they will study classification in elaborative way giving reasons why a particular animal is categorized in a particular division or group; phylum or class. In addition the learners will also be acquainted with some specific features of the phylum.
As a part of their syllabus, during their study tour, students observe live animals in zoo, national parks, sanctuaries, aquariums etc. This paper will make them confident in identifying animals up to class. Moreover, this understanding and awareness about classification of animals will help them in their research project based on biodiversity study.
The learner's space provided in the syllabus will be supportive to enthusiastic learners in gaining extra knowledge through various suggested activities to make their concepts impeccable and gain additional subject knowledge.

Course USZO502 includes Basic and Applied Haematology as well as Immunology. The topics included in Basic and Applied Haematology will help the students to understand various aspects of human blood, clinical disorders and their diagnosis. The significance of the diagnostic tools must be stressed upon as they are relevant to human health. Basic and applied Immunology will add up to the knowledge gained from haematology. Use of ICT and audio-visual simulations is recommended so that the learner gets better insights and understanding of topics like antigen-antibody interactions, immunoassays etc. These units can be taught by the conventional chalk-talk method augmented by hands-on practical sessions and visits to various institutions that focus on pathology and immunology procedures. Teachers are expected to elucidate the scope of haematology and immunology as career option in the field of pathology.
Course USZO602 deals with physiology concepts of enzymes, homeostasis and endocrine glands. Teachers while dealing with topics must ensure that the learner has a sound understanding of the subject preparing them to engage further in this field. Documentaries from BBC, National Geographic can be effectively used to create interest in the learners about adaptive responses of animals to environment for their survival. Industrial visits, guest lectures from industry persons will help in generating awareness about industrial significance of enzymes. Once the learner is equipped with the knowledge of basic physiology it will become easier to comprehend the topic of Animal tissue culture. Theory supplemented with hands-on practical on sterilization and culture techniques will help the learner to appreciate the importance of animal tissue culture. Visits to departments of microbiology and biotechnology in the institution may be encouraged to interact with teachers & students so as to create more interest and strengthen inter-departmental relations. Student led seminars are a self-learning interactive method that may be encouraged.

Course USZO503 includes Mammalian Histology, Basic Toxicology, General Pathology and Biostatistics. The students should be taught to appreciate central role that histology plays in the field of diagnostics. The microtomic skills acquired through the laboratory course will empower the students to work effectively in the field of histology. The emphasis should be given to the pharmaceutical aspects of toxicology. In addition to the basic toxicology, an introduction to the regulatory toxicology gives an insight into the practical difficulties and the norms associated with toxicity testing. Therefore, it is recommended that aspects of regulatory toxicology may be touched upon. Pathology forms one of the most important aspects of the field of diagnostics. The teacher is expected to elucidate the role of Histology as well as Toxicology in Pathological studies. Use of ICT is highly recommended as a pedagogical tool in this unit. The use of biostatistics in interpretation and validation of experimental data should be highlighted. It is expected that the students are introduced to biostatistical software.
Course USZO603 includes Molecular Biology, Genetic Engineering, Human Genetics and Bioinformatics. Molecular biology and genetic engineering should be taught using ICT and videos available online. It is recommended to have an industrial interface to explore teaching beyond classroom. Teachers are expected to explain the scope of gene manipulation techniques in medical science as well as industry. Teachers should sensitise students to the problems associated with genetic abnormalities. Bioinformatics is expected to be taught using ICT. The practical utilization of bioinformatics in preparing probes using database should be stressed. Use of software to understand protein sequencing, construction of evolutionary trees etc. is recommended. The focus should be on utility of the available software in public domain to study human diseases

Syllabus of Paper IV (Semester V) deals with the importance of various types of epidermal and dermal derivatives, human skeleton, their structure, types and functions along with various types of long limb muscles, arrangement and their role in body movements. Furthermore, it encompasses the developmental processes involved in choreographing of chick embryo. Syllabus of the Paper IV (Semester VI) deals with the various environmental issues and their management. Additionally, it includes various new techniques/methods for wildlife conservation apart from traditional techniques, enabling the learner to understand the human-animal conflict. The present syllabus gives an insight into the various paradigms of discovery and commercialization of biological resources and self-medication exhibited by animals. It acquaints he learner with the overall distribution of different animal species throughout the globe.

Syllabus for T.Y.B. Sc.
Course: ZOOLOGY
(Credit Based Semester and Grading System)
(To be implemented from the Academic Year 2018-2019)

SEMESTER-V					
THEORY					
COURSE NO.	**COURSE CODE**	**UNIT**	**TOPICS**	**CREDITS**	**LECTURES/ WEEK**
11	USZO501	I	Principles of Taxonomy	2.5	1
		II	Kingdom: Animalia I		1
		III	Kingdom: Animalia II		1
		IV	Type study: *Sepia*		1
12	USZO502	I	Basic Haematology	2.5	1
		II	Applied Haematology		1
		III	Basic Immunology		1
		IV	Applied Immunology		1
13	USZO503	I	Mammalian Histology	2.5	1
		II	Toxicology		1
		III	General Pathology		1
		IV	Biostatistics		1
14	USZO504	I	Integumentary system and derivatives	2.5	1
		II	Human Osteology		1
		III	Muscles of long bones of Human limbs		1
		IV	Developmental biology of Chick		1
				10	**16**
PRACTICAL					
USZOP05	Practicals based on all four courses			**06**	**16**
Total Number of Credits and Workload				**16**	**32**

Syllabus for T.Y.B. Sc.
Course: ZOOLOGY
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SEMESTER-VI					
THEORY					
COURSE NO.	**COURSE CODE**	**UNIT**	**TOPICS**	**CREDITS**	**LECTURES/ WEEK**
15	USZO601	I	Phylum Chordata and Euchordata I	2.5	1
		II	Group Euchordata II		1
		III	Group Euchordata III		1
		IV	Type study: Shark		1
16	USZO602	I	Enzymology	2.5	1
		II	Homeostasis		1
		III	Endocrinology		1
		IV	Animal Tissue Culture		1
17	USZO603	I	Molecular Biology	2.5	1
		II	Genetic Engineering		1
		III	Human Genetics		1
		IV	Bioinformatics		1
18	USZO604	I	Environment management	2.5	1
		II	Wildlife management		1
		III	Bioprospecting and Zoopharmacognosy		1
		IV	Zoogeography		1
				10	**16**
PRACTICAL					
USZOP06	Practicals based on all four courses			**06**	**16**
Total Number of Credits and Workload				**16**	**32**

T. Y. B. Sc. Zoology: Semester V (Theory)
Course Code: USZO501: Taxonomy and Type Study I
Course 11

Unit I: Principles of Taxonomy **(15L)**

Objective:

- *To introduce the principles of taxonomy and modern system of classification in animal kingdom so as to give the students with evolution point of view.*

Desired outcome:

- *Learners will apprehend the basis of classification and modern classification up to class of the lower invertebrate animals.*

1.1: Levels of Organization:

1.1.1: Unicellularity, colonization of cells, multicellularity

1.1.2: Levels of Organization: Acellular, Cellular, Tissue level, Organ level and 'Organ-system' level

1.2: Symmetry

1.2.1: Basic concept and definition

1.2.2: Types:

a. Asymmetry: e.g. *Amoeba*
b. Radial symmetry: e.g. Starfish
c. Bi-lateral symmetry: e.g. Invertebrate – Planaria
Vertebrate – Man

1.2.3: Evolutionary significance of symmetry

1.3: Coelom

1.3.1: Basic concept and definition

1.3.2: Formation of coelom

1.3.3: Types:

a. Acoelomate: Platyhelminthes e.g. Liverfluke
b. Pseudocoelomate: Nematoda e.g. *Ascaris*
c. Coelomate: e.g. Frog

1.3.4: Evolutionary significance of coelom

1.4: Metamerism

1.4.1: Basic concept and definition

1.4.2: Types:

a. Pseudometamerism: e.g. Tapeworm
b. True metamerism:
   i. Homonomous – Annelida e.g. *Nereis*
   ii. Heteronomous – Cephalization – Insecta e.g. Dragonfly
   Cephalothorax – Crustacean e.g. Lobster

1.4.3: Evolutionary significance of metamerism

1.5: Taxonomy

1.5.1: Basic concept, definition and objectives

1.5.2: Linnaean Hierarchy, Binomial Nomenclature

1.5.3: Six Kingdom classification:
General characters of each Kingdom with examples:

- Kingdom Archaebacteria
- Kingdom Eubacteria
- Kingdom Protista
- Kingdom Fungi
- Kingdom Plantae
- Kingdom Animalia

1.6: Kingdom Protista: Animal like Protists: Protozoa
1.6.1: General characters of Protozoa

1.6.2: Classification of Protozoa with distinguishing features and suitable examples:

- Phylum Sarcomastigophora
  - Class Sarcodina e.g. *Amoeba*
  - Class Mastigophora e.g. *Trypanosoma*
- Phylum Ciliophora
  - Class Ciliata e.g. *Opalina*
  - Class Phyllopharyngea e.g. *Dysteria*
- Phylum Sporozoa
  - Class Aconoidasida e.g. *Plasmodium*
  - Class Conoidasida e.g. *Toxoplasma*

Unit II: Kingdom Animalia I **(15L)**

Objective:

- *To comprehend the general characters and classification of Kingdom Animalia from Porifera to Nematoda and specific characters of organisms.*

Desired outcome:

- *The learners will be familiarized with classification up to phylum Nematoda along with their examples.*

2.1: Phylum Porifera

a. General characters
b. Classification up to class with distinguishing features and suitable examples:
   - Class Calcarea e.g. *Leucosolenia*
   - Class Hexactinellida e.g. *Hyalonema* (Glass-rope sponge)
   - Class Demospongia e.g. *Euspongia* (Bath sponge)

2.2: Phylum Cnidaria

a. General characters
b. Classification up to class with distinguishing features and examples
   - Class Hydrozoa e.g. *Hydra*
   - Class Scyphozoa e.g. *Aurelia* (Jelly fish)
   - Class Anthozoa e.g. *Meandrina* (Maze Coral)

