T.Y.B.Sc Zoology Draft syllabus (2018-2019) for public criticisms and suggestion

suggestion to be mailed on before 15th November 2017 on the email-id given

dalvie@gmail.com

readersmail@rediffmail.com

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	Basic Haematology	2.5	1
		II	Applied Haematology		1
		III	Basic Immunology		1
		IV	Applied Immunology		1
12	USZO502	I	Mammalian Histology	2.5	1
		II	Toxicology		1
		III	General Pathology		1
		IV	Biostatistics		1
13	USZO503	I	Principles of Taxonomy	2.5	1
		II	Kingdom: Animalia - I		1
		III	Kingdom Animalia - II		1
		IV	Type Study –Sepia		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					
USZOP505	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	Enzymology	2.5	1
		II	Homeostasis		1
		III	Endocrinology		1
		IV	Tissue Culture		1
16	USZO602	I	Molecular Biology	2.5	1
		II	Genetic Engineering		1
		III	Human Genetics		1
		IV	Bioinformatics		1
17	USZO603	I	Chordata	2.5	1
		II	Euchordata- I		1
		III	Euchordata- II		1
		IV	Type study - Shark		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
Course 11

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

Objective:

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

Desired outcome:

- *Learner shall be familiar with the fundamental concepts in haematology.*
- *Learner shall comprehend basic haematology.*
- *Learner will be able to identify