2.3: Phylum Platyhelminthes

a. General characters

b. Classification up to class with distinguishing features and examples
   - Class Turbellaria e.g. *Planaria*
   - Class Trematoda e.g. *Schistosoma* (Blood-fluke)
   - Class Cestoda e.g. *Taenia sp.* (Tapeworm)

c. Morphology, life cycle and pathogenicity of *Fasciola sp.*

2.4: Phylum Nematoda

a. General characters
b. Classification up to class with distinguishing features and examples
   - Class: Aphasmida / Adenophorea e.g. *Trichinella* (Trichina worm)
   - Class: Phasmida / Secernentea e.g. *Ascaris* (Roundworm)

Unit III: Kingdom Animalia II **(15L)**

Objective:

- *To introduce basic concepts of classification up to class in animal kingdom from phylum Annelida to Hemichordata and to familiarize with their characters.*

Desired outcome:

- *Learners will get an idea of higher groups of invertebrate animal life, their classification and their peculiar aspects.*

3.1: Phylum Annelida

3.1.1: General characters

3.1.2: Classification up to class with distinguishing features and examples
   - Class Polychaeta e.g. *Neries* (Clamworm)
   - Class Oligochaeta e.g. *Pheretima* (Earthworm)
   - Class Hirudinea e.g. *Hirudinaria* (Leech)

3.2: Phylum Arthropoda

3.2.1: General characters

3.2.2: Classification up to class with distinguishing features and examples
   - Subphylum Chelicerata
     - Class Arachnida e.g. *Hottentotta tamulus* (Indian Red Scorpion)
     - Class Merostomata e.g. *Limulus* (Horse-shoe crab)
     - Class Pycnogonida e.g. *Nymphon* (Sea spider)
   - Subphylum Crustacea
     - Class Malacostraca e.g. *Scylla serrata* (Giant Mud Crab)
     - Class Maxillipoda e.g. *Balanus* (Barnacle)
   - Subphylum Uniramia
     - Class Chilopoda e.g. Centipede
     - Class Diplopoda e.g. Millipede
     - Class Insecta e.g. *Attacus atlas* (Atlas moth)

3.3: Phylum Mollusca

3.3.1: General characters of the Phylum.

3.3.2: Classification up to class with distinguishing features and examples

- Class Aplacophora e.g. *Chaetoderma*
- Class Polyplycophora e.g. *Chiton* (Coat-of-mail shells)
- Class Monoplacophora e.g. *Neopilina*
- Class Gastropoda e.g. *Nerita* (Nerit)
- Class Pelecypoda e.g. *Solen* (Razor clam)
- Class Scaphopoda e.g. *Dentalium* (Tusk shell)
- Class Cephalopoda e.g. *Nautilus* (Pearly nautilus)

3.4: Phylum Echinodermata

3.4.1 General characters

3.4.2 Classification up to class with distinguishing features and examples

- Class Asteroidea e.g. *Protoreaster* (Starfish)
- Class Ophiuroidea e.g. *Ophiothrix* (Brittle star)
- Class Echinoidea e.g. *Clypeaster* (Sand dollar)
- Class Holothuroidea e.g. *Cucumaria* (Sea cucumber)
- Class Crinoidea e.g. *Antedon* (Sea lily)

3.5 Minor phyla

3.5.1: General characters along with examples of

- Phylum Acanthocephala e.g. *Moniliformis*
- Phylum Onychophora e.g. *Peripatus* (Velvet worm)
- Phylum Chaetognatha e.g. *Sagitta* (Arrow worm)

3.5.2: *Peripatus*, a connecting link

3.6 Phylum Hemichordata

3.6.1: General characters and classification with distinguishing features and examples

- Class Enteropneusta e.g. *Balanoglossus* (Acorn worm)
- Class Pterobranchia e.g. *Rhabdopleura*
- Class Planctosphaeroidea e.g. *Planctosphera*

3.7 Basic concepts of phylogeny: Phylogenetic tree of invertebrates

Unit IV: Type study: *Sepia* **(15L)**

Objective

- *To acquaint learners with the details of Sepia as a representative of invertebrate animals.*

***Desired* outcome**

- *Learners will get an idea of general characteristics and details of invertebrate animal systems.*

4.1: General characters and classification, Habit and habitat, External characters, mantle cavity, locomotion, economic importance

4.2: Digestive system, Respiratory system, Circulatory system, Excretory system, Nervous system and Sense organs, Reproductive system

Course Code: USZO502: Haematology and Immunology
Course 12

Unit I: Basic Haematology **(15L)**

Objectives:

- *To introduce to the learner the composition of blood, haemorrhage and haematopoiesis*
- *To acquaint the learner with the physiology of blood clotting and clinical aspects of haematology,*

Desired outcome:

- *The learner shall comprehend basic haematology.*
- *The learner will be able to identify various components of haemostatic systems*

1.1: Composition of plasma: Water, respiratory gases, dissolved salts, plasma proteins, nutrients, enzymes, hormones, nitrogenous waste products

1.2: Haematopoiesis: Erythropoiesis, leucopoiesis and thrombopoiesis

1.3: Erythrocytes: Structure and functions, abnormalities in structure, total count, variation in number; ESR; types of anaemia

1.4: Haemoglobin: Structure, formation and degradation; variants of haemoglobin (foetal, adult), abnormalities in haemoglobin (Sickle cell and Thalassemia)

1.5: Leucocytes: Types and functions, total count and variation in number; leukaemia and its types

1.6: Thrombocytes: Structure, factors and mechanism of clotting, failure of clotting mechanism

1.7: Blood volume: Total quantity and regulation; haemorrhage

Unit II: Applied Haematology **(15L)**

Objective:

- *To introduce to the learner the basics of applied haematology and to impart knowledge of diagnostic techniques used in pathology.*

Desired outcome:

- *The learner will be familiar with the terminology used and diagnostic tests performed in a pathological laboratory.*
- *The learner shall be acquainted with diagnostic approaches in haematological disorders.*
- *The learner will be better equipped for further pathological course or working in a diagnostic laboratory.*

2.1: Introduction and scope of Applied Haematology: Clinical, microbiological, oncological and forensic haematology

2.2: Clinical significance of Diagnostic Techniques

2.2.1: Microscopic examination of blood:

- Blood cancer (lymphoma, myeloma),
- Infectious diseases (malaria, leishmaniasis),
- Haemoglobinopathies (sickle cell anaemia, thalassemia)

2.2.2**:** Coagulopathies: Haemophilia and purpura

2.2.3**:** Biochemical examination of blood:

- Liver function tests: AST, ALT, LDH, Alkaline phosphatase , Total and direct bilirubin
- Kidney function test**:** Serum creatinine, Blood Urea Nitrogen (BUN)
- Carbohydrate metabolism tests: Blood sugar, Glucose tolerance test, Glycosylated haemoglobin test
- Other biochemical tests: Blood hormones - TSH, FSH, LH.

Unit III: Basic Immunology (15L)

Objective:

- *To introduce the topic of immunology by emphasizing the basic concepts to build a strong foundation and to give an overview of the immune system that plays an important role in disease resistance.*

Desired outcome:

- *The learner shall comprehend the types of immunity and the components of immune system.*
- *The learner will realize the significant role of immune system in giving resistance against diseases.*

3.1: Overview of Immunology

3.1.1**:** Concept of immunity

3.1.2**:** Innate immunity – Definition, factors affecting innate immunity, Mechanisms of innate immunity – First line of defence – physical and chemical barriers; Second line of defence- phagocytosis, inflammatory responses and fever

3.1.3**:** Adaptive or Acquired immunity, Antibody mediated and cell mediated immunity; Active Acquired immunity – Natural and Artificial; Passive Acquired immunity – Natural and Artificial

3.2: Cells and Organs of immune system

3.2.1: Cells of immune system – B cells, T cells and null cells, macrophages, dendritic cells and mast cells

3.2.2: Organs of immune system

- Primary: Thymus and bone marrow
- Secondary: Lymph nodes and spleen

3.3: Antigens: Definition and properties; haptens

3.4: Antibodies: Definition, basic structure, classes of antibodies – IgG, IgA, IgM, IgD and IgE

3.5: Antigen processing and presentation

3.5.1: Endogenous antigens – cytosolic pathways

3.5.2: Exogenous antigens – endocytic pathways

Unit IV: Applied Immunology **(15L)**

Objectives:

- *To introduce immunopathology to the learner*
- *To introduce the concept of vaccines and vaccination.*
- *To familiarise the learner to immunological perspectives of organ transplantation.*

Desired outcome:

- *The learner shall understand immunopathology and the principles and applications of vaccines.*
- *The learner will develop basic understanding of immunology of organ transplantation.*

4.1: Antigen-Antibody interaction

4.1.1**:** General features of antigen-antibody interaction

4.1.2**:** Precipitation reaction – Definition, characteristics and mechanism.

- Precipitation in gels (slide test)
- Radial immunodiffusion (Mancini method)
- Double immunodiffusion (Ouchterlony method)

4.1.3**:** Immunoelectrophoresis – Counter-current and Laurel's Rocket electrophoresis

4.1.4**:** Agglutination reaction definition, characteristics and mechanism.

- Haemagglutination (slide and micro-tray agglutination)
- Passive agglutination
- Coomb's test

4.1.5**:** Immunoassay- ELISA

4.2: Vaccines and Vaccination

4.2.1**:** Principles of vaccines – active and passive immunization, Routes of vaccine administration

4.2.2**:** Classification of vaccines:

- Live attenuated
- Whole-Killed or inactivated
- Sub-unit vaccines: Toxoids, Protein vaccines, Viral-like particles, DNA vaccines

4.2.3**:** Adjuvants used for human vaccines:

- Virosomes and Liposomes
- Saponins

- Water-in-oil emulsions

4.2.4**:** Vaccines against human pathogens:
- Polio
- Hepatitis A and B
- Tuberculosis (BCG)

4.3: Transplantation Immunology: Introduction to transplantation; Types of grafts; Immunologic basis of graft rejection: MHC compatibility in organ transplantation, Lymphocyte and Antibody mediated graft rejection; Precautionary measures against graft rejection

Course Code: USZO503: Mammalian Histology, Basic Toxicology, General Pathology and Biostatistics Course 13

Unit I: Mammalian Histology (15L)

Objectives:
- *To familiarize the learner with the cellular architecture of the various organs in the body.*
- *To make the learner understand the need and importance of different types of tissues in the vital organs and their functions.*

Desired outcome:
- *Learner would appreciate the well planned organization of tissues and cells in the organ systems.*

1.1: Vertical section (V.S.) of skin: Layers and cells of epidermis; papillary and reticular layers of dermis; sweat glands, sebaceous glands and skin receptors

1.2: Digestive System

1.2.1: Vertical section (V.S.) of tooth; hard tissue – dentine and enamel; soft tissue – dentinal pulp and periodontal ligaments

1.2.2: Transverse section (T.S.) of tongue – mucosal papillae and taste buds

1.2.3: Alimentary canal – Transverse section (T.S.) of stomach, small intestine, large intestine of mammal.

1.2.4: Glands associated with digestive system – Transverse section (T.S.) of salivary glands, liver.

Unit II: Toxicology (15 L)

Objective:

- *To introduce the learner to the principles of toxicology with particular emphasis on toxic responses to chemical exposures, nature and effect of toxicity and toxicity testing.*
- *It also intends to develop amongst students an introductory understanding of regulatory affairs in toxicology.*

Desired outcome:

- *The course will prepare learner to develop broad understanding of the different areas of toxicology.*
- *It will also develop critical thinking and assist students in preparation for employment in pharmaceutical industry and related areas.*

2.1: Basic toxicology

2.1.1: Introduction to toxicology – brief history, different areas of toxicology, principles and scope of toxicology

2.1.2: Toxins and Toxicants – Phytotoxins (caffeine, nicotine), Mycotoxins (aflatoxins), Zootoxins (cnidarian toxin, bee venom, scorpion venom, snake venom)

2.1.3: Characteristics of Exposure – Duration of exposure, Frequency of exposure, Site of exposure and Routes of exposure

2.1.4: Types of Toxicity – Acute toxicity, Sub-acute toxicity, Sub-chronic toxicity and Chronic toxicity

2.1.5: Concept of LD_{50}, LC_{50}, ED_{50}

2.1.6: Dose Response relationship – Individual / Graded dose response, Quantal dose response, shape of dose response curves, Therapeutic index, Margin of safety

2.1.7: Dose translation from animals to human – Concept of extrapolation of dose, NOAEL (No Observed Adverse Effect Level), Safety factor, ADI (Acceptable Daily Intake)

2.1.8: Target organ toxicity:
Hepatotoxicity: susceptibility of the liver, types of liver injury, examples of hepatotoxicants;
Neurotoxicity: vulnerability of nervous system, examples of neurotoxicants;
Nephrotoxicity: susceptibility of kidney, examples of nephrotoxicants

2.2: Regulatory toxicology

2.2.1: OECD guidelines for testing of chemicals (an overview)

2.2.2: CPCSEA guidelines for animal testing centre, ethical issues in animal studies

2.2.3: Animal models used in regulatory toxicology studies

2.2.4: Alternative methods in toxicology (*in vitro* tests)

Unit III: General Pathology **(15L)**

Objectives:

- *To introduce the learner to basics of general pathology.*
- *To impart knowledge of retrogressive, necrotic, pathological conditions in the body.*
- *To explain repair mechanism of the body.*

Desired outcome:

- *Learner will be familiar with various medical terminology pertaining to pathological condition of the body caused due to diseases.*

3.1: General Pathology: Introduction and scope

3.2: Cell injury: Mechanisms of cell injury: ischemic, hypoxic, free radical mediated and chemical

3.3: Retrogressive changes: Definition, cloudy swelling, degeneration: fatty, mucoid and amyloid (causes and effects)

3.4: Disorders of pigmentation: Endogenous: Brief ideas about normal process of pigmentation, melanosis, jaundice (causes and effects)

3.5: Necrosis: Definition and causes; nuclear and cytoplasmic changes; types: coagulative, liquefactive, caseous, fat and fibroid

3.6: Gangrene: Definition and types – dry, moist and gas gangrene

Unit IV: Biostatistics **(15L)**

Objective:

- *To make learner familiar with biostatistics as an important tool of analysis and its applications.*

Desired outcome:

- *The learner will be able to collect, organize and analyze data using parametric and non-parametric tests.*
- *They will also be able to set up a hypothesis and verify the same using limits of significance.*

4.1: Probability Distributions: Normal, Binomial, Poisson distribution, Z-transformation, p-value, Probability - Addition and multiplication rules and their applications.

4.2: Measures of Central Tendency and Dispersion: Variance, standard deviation, standard error

4.3: Testing of Hypothesis: Basic concepts, types of hypothesis: Null hypothesis and Alternate hypothesis, Levels of significance and testing of hypothesis

4.4: Parametric and non-parametric test: Parametric tests: two-tailed Z-test and t-test
Non-parametric test: Chi-square test and its applications

4.5: Correlation: Correlation coefficient and its significance

Course Code: USZO504: Integumentary system, Human Osteology, Limb Muscles and Developmental Biology of Chick Course 14

Unit I: Integumentary system and derivatives **(15L)**

Objective:

- *To introduce the learner to understand different integumentary structures and derivatives in the vertebrates and to acquaint learners with special derivatives of integument.*

Desired outcome:

- *Learner will be able to understand the importance of various types of epidermal and dermal derivatives along with their functions.*

1.1: Basic structure of integument: Epidermis and dermis

1.2: Epidermal derivatives of Vertebrates

1.2.1: Hair, hoof, horn, claw, teeth, beak and epidermal scales (small scales, large scales, modified scales - spine)

1.2.2: Glands - types (mucous, serous, ceruminous, poison, uropygial, and salt gland) and functions

1.2.3: Type of feathers

1.3: Dermal derivatives of Vertebrates: Scales in fish; scutes in reptiles and birds; dermal scales in mammals – Armadillo, Antler – Caribou

1.4: Special derivatives of integument: Wart in toad, rattle in snake, whale bone in baleen whale, kneepads in camel.

Unit II: Human Osteology **(15L)**

Objective:

- *To introduce the learner to different bones of human skeleton and their functional importance.*

Desired outcome:

- *Learner will be able to understand the structure, types and functions of human skeleton.*

2.1: Introduction: Bone structure (Histology), physical properties, chemical composition and general functions of bones.
Cartilage: General structure, functions

2.2: Axial skeleton

2.2.1: Skull: General characteristics of skull bones - Cranial and facial bones

2.2.2: Vertebral column: General characteristics of a vertebra, structure of different types of vertebrae (cervical, thoracic, lumbar, sacrum and coccyx)

2.2.3: Ribs and sternum: General skeleton of ribs and sternum

2.2.4: Hyoid bone: Structure and function.

2.3: Appendicular skeleton

2.3.1: Pectoral girdle and bones of forelimbs

2.3.2: Pelvic girdle and bones of hind limbs

Unit III: Muscles of long bones of Human limbs (15L)

Objectives:

- *To study long limb muscles involved in body movements.*
- *To identify various arrangements of the long limb muscles and to relate the arrangement with contraction and motion.*
- *To study muscle injuries and syndromes.*

Desired outcome:

- *Learner will be able to understand the types of long limb muscles, its arrangement and their role in body movements.*

3.1: Introduction and types of long limb muscles

3.1.1: Flexors, Extensor, Rotator, Abductors, Adductors

3.2: Muscles of forelimbs

3.2.1: Muscles that move the arm (Humerus) – *Triceps brachii, Biceps brachii, brachialis* and *brachioradialis*

3.2.2: Muscles that move the forearm (Radius-ulna) – *Flexor carpi radialis, Flexor carpi ulnaris* and *Extensor carpi ulnaris*

3.2.3: Muscles that move the wrist, hand and fingers – *Flexor digitorium superficialis, Extensor carpi radialis* and *Extensor digitorum*

3.3: Muscles of hind limbs

3.3.1: Muscles that move the thigh (Femur) – Sartorius, Adductor group, Quadriceps group (*Rectus femoris, Vastus lateralis, Vastus medialis*), Hamstring group (*Biceps femoris, Semimembranosus, Semitendinosus*)

3.3.2: Muscles that move the lower leg (tibia-fibula) – *Fibularis longus, Gastrocnemius, Tibialis anterior, Soleus, Extensor digitorum longus* and *Fibularis tertius*

3.3.3: Muscles that move the ankle, foot and toes - *Tibialis anterior, Extensor digitorum, Longus* and *Fibularis* muscles

Unit IV: Developmental biology of Chick (15L)

Objective:

- *To introduce the learner to the basics of developmental biology with reference to chick as a model and also familiarize with experiments related to it.*

Desired outcome:

- *Learner will be able to understand the processes involved in embryonic development and practical applications of studying the chick embryology.*

4.1: Introduction to Developmental Biology: Basic concept and principles of developmental biology - morphogenesis, organogenesis, fate maps, cell adhesion, cell affinity and cell differentiation.

4.2: Development of Chick embryo

4.2.1: Structure of Hen's egg, physico-chemical nature and forms of yolk- granular, platelets and spheres; fertilization, cleavage, blastulation, gastrulation

4.2.2: Structure of chick embryo – 18 hours, 24 hours, 33 hours, 48 hours and 72 hours

4.2.3: Extra embryonic membranes

4.2.4: Organizer: Introduction, Spemann Mangold experiment, Hensen's node as an organizer.

Practical Syllabus for Semester V
Course code: USZOP05; Course 11

1. Classification of phyla up to class and study of the general characters up to class.

Kingdom Protista – Animal-like Protists: Protozoa

A. Phylum: Sarcomastigophora
   - Class Sarcodina e.g. *Amoeba*
   - Class Mastigophora e.g. *Euglena*

B. Phylum: Ciliophora
   - Class Ciliata e.g. *Paramoecium*
   - Class Phyllopharyngea e.g. *Dysteria*

C. Phylum: Apicomplexa / Sporozoa,
   - Class Aconoidasida e.g. *Eimeria*
   - Class Conoidasida e.g. *Sarcocystis*

Kingdom Animalia

D. Phylum: Porifera
   - Class Calcarea e.g. *Scypha*
   - Class Hexactinellida e.g. *Hyalonemma*
   - Class Demospongia e.g. *Spongilla*

E. Phylum Cnidaria
   - Class Hydrozoa e.g. *Vellela*
   - Class Scyphozoa e.g. *Rhizostoma*
   - Class Anthozoa e.g. *Corallium*

F. Phylum Platyhelminthes
   - Class Turbellaria e.g. *Dugesia tigrina*
   - Class Trematoda e.g. *Fasciola hepatica*
   - Class Cestoda e.g. *Taenia solium*

G. Phylum Nematoda
   - Class Aphasmida / Adenophorea e.g.*Trichinella*
   - Class Phasmida / Secernentea e.g. *Ascaris*

H. Phylum Annelida
   - Class Polychaeta e.g. *Arenicola*
   - Class Oligochaeta e.g. *Tubifex*
   - Class Hirudinea e.g. *Pontobdella*

I. Phylum Arthropoda

Subphylum Chelicerata
   - Class Arachnida e.g. (Scorpion)
   - Class Merostomata e.g. *Limulus*
   - Class Pycnogonida e.g. (Sea spider)

Subphylum Crustacea

- Class Malacostraca e.g. Lobster
- Class Maxillipoda e.g. Copepods

Subphylum Uniramia

- Class Chilopoda e.g. Centipedes
- Class Diplopoda e.g. Millipedes
- Class Insecta e.g. Moth

J. Phylum Mollusca

- Class Aplacophora e.g. *Chaetoderma*
- Class Polyplacophora e.g. *Tonicella*
- Class Monoplacophora e.g. *Neopilina*
- Class Gastropoda e.g. *Turbo*
- Class Pelycypoda e.g. *Donax*
- Class Scaphopoda e.g. *Dentalium*
- Class Cephalopoda e.g. *Octopus*

K. Phylum Echinodermata

- Class Asteroidea e.g. Starfish
- Class Ophiuroidea e.g. Brittle star
- Class Echinoidea e.g. *Echinus* (Sea urchin)
- Class Holothuroidea e.g. *Holothuria* (Sea cucumber)
- Class Crinoidea e.g. Crinoid (Sea lily)

L. Phylum Hemichordata

- Class Enteropneusta e.g. *Saccoglossus*
- Class Pterobranchia e.g. *Rhabdopleura*
- Class Planctosphaeroidea e.g. *Planctosphaera*

2. Minor Phyla

Acoelomate

M. Phylum Acanthocephala e.g. *Echinorhynchus*

Coelomate

N. Phylum Chaetognatha e.g. *Sagitta*
O. Phylum Onychophora e.g. *Peripatus*

3. Study of Sepia with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected.

a) Digestive system,
b) Reproductive system
c) Nervous system
d) Jaws
e) Radula
f) Chromatophores
g) Spermatophores
h) Statocyst

4. Study tour – Visit to fish market / Aquarium / Any other place to observe invertebrates and submit a report.

Course code: USZOP05; Course 12

1. Enumeration of Erythrocytes – Total Count.
2. Enumeration of Leucocytes – Total Count.
3. Differential count of Leucocytes.
4. Erythrocyte Sedimentation Rate by suitable method – Westergren or Wintrobe method.
5. Estimation of haemoglobin by Sahli's acid haematin method.
6. Determination of serum LDH by using colorimeter/ spectrophotometer.
7. Estimation of total serum/ plasma proteins by Folin's method.
8. Estimation of serum/ plasma total triglycerides by Phosphovanillin method.
9. Latex agglutination test – Rheumatoid Arthritis.
10. Determination of bleeding and clotting time.

Course code: USZOP05; Course 13

1. Study of mammalian tissues: V.S. of Tooth, T.S. of Stomach, T.S. of small intestine**,** T.S. of Liver.
2. Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation, sectioning, staining.
3. Identification of diseases or conditions (from slides or pictures): Vitiligo, Psoriasis, Bed sores, Necrosis, Oedema
4. To study the effect of CCl_4 on the level of enzyme activity in liver on aspartate and alanine amino transferase, alkaline phosphatase (*in vitro* approach).
5. Study and interpretation of pathological reports: Blood, Urine and Stool (faeces).
6. Following biostatistics practicals will be done using data analysis tool of Microsoft Excel (DEMONSTRATION in regular practicals) & manually:
   a. Problems based on Z test
   b. Problems based on t test
   c. Problems based on Chi square test
   d. Correlation, regression analysis – demonstration only.
   e. Problems based on ANOVA – demonstration only.

   (Learner is expected to identify appropriate test for the given problem)

Course code: USZOP05; Course 14

1. Study of integumentary systems – V. S. of Skin of Shark, Frog, *Calotes*, Pigeon and Human
2. Study of Human Axial Skeleton – Skull and Vertebral column
3. Study of Human Appendicular Skeleton – Pectoral and pelvic girdle with limb bones
4. Study of muscles of forelimbs – *Biceps brachii, Brachialis, Brachio radialis, Triceps brachii, Flexor carpi radialis, Flexor carpi ulnaris* and *Extensor carpi ulnaris*
5. Study of muscles of hind limbs – Sartorius, Adductor group, Quadriceps group
6. *Rectus femoris, Vastus lateralis, Vastus medialis, Hamstring* group (*Biceps femoris, Semimembranosus, Semitendinosus*), *Fibularis longus, Gastrocnemius*
7. *Tibialis anterior, Soleus, Extensor digitorum longus, Fibularis tertius*
8. Study of ontogeny of chick embryo using permanent slides – 18 hours, 24 hours, 33 hours, 48 hours and 72 hours.

9. Prepare temporary mounting of chick embryo up to 48 hours of incubation (demonstration).

References and Additional Reading for Semester V

Course 11:

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ADDITIONAL READING

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- https://www.earthlife.net/inverts/annelida.html

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- http://www.fossilmuseum.net/Tree_of_Life/PhylumAnnelida.htm
- http://www.austincc.edu/sziser/Biol%201413/LectureNotes/lnexamIII/Phylum%20Annelida.pdf
- http://animaldiversity.org/accounts/Annelida/classification/
- http://faculty.college-prep.org/~bernie/sciproject/project/Kingdoms/Animal%20Kingdom%20-%205/Local%20copy/classification/arthropoda.html
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- Williams Hematology; Kenneth Kaushansky, Marshall A. Lichtman, E. Beutler, Thomas J. Kipps, Josef Prchal, Uri Seligsohn
- Essential Haematology; Victor Hoffbrand, Paul Moss, John Pettit
- Rapid Review of Hematology; Ramadas Nayak; Jaypee Brothers
- Precise Haematology; Usha Rusia, Meera Sikka, Renu Saxena; Wiley India
- Short Textbook of Haematology; Shah B.S.; C.B.S. Publisher and Distributor
- Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd., Kolkata; 1999
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Course 11
LEARNERS' SPACE

1. Learners can visit different websites to get information about the invertebrates discovered recently in Maharashtra as well as in the world.
2. Learners can play games to identify kingdom, phylum or class based on the characters of animals.
3. Investigate the reason of formation of first life/cell on earth
4. List the names of places in India where corals are found.
5. Study the corals as an indicator of healthy ecosystem.
6. Enlist medicinal uses of leech.
7. State the differences between *Loligo* and *Sepia*.
8. Collect information on differences between minor phyla and major phyla.
9. Study the criteria to put an animal in minor phylum.
10. Collect the information on torsion-detorsion in gastropods.

Course 12
Learners' space

1. Study the latest medical applications of haemopoietic cells.
2. Prepare a report on thrombosis, its causes, risk factors, symptoms and prevention.
3. Other than haemophilia, there are many more coagulation factor disorders. Explore this area.
4. Investigate the traditional and recent methods of grouping and cross matching of blood.
5. Compile information on Bombay blood group.
6. Study the recent advancements in organ transplantation.
7. Autoimmune diseases are on the rise. Explore the reasons, types as well as its mechanisms.
8. Distinguish different types of hypersensitivity.
9. Make a detailed report on bone marrow transplantation.
10. Explain the application of radiation technology in vaccine development.
11. Attempt to understand immune mechanisms in invertebrates.
12. Attempt to understand immune mechanisms in pets.

Course 13
Learners' Space:

1. Define- Histopathology. Name the cytological techniques used to stain DNA in the tissues.
2. Prepare a chart as follows

Sr. No.	Type of Embryonic origin	Tissues/Organ/Gland	Position in the body of vertebrates
1.	Ectoderm		
2.	Endoderm		
3.	Mesoderm		
4.	Dual origin		

3. From internet, survey types of stains used in temporary and permanent preparation of slides.
4. Find the ways to prevent post mortem changes in histological preparation of experimental animals.
5. Enumerate sub-lethal dose or sub-lethal concentration of a toxicant.

6. Give the significance of probit analysis and comment on Finney method of toxicity evaluation.
7. Find the differences between bioaccumulation, biotransformation and bio-magnification in the trophic levels. Do search for bioremediation against pollutants.
8. Discuss the various routes of intoxication in vertebrate animals.
9. Enlist the common inflammatory diseases.
10. Define – Metastasis and Neoplasia
11. Explain the procedure of biopsy. Give its significance.
12. Prepare a chart as follows:

Sr. No.	Samples	Types of pathological test conducted.	Confirmation of diseases
1.	Blood		
2.	Urine		
3.	Sputum		
4.	Semen		
5.	Root hair somatic cell		
6.	Bone marrow		
7.	Stool		

13. Give the use of standard error in biological research.
14. Explain various types of correlations possibilities in biological events.
15. Differentiate between primary and secondary data.
16. Study computer spreadsheet programme. Find software programmes for statistical tests used in biological research.

Course 14
LEARNERS' SPACE

1. Distinguish between holocrine, merocrine and apocrine glands.
2. Explain the difference between plastic and cosmetic surgery.
3. Comment on skin cancer and its preventive measures.
4. Find the ABCD rule for recognizing melanoma
5. Elaborate the term cyanosis.
6. Find the correlation between biological clock/rhythm melanin secretion and sleep.
7. List various applications of forensic osteology and human osteoarchaeology.
8. Role of osteology in understanding human evolution and taxonomy.
9. Give the correlation between age, nutrition and growth of bones.
10. Find out the following:
    a) Correlation between muscles and body building
    b) Smallest muscle, strongest muscle and the muscle that is never tired in our body.
    c) Number of muscles required for taking one step
11. Name three muscles or muscle groups used as sites for intramuscular injections especially used in babies.
12. Distinguish between the effect of exercises on muscles of a marathon runner and a weight lifter.
13. Describe different theories of experimental embryology.
14. Collect the brief information regarding the human embryogenesis.

15. Explain recapitulation theory.
16. Use of French flag model to understand developmental biology.
17. Complete the following table:

Drosophila body Patterning		
Category of genes	**Name of genes**	**Role of genes**
Egg-polarity genes	----------	Establish the Antero-posterior axis
Gap genes	----------	Establish 3 broad segments of the embryo
Pair-rule genes	----------	Establishes odd and even segments
Segment-polarity genes	----------	Establishes anterior posterior polarity of each segment
Homeotic genes	----------	Establishes segmental identity

T. Y. B. Sc. Zoology: Semester VI (Theory)
Course Code: USZO601: Taxonomy and Type Study II
Course 15

Unit I: Chordata: Protochordata and Euchordata I (**15L**)

Objective:

- *To introduce basic concepts of modern Chordate classification with evolution point of view and to understand the concept of taxonomy in higher animal kingdom.*

Desired outcome:

- *Learners will get an idea of origin of Chordates, its taxonomy up to class with reference to phylogeny and their special features.*

1.1: General characters, Difference between non-chordates and chordates

Origin of chordates: Annelids as ancestors, Arachnids as ancestors and affinities with Echinodermata

1.2: **Protochordata**

1.2.1: General characters of Group Protochordata

1.2.2: Distinguishing characters of Subphylum Urochordata and Cephalochordata

1.2.3: Subphylum Urochordata

- Class Ascidiacia e.g. *Herdmania*
- Class Thaliacia e.g. *Salpa*
- Class Larvacia e.g. *Oikopleura*

1.2.4: Subphylum Cephalochordata

- Class Leptocardii e.g. Branchiostoma (Amphioxus)

1.3: Euchordata I

Group Euchordata: General characters

- Subphylum Vertebrata: General characters
- Division Agnatha and Gnathostomata: Distinguishing characters.

General characters with examples of:

- Class Ostracodermii e.g. *Cephalaspis*
- Class Cyclostomata e.g. *Petromyzon* (Lamprey)

Unit II: Euchordata II **(15L)**

2.2.1: Division: Gnathostomata

- Superclass: Pisces and Tetrapoda
- Superclass – Pisces: Distinguishing characters
  - Class Placodermi e.g. *Climatius*
  - Class Chondrichthyes e.g. *Rhinobatus* (Guitar fish)
  - Class Osteichthyes e.g. *Exocetus* (Flying fish)

2.2.2: Dipnoi (Lung fish): Distribution, habit and habitat, external and internal characters, affinities with super class Pisces, affinities and differences with class Amphibia

2.3: Superclass Tetrapoda

- Class Amphibia: General characters
  Examples:
  a. Limbless amphibian e.g. *Ichthyophis* (Caecilian)
  b. Tailed amphibian e.g. *Amphiuma*
  c. Tailless amphibian e.g. *Hyla* (Tree frog)

Unit III: Group Euchordata III **(15L)**

Objectives:

- *To introduce the learners to the distinguishing characters of classes Reptilia, Aves and Mammalia and their adaptive features with reference to their habitat.*

Desired outcome:

- *Learners will understand the characteristic features and examples of class of Reptilia, Aves and Mammalia.*

3.1: Class Reptilia: General characters

Examples

a. Extinct reptile e.g. *Ichthyosaurus*
b. Living fossil e.g. *Sphenodon*
c. Aquatic reptile e.g. *Chelonia sp. (Sea turtle)*
d. Arboreal reptile e.g. Chamaeleon

3.2: Class Aves: General Characters

Examples

a. Arboreal bird e.g. *Melanerpes sp.* (Wood pecker)
b. Terrestrial bird e.g. *Gallus sp.* (Jungle fowl)
c. Swimming bird e.g. *Phalacrocorax sp.* (Cormorant)
d. Wading bird e.gs. *Ardeola sp.* (Pond heron)
e. Birds of prey e.g. *Tyto sp.* (Owl)
f. Flightless birds e.g. *Dromaius sp.* (Emu)

3.3: Class Mammalia: General characters

Examples

a. Egg-laying mammals e.g. *Ornithorhyncus sp.* (Duck-billed platypus)
b. Pouched mammals e.g. *Macropus sp.* (Kangaroo)
c. Insect eating mammals e.g. *Sorex sp.* (Common shrew)
d. Toothless mammals e.g. *Bradypus sp.* (Sloth)
e. Gnawing mammals e.g. *Funambulus sp.* (Squirrel)
f. Primates e.g. *Macaca sp.* (Monkey)

Unit IV: Type study: Shark **(15L)**

Objective:

- *To study in depth one vertebrate animal type i. e. general characteristics and salient features of animal type - shark.*

Desired outcome:

- *Learners will get an idea of vertebrate animal life after studying one representative animal Shark.*

4.1: Habit & habitat, distribution, external characters, classification and economic importance.

4.2: Skin, exoskeleton, endoskeleton and systems

a) Digestive system
b) Respiratory system
c) Blood vascular system
d) Nervous system and receptor organs
e) Urinogenital system, copulation, fertilization and development

Course Code: USZO602: Enzymology, Homeostasis, Endocrinology and Animal Tissue Culture
Course 16

Unit I: Enzymology **(15L)**

Objective:

- *To introduce to the learner the fundamental concepts of enzyme biochemistry and to enable the learner realize applications of enzymes in basic and applied sciences.*

Desired outcome:

- *The learner shall understand fundamentals of enzyme structure, action and kinetics.*
- *The learner shall appreciate the enzyme assay procedures and the therapeutic applications of enzymes.*

1.1: Introduction and Nomenclature: Definition; concept of activation energy; nomenclature and classification (based on IUB – Enzyme Commission) of enzymes; chemical nature of enzyme, co-factors and co-enzymes.

1.2: Enzyme Action and Kinetics: Mechanism; Factors affecting enzyme activity – substrate, pH and temperature. Derivation of Michaelis-Menten equation and Lineweaver-Burk plot; Concept and significance of K_m, V_{max} and K_{cat}.

1.3: Enzyme Inhibition: Competitive and non-competitive inhibitors and their kinetics; therapeutic applications of enzyme inhibitors.

1.4: Regulation of Enzyme Activity: Allosteric regulation and regulation by covalent modification of enzymes; Isozymes (LDH)

1.5: **Industrial applications of enzymes**: Food and detergents

Unit II: Homeostasis **(15L)**

Objective:

- *To introduce to the learner the concept of homeostasis-thermoregulation and osmoregulation*

Desired outcome:
- *The learner shall comprehend the adaptive responses of animals to environmental changes for their survival.*

2.1: Homeostasis
2.1.1: External and internal environment; Acclimation and acclimatization.

2.1.2: Body clock – Circadian & Diurnal rhythm.

2.2: Thermoregulation
2.2.1: Endothermy and ectothermy

2.2.2: Temperature balance: Heat production – shivering and non-shivering thermogenesis; Brown fat, Mechanisms of heat loss.

2.2.3: Adaptive response to temperature - daily torpor, hibernation, aestivation

2.3: Osmotic and Ionic Regulation
2.3.1: Living in hypo-osmotic, hyper-osmotic and terrestrial environment – Water absorption, salt water ingestion and salt excretion, Salt glands, Metabolic water

2.3.2: Role of kidney in ionic regulation

Unit III: Endocrinology **(15L)**

Objective:
- *To introduce to the learner the details of endocrine glands and its disorders.*

Desired outcome:
- *The learner shall understand the types and secretions of endocrine glands and their functions.*

3.1: General organization of mammalian endocrine system

3.2: Hormones: Classification, properties, mechanism of hormone action.

3.3: Histology, functions and disorders of the following endocrine glands:
- Pituitary
- Thyroid
- Parathyroid
- Pancreas
- Adrenal

Unit IV: Animal Tissue Culture **(15L)**

Objective*:*

- To *introduce to the learner the fundamental concepts of tissue culture and guide them progressively to certain areas of animal tissue culture.*

Desired outcome*:*
- *The learner shall understand the significance of tissue culture as a tool in specialized areas of research*
- *The learner will appreciate its applications in various industries.*

4.1: Aseptic techniques

4.1.1**:** Sterilization – basic principles of sterilization, importance of sterility in cell culture

4.1.2**:** Sterile handling – swabbing, capping, flaming, handling bottles and flasks, pipetting, pouring.

4.2: Culture media

4.2.1: Types of media – Natural and Artificial media

4.2.2: Balanced Salt Solutions

4.2.3: Complete Media – amino acids, vitamins, salts, glucose, oxygen supplements, hormones and growth factors, antibiotics

4.2.4: Factors influencing cell culture – surface tension and foaming, viscosity, temperature, osmolality, pH, CO_2, bicarbonate and O_2

4.3: Advantages of tissue culture – control of the environment, *in vitro* modelling of *in vivo* conditions

4.4: Limitations of tissue culture

4.5: Culture techniques

4.5.1: Preparation of cells / organs for culture

4.5.2**:** Cover slip, Flask and Tube culture

4.5.3: Primary and established cell lines

4.5.4: Hybridoma technology

Course Code: USZO603: Molecular Biology, Genetic Engineering, Human Genetics and Bioinformatics Course 17

Unit I: Molecular Biology **(15 L)**

Objectives:
- *To introduce learner to chemical and molecular processes that affect genetic material.*
- *To make learner understand the concept of DNA damage and repair, and how gene control is necessary for cell survival.*

Desired outcome:

- *Learner shall get an insight into the intricacies of chemical and molecular processes that affect genetic material.*
- *The course shall prepare learner to recognize the significance of molecular biology as a basis for the study of other areas of biology and biochemistry.*
- *Learner shall also understand related areas in relatively new fields of genetic engineering and biotechnology.*

1.1: Types of mutation

1.1.1**:** Point mutations – substitution, deletion and insertion mutations

Substitution mutations – silent (same-sense), missense and nonsense mutations, transition and transversion

Deletion and Insertion mutations – frameshift mutations

1.1.2**:** Trinucleotide repeat expansions – fragile X syndrome, Huntington disease

1.1.3**:** Spontaneous mutation – tautomeric shifts, spontaneous lesions

1.2: Induced mutations

1.2.1**:** Physical agents:

- Ionizing radiation (X-rays, α, β and γ rays)
- Non-ionizing radiation (UV light)

1.2.2**:** Chemical agents:

- Base analogs (5-bromouracil)
- Intercalating agents (ethidium bromide)
- Deaminating agents (nitrous acid)
- Hydroxylating agents (hydroxylamine)
- Alkylating agents (mustard gas)
- Aflatoxin (aflatoxin B_1)

1.3: Preventative and repair mechanisms for DNA damage

1.3.1**:** Mechanisms that prevent DNA damage – superoxide dismutase and catalase

1.3.2**:** Mechanisms that repair damaged DNA – direct DNA repair (alkyltransferases, photoreactivation, excision repair)

1.3.3: Postreplication repair – recombination repair, mismatch repair, SOS repair

1.4: Eukaryotic gene expression

1.4.1: Regulatory protein domains– zinc fingers, helix-turn-helix domain and leucine zipper

1.4.2**:** DNA methylation

Unit II: Genetic Engineering **(15 L)**

Objective:

- *To introduce learner to a set of techniques to modify an organism's genome to produce improved or novel genes and organisms.*

Desired outcome:

- *The learner shall get acquainted with the vast array of techniques used to manipulate genes which can be applied in numerous fields like medicine, research, etc. for human benefit.*

2.1: Tools in Genetic Engineering

2.1.1: Enzymes involved in Genetic Engineering: Introduction, nomenclature and types of restriction enzymes with examples, Ligases – E.coli DNA ligase, T4 DNA ligase, polynucleotide kinase, phosphatases, DNA polymerases, reverse transcriptase, terminal transferase

2.1.2: Vectors for gene cloning: General properties, advantages and disadvantages of cloning vectors - plasmid vectors (pBR322), phage vectors (λ Phage), cosmid vectors (c2XB)

2.1.3**:** Cloning techniques: Cloning after restriction digestion - blunt and cohesive end ligation, creation of restriction sites using linkers and adapters, cloning after homopolymer tailing, cDNA synthesis (Reverse transcription), genomic and cDNA libraries

2.2: Techniques in Genetic Engineering

2.2.1**:** PCR techniques: Principle of polymerase chain reaction (PCR), Applications of PCR

2.2.2**:** Sequencing techniques: DNA sequencing: Maxam-Gilbert method, Sanger's method Protein sequencing: Sanger's method, Edman's method Applications of sequencing techniques

2.2.3**:** Detection techniques: Blotting techniques – Southern blotting, Northern blotting and Western blotting Applications of blotting techniques

Unit III: Human Genetics **(15L)**

Objective:

- *To introduce learner with genetic alterations in human genome and their diagnosis.*

Desired outcome:

- *The learner shall become aware of the impact of changes occurring at gene level on human health and its diagnosis.*

3.1: Non-disjunction during mitosis and meiosis

3.1.1**:** Chromosomal Aberrations: Structural: Deletion: types, effects and disorders;
Translocation: types: Robertsonian and non-Robertsonian disorders;
Inversion: types, effects and significance;
Duplication and their evolutionary significance (multigene families)
Numerical: Aneuploidy and Polyploidy (Autopolyploidy and Allopolyploidy)

3.2: Genetic Disorders

3.2.1**:** Inborn Errors of Metabolism: Phenylketonuria, G-6-PD deficiency, Alkaptonuria, Albinism

3.2.2**:** Single gene mutation: Cystic fibrosis

3.2.3**:** Multifactorial: Breast Cancer

3.2.4**:** Uniparental Disomy: Angelman Syndrome and Prader-Willi Syndrome

3.3: Diagnosis

3.3.1**:** Prenatal Diagnosis: Amniocentesis and Chorionic villus sampling, Banding techniques (G, C, Q), FISH, Protein truncation test (PTT),

3.3.2**:** Genetic counselling

Unit IV: Bioinformatics **(15L)**

Objective:

- *To introduce learner to bioinformatics – a computational approach to learning the structure and organization of genomes, phylogeny and metabloism.*

Desired outcome:

- *Learner shall become aware of the computational point of view of studying the genomes.*

4.1: Introduction

4.1.1**:** Introduction to Bioinformatics and Bioinformatics web resource (NCBI, EBI, OMIM, PubMed)

4.1.2**:** Applications of Bioinformatics

4.2: Databases – Tools and their uses

4.2.1**:** Biological databases;
Primary sequence databases: Nucleic acid sequence databases **(**GenBank, EMBL-EBI, DDBJ) Protein sequence databases (UniProtKB, PIR)
Secondary sequence databases
Derived databases - PROSITE, BLOCKS**,**
Structure databases and bibliographic databases
High wire Sci Direct

4.3: Sequence alignment methods

4.3.1**:** BLAST, FASTA

4.3.2: Types of sequence alignment (Pairwise & Multiple sequence alignment)

4.3.3: Significance of sequence alignment

4.4: Predictive applications using DNA and protein sequences

4.4.1: Evolutionary studies: Concept of phylogenetic tree, convergent and parallel evolution

4.4.2**:** Pharmacogenomics: Discovering a drug: Target identification

4.4.3**:** Protein Chips in an infant stage and Functional Proteomics: Different types of protein chip (detecting and quantifying), applications of Proteomics

4.4.4: Metabolomics: Concept and applications

Course Code: USZO604: Environment and Wildlife Management, Bioprospecting, Zoopharmacognosy and Zoogeography
Course 18

Unit I: Environment management **(15L)**

Objective:

- *Learner should understand different factors affecting the environment and various methods to improve environmental stewardship.*

Desired outcome:

- *Learner will understand the different factors affecting environment, its impact and environment management laws.*

1.1: Natural resources and their Classification

1.1.1: Forest resources, water resources (surface and ground) and mineral resources

1.1.2: Energy resources: renewable and non-renewable resources.

1.2: Exploitation and Modification of Natural Resources: Impact on climate, flora and fauna

1.3: Waste Management

1.3.1: 3R's (Reduce, Reuse and Recycle) of solid waste management.

1.3.2: e-waste and hazardous waste (biological, chemical, medical and nuclear) management

1.3.3: Recent technology in solid waste management:

a) Traditional methods for solid waste management: Composting, Incineration, Landfill Recycling, Windrow composting

b) Modern methods for solid waste management: Anaerobic digestion, ethanol production, biodrying, pyrolysis, Upflow anaerobic sludge blanket (UASB) technology, waste autoclave

1.4: Water management

1.4.1: Rainwater harvesting: Definition ways of harvesting, components, model of rain water harvesting: Rural and Urban, Advantages and disadvantages

1.4.2: Watershed management: Definition, need and objectives, classification (mini, micro, mili, sub-watershed, macro-watershed), Watershed management practices: Contour,

gully control, stone bunds. Growing greenery and integrated watershed approach (IWA).

1.4.3: Case study: Ice-stupa artificial glaciers by Sonam Wangchuk

1.4.4: Effluent treatment, recycling plants, control and treatment of sewage water.

1.5: Acts and Rules of Environment Management

1.5.1: Environment Protection Act – 1986, Air (Prevention and Control of Pollution) Act – 1981, Water (Prevention and Control of Pollution) Act – 1974

1.5.2: Hazardous Wastes (Management and Handling) Rules – 1989

1.5.3: EIA (Environmental Impact Assessment)

1.5.4: Role of Central and State Government (Pollution Control Board) and NGOs

Unit II: Wildlife Management (15L)

Objectives:

- *To sensitize learner regarding the various threats to the wildlife*
- *To introduce learner various ways that can help in the protection, conservation, management, and enhancement of wildlife populations and habitat.*

Desired outcome:

- *Learner will be able to understand various methods for wildlife conservation.*
- *Learner will be able to apply knowledge to overcome the issues related to wildlife conservation and management.*

2.1: Habit, Habitat, Territory and Niche of Wild Animals: Herbivores, carnivores, solitary, social (flock, pod, community), pack and herd, types of habitats and territories, niche concept

2.2: Threats to Wildlife

2.2.1: Poaching and hunting, deforestation, encroachment, competition (intra-specific and inter-specific), overgrazing and climate change, diseases (zoonosis and reverse zoonosis)

2.2.2: Tourism and human animal conflict

2.3: Wildlife Conservation

2.3.1: Techniques and methods used for wildlife census: Aerial counts, camera trap, line transect census and track surveys, capture mark recapture method, wildlife radio telemetry

2.3.2: Forest management, policies and Acts: Harvesting Trees, Thinning harvest, Clearcut Harvest, Shelterwood harvest, Seed tree harvest, Group selection harvest, Single-tree selection harvest, Prescribed burning, Reforestation

2.3.3: Forest policy 1894, 1952, 1988; The Indian Forest Act, 1927; Forest (Conservation) Act, 1980.

Unit III: Bioprospecting and Zoopharmacognosy (15L)

Objectives:

- *To introduce the learner to the concepts of bioprospecting and zoopharmacognosy.*
- *Learner will be made aware of the process of discovery and commercialization of new products based on biological resources.*
- *To introduce learner with various ethological aspects by which non-human animals apparently self-medicate themselves.*

Desired outcome:

- *Learner will understand the paradigms of discovery and commercialization of biological resources and knowledge gained by self-medication by animals.*

3.1: Bioprospecting

3.1.1: Traditional and modern bioprospecting, economic value of bioprospecting

3.1.2: Bioprospecting and conservation, advantages and disadvantages

3.2: Zoopharmacognosy

3.2.1: Definition and types

3.2.2: Self-medication and its mechanism

3.2.3: Methods of self-medication through:

a) Ingestion- ants and mammals
b) Geophagy- invertebrates and birds
c) Absorption and adsorption

3.2.4: Applications – Social and trans-generational aspects of insects, birds and mammals

3.2.5: Contribution to human medicines

Unit IV: Zoogeography (15L)

Objectives:

- *To introduce learner to the geographic distribution (present and past) of animal species.*
- *To introduce learner to various ways by which animals distributed.*

Desired outcome:

- *The learners will become acquainted with how and why different animal species are distributed around the globe.*

4.1: Introduction: Plate tectonics and continental drift theory

4.2: Animal Distribution and Barriers

4.2.1: Patterns of animal distribution – continuous, discontinuous, isolation and bipolarity

4.2.2: Barriers of distribution –Topographic, climatic, vegetative, large water masses, land mass, lack of salinity and special characteristic habit (homing instinct).

4.2.3: Means of dispersal – land bridges, natural rafts and drift wood, favouring gales, migration by host, accidental transportation and by human agencies

4.3: Zoogeographical Realms: Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic and Antarctic

Practical Syllabus for Semester VI
Course code: USZOP06: COURSE 15

1. Group Protochordata

- Subphylum Urochordata
  - Class Larvacea e.g. *Oikopleura*
  - Class Ascidiacea e.g. *Ciona*
  - Class Thaliacea e.g. *Salpa*

- Subphylum Cephalochordata
  - Class Leptocardii e.g. *Branchiostoma* (Amphioxus)

- Subphylum Vertebrata: Division Agnatha
  - Class Ostracodermi e.g. *Pharyngolepis*
  - Class Cyclostomata e.g. *Petromyzon*

2. Division Gnathostomata

- Superclass Pisces:
  - Class Placodermi e.g. *Bothriolepis*
  - Class Chondrichthyes e.g. *Rhinobates,* Chimaera
  - Class Osteichthyes e.g. *Protopterus,* Catfish
- Superclass Tetrapoda:
  - Class Amphibia, e.g. *Alytes* and *Triton*
  - Class Reptilia: e.g. *Varanus,* and crocodile

3. Class Aves: Examples: Penguin, Flamingo and Vulture

4. Class Mammalia: Examples: *Dasyurus* (Tiger cat), Flying Squirrel and *Gorilla*.

5. Study of Shark with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected.

a) Digestive system
b) Heart and Aortic arches
c) Urinogenital System
d) Endoskeleton of shark:
   i. Axial – Skull and vertebral column
   ii. Appendicular – Pelvic and pectoral fins, pelvic and pectoral girdle

6. Visit to fish market / Aquarium / Zoo / National Park /Any other relevant place to observe chordates and prepare a report.

Course code: USZOP06: COURSE 16

1. Effect of varying pH on activity of enzyme Acid Phosphatase
2. Effect of varying enzyme concentration on activity of enzyme Acid Phosphatase
3. Effect of varying substrate concentration on activity of enzyme Acid Phosphatase
4. Effect of inhibitor on the activity of enzyme Acid Phosphatase
5. Separation of LDH isozymes by agarose / polyacrylamide gel electrophoresis

6. Histology of glands: T.S. of pituitary, thyroid, parathyroid, pancreas, adrenal.
7. Instruments for tissue culture- Autoclave, Millipore filter, CO_2 incubator, Laminar air-flow. (Principle & use)
8. Packaging of glassware for tissue culture.
9. Aseptic transfer techniques.
10. Trypsinization and vital staining using Trypan blue stain.

Course code: USZOP06: COURSE 17

1. Quantitative Estimation of RNA by Orcinol method.
2. Quantitative Estimation of DNA by Diphenylamine method.
3. Separation of Genomic DNA by Agarose gel electrophoresis.
4. Colorimetric estimation of proteins from given sample by Bradford's method.
5. Problems based on Restriction endonucleases.
6. Karyotype (Idiogram) analysis for the following syndromes with comments on numerical &/or structural variations in chromosomes (no cutting of chromosomes):
    a. Turner's syndrome
    b. Klinefelter's syndrome
    c. Down's syndrome
    d. Cri-du-chat syndrome
    e. D-G translocation
    f. Edward's syndrome
    g. Patau's syndrome

7. Interpretation of genetic formulae: Deletion, duplication, inversion and translocation.
8. Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells.
9. Explore BLAST for nucleotide sequence comparison.
10. Explore the databases (Nucleotide, Protein) at NCBI for querying a nucleotide or protein sequence.
11. Exploring bibliographic database PubMed for downloading a research paper on subject of interest with the use of operators.

Course code: USZOP06: Course 18

1. Estimation of phosphates from sample water.
2. Estimation of BOD from sample water.
3. Estimation of COD from sample water.
4. Estimation of Nitrates from sample water.
5. Estimation of acidity and alkalinity of sample water by methyl orange and phenolphthalein indicator.
6. Comparative study of sound intensity in different places by Decibel meter.
7. Study of bioprospecting:
    a. Tumour suppression compounds e.g. Sponge
    b. Skin erythema treatment from gel
8. Study of Zoopharmacognosy in ants, cats, elephants and dogs.
9. Indicate the distribution of fauna in the world map w.r.t. to its realm and comment on the pattern of distribution.
    a. Palearctic: Giant Panda and Japanese Macaque

b. Ethiopian: Common ostrich and African bush elephant
c. Oriental: Indian one-horned Rhinoceros and Gharial
d. Australian: Platypus and Red Kangaroo
e. Neotropical: Guanaco and South American Tapir
f. Nearctic: Virginia opossum and Sea otter
g. Antarctic: Emperor Penguin and Antarctic Minke Whale

10. Long Excursion (Study tour / Visit) to Zoo / Sanctuary / National park / Research institute and submit a report.

References and Additional Reading for Semester VI

Course 15

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- Chordate Anatomy Mohan P. Arora, Himalaya Publishing House, First edition.
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- The life of Vertebrates; J.Z. Young; ELBS - Oxford University Press; Third edition, 2006
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- Introduction to Zoology – Vol II: K. K. Chaki, G. Kundu and S. Sarkar, New Crystal Book Agency.
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- Chordate Zoology by E. L. Jordan and P. S. Verma, edition,2009, Chand publications
- Chordate Zoology by P. S. Verma, edition,2009, Chand publications
- Modern Textbook of Zoology Vertebrates by R.L. Kotpal, edition Jan 2015, Rastogi publications
- Practical Zoology: Vertebrate, by S. S. Lal, 2015
- A Textbook of Invertebrate Zoology & Cell Biology, by V. S. Kanwate, A. N. Kulkarni et al. ed. Alka Prakashan
- The Animal Kingdom: An Elementary Textbook in Zoology; Specially Classified and Arranged for the Use of Science Classes, Schools and Colleges (Classic Reprint), by Ellis A. Davidson, Sept. 2015, Publisher: Forgotten Book.

ADDITIONAL READING

- http://faculty.college-prep.org/~bernie/sciproject/project/Kingdoms/Animal%20Kingdom%20-%205/Local%20copy/classification/chordata.html
- http://www.ucmp.berkeley.edu/chordata/chordata.html
- http://animaldiversity.org/accounts/Chordata/
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- https://manoa.hawaii.edu/exploringourfluidearth/biological/invertebrates/phylum-chordata
- http://www.nhptv.org/wild/chordata.asp
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Course 16

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- Text book of Endocrinology; Williams
- Textbook of Endocrinology Hardcover; Dharmalingam; 2010
- Endocrinology; 6th Edition; Mac Hadley , Jon E. Levine
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Course 15

Learner's space

1. Organize a lecture and interaction of an expert working in the field of vertebrate study like wild photography, research project etc.
2. Collect information on phylogeny and geological time scale.
3. Did you notice that the number of frogs or earthworms is decreasing? Find out the probable reasons.
4. Comprehend the benefits of frog to farmer.
5. Study the reasons of extinction of dinosaurs
6. Enlist names of extinct birds.
7. Find out the reasons the *Archaeopteryx* is a connecting link between reptiles and birds.
8. Name the largest terrestrial and aquatic mammal.
9. List the scientific names of sharks found in Indian Ocean.
10. Study how is the age of the fossil decided.

Course 16

Learners' space

1. Elucidate on the Nobel Prize winning research work in the field of enzymology.
2. Study Eadie- Augustinsson plot and Hanes-Woolf plot of enzyme kinetics.
3. Make a report of isoenzymes (other than LDH) and their role in human body.
4. Kangaroo rats do not need to drink water at all. Explore the reason.
5. Collect information on:
   - Allen's rule
   - Bergman's rule
   - Gloger's rule
   - Jordan's rule
   - Rensch's rule
6. Review the mechanism and role of hormones like ecdysone and juvenile hormone in invertebrates.
7. Pineal gland has received attention as a 'mystery gland'. Find the reasons for it.
8. Prepare a report on therapeutic applications of hormones.
9. Present an account on recent advances in animal tissue culture.
10. 'HeLa' cells make the oldest immortal human cell line. Trace its history and significance.
11. Compare mortal and immortal cell lines.

Course 17

Learner's Space

1. Study various types of genetic recombination. Explain any one mechanism.
2. Enlist enzymes involved in the central dogma of molecular biology. Comment on the specific biochemical reaction they catalyze.
3. Collect the information on satellite DNA. Discuss several forms of DNAs.
4. Give significance of telomere.
5. Gain information on chimeric DNA. Give its applications.
6. Comment on gene splicing.
7. Explore DNA microarray applications.
8. Comment on role of transgenic bacteria in pharmaceuticals.
9. Give interesting output of HGP.
10. Give examples of lysosomal storage disorders.
11. Explore information on lethal genes and jumping genes.

12. Enlist the variations in BLAST and FASTA.
13. Find the structure of a protein of your choice using UNIPROT.
14. Give role of bioinformatics in clinical biology.
15. Browse through website OMIA.

Course 18
Learners' Space

1. Find out the role of an ISO 14001 environmental management system.
2. Explain environmental audit and carbon footprint.
3. Collect information on life cycle assessment (LCA) as an environmental management tool.
4. Collect the information about institutes those provide environmental management education.
5. Find out the role of industries such as TATA steel in environmental management.
6. Explain the benefits of environmental monitoring for an industry.
7. Comment on ethics of Wildlife Management and Conservation.
8. Role of WTI in wildlife research and management.
9. Comment on Sustainable Wildlife Management (SWM).
10. Convention on Biological Diversity (CBD)
11. Find the following:
    - Bioprospecting and Maya ICBG controversy.
    - Contribution of Babu Kalunde in self-medication.
12. Link the study of human evolution with Zoopharmacognosy.
13. Explain Wallace's Line and Weber's line.
14. Role of zoogeography in speciation.
15. List the animal species which exhibit homing instincts.

***Note – The practicals may be conducted by using specimens authorized by the wild life and such other regulating authorities though it is strongly recommended that the same should be taught by using photographs/audio-visual aids/simulations/ models etc. as recommended by the UGC and as envisaged in the regulation of the relevant monitoring bodies. No new specimens, however, shall be procured for the purpose of conducting practicals mentioned here-in above.**

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) to ensure that no dissections are done.

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 neighbouring colleges.

Use of animals for any experiment /dissection /mounting is banned. Simulations, authorized permanent specimens/slides, charts, models and other innovative methods are encouraged.

Scheme of Examination (Theory and Practical)

(a) External assessment of one hundred (100) marks per course per semester should be conducted as per the following skeleton question paper pattern.
(c) One practical examination of fifty (50) marks per course each should be conducted at the end of every semester.

SKELETON- EXAMINATION PATTERN FOR THE ABOVE SYLLABUS

All Questions are compulsory
Figures to the right indicate full marks

Time: 3 hours **Total marks: 100**

Q1		20 marks
Q.2.		20 marks
Q.3.		20 marks
Q.4.		20 marks

Q.5.		20 marks

T. Y. B.Sc. Zoology: Semester V (Practical)
Course Code: USZOP05: Course 11

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Sepia: Sketch and label _____ system. (Digestive / Reproductive system / Nervous system) **OR** Identify and Describe: a & b (Jaws / Radula / Chromatophores / Spermatophores / Statocyst) **OR** Perform virtual dissection of _____ system.	04
Q.2.	Identify and classify giving reasons: a) Protozoa / Porifera / Cnidaria b) Platyhelminthes / Nematoda c) Annelida / Arthropoda d) Mollusca / Echinodermata	12
Q.3	Identify, classify and describe a) Acanthocephala / Chaetognatha / Onychophora b) Hemichordata c) Observe the animal* (photo/existing preserved specimen) and identify phylum giving reasons. *A suitable animal which is not prescribed in the syllabus	09
Q.4	Field report	10
Q.5	Viva based on Paper I	05
Q.6	Journal with neatly drawn and labelled diagrams.	10

T. Y. B.Sc. Zoology: Semester V (Practical)
Course Code: USZOP05: Course 12

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1 Enumerate erythrocytes in the given sample and comment on clinical condition. 15

OR

Q.1 Enumerate leucocytes in the given sample and comment on clinical condition. 15

OR

Q.1 Present a report on differential count of leucocytes and comment on clinical condition.

Q.2 Estimate total plasma proteins by Folin's method. 10

OR

Q.2 Estimate serum / plasma total triglycerides by Phosphovanillin method. 10

Q.3 Estimate haemoglobin by Sahli's acid haematin method. 10

OR

Q.3 Record Erythrocyte Sedimentation Rate by Westergren / Wintrobe method. 10

OR

Q.3 Determine serum LDH by colorimetric/spectrophotometric method. 10

Q.4 Perform Latex agglutination test – Rheumatoid Arthritis. 05

OR

Q.4 Record bleeding/clotting time and comment on clinical significance. 05

Q.5 Viva voce based on theory 05

Q.6 Journal. 05

T. Y. B.Sc. Zoology: Semester V (Practical)
Course Code: USZOP05: Course 13

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. Total Marks: 50

Q.1	Demonstrate the effect of CCl_4 on the level of enzyme activity of aspartate/ alanine amino transferase / alkaline phosphatase in liver (*in vitro* approach)	10
Q.2	From the infiltrated tissue prepare block, trim and mount it on the block holder.	06
	OR	
Q.2	Mount the ribbon on slide from the given block.	06
	OR	
Q.2	Stain the given histological slide and identify the tissue.	06
Q.3	Identify and describe a, b, c, d. a) & b) based on study of mammalian tissues c) & d) based on diseases or conditions	08
Q.4	Interpret the pathological report – blood / urine / stool.	03
Q.5	Problems in Biostatistics (any one)	08
Q.6	Viva based on theory	05
Q.7	Journal	10

T. Y. B. Sc. Zoology: Semester V (Practical)
Course Code: USZOP05: Course 14

Skeleton Question Paper for Practical Examination

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Identify and describe a) and b) Based on integumentary system c) and d) Based on forelimb muscle e) and f) Based on hind limbs muscle g) and h) Based on osteology – human axial skeleton i) Based on osteology – human appendicular skeleton	27
Q.2	Identify, sketch, label and describe the given stage of chick embryo	08
Q.3	Viva-voce based on theory	05
Q.4	Journal	10

T. Y. B.Sc. Zoology: Semester VI (Practical)
Course Code: USZOP06: Course 15

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Identify, classify giving reasons a) Urochordata / Cephalochordata / Ostachodermi / Cyclostomata b) Observe the animal* (photo/existing preserved specimen) and state its class giving reasons. * The animal should be other than prescribed in the syllabus	06
Q.2.	Identify, classify and describe a) Pisces b) Amphibia c) Reptilia d) Aves e) Mammalia	15
Q.3	Study of shark with the help of Specimen / Photograph / Simulation (Digestive system / Urinogenital system / Heart and aortic arches)	06
Q.4	Identify, sketch and label/ Identify and describe marked portion in given diagram Skull or vertebra of shark/ Fin of shark (Pectoral / Pelvic) / Girdle of shark (Pectoral / Pelvic)	03
Q.5	Field report and viva based on Paper I	10
Q.6	Journal with neatly drawn and labelled diagrams.	10

T. Y. B.Sc. Zoology: Semester VI (Practical)
Course Code: USZOP06: Course 15

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1 Demonstrate the effect of _____ on the activity of acid phosphatase (Substrate concentration / pH variation / Enzyme concentration / Inhibitor concentration) 15

OR

Q.1 Perform trypsinization and show the isolated cells using suitable vital stain. 15

Q.2 Separate LDH isozymes from the given sample by agarose / polyacrylamide gel electrophoresis 10

OR

Q.2 Demonstrate the packaging of glassware for tissue culture (any 3) 10

OR

Q.2 Demonstrate the technique of aseptic transfer. 10

Q.3 Identify and describe a, b, c, d, e 15

a to d: Slides / Photographs of T.S of Pituitary, thyroid, parathyroid, pancreas, adrenal (any 4)

e: Any one instrument – Autoclave, Millipore filter, CO_2 incubator, Laminar air-flow.

Q.4 Viva voce based on theory 05

Q.5 Journal 05

T. Y. B.Sc. Zoology: Semester VI (Practical)
Course Code: USZOP06: Course 17

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Isolation & Estimation of RNA by Orcinol method.	15
	OR	
Q.1	Isolation & Estimation of DNA by Diphenylamine method.	15
Q.2	Separation of Genomic DNA by Agarose gel electrophoresis.	08
	OR	
Q.2	Colorimetric estimation of proteins from given sample by Folin's method.	08
Q.3	A problem based on Restriction endonucleases.	06
	OR	
Q.3	Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells.	06
	OR	
Q.3a	Analyse the given syndrome and comment on numerical and/or structural variations in chromosomes.	03
Q.3b	Interpretation of a genetic formula.	03
Q.4	Demonstrate the use of bioinformatics tool: BLAST for nucleotide sequence comparison. **OR** Databases at NCBI for querying a nucleotide/protein sequence with the help of suitable operator. **OR** PubMed for downloading a research paper of interest with the help of suitable operator.	06
Q.5	Viva based on theory	05
Q.6	Journal	10

T. Y. B. Sc. Zoology: Semester VI (Practical)
Course Code: USZOP06: Course 18

Skeleton Question Paper for Practical Examination

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Estimation of BOD / COD from the given water sample	10
Q.2	Estimation of phosphates / nitrates from the given water sample	10
	OR	
Q.2	Estimation of acidity / alkalinity of sample water by methyl orange and phenolphthalein indicator.	10
Q.3	Identification a) Based on bioprospecting (*Sponge* / *Aloe ferox* / *Aloe vera*) b) Zoopharmacognosy (any one – ants, cats, elephants and dogs)	06
Q.4	Identify the given animals (any 2) with respect to their realms and comment.	06
Q.5	Study tour visit report.	08
Q.6	Journal	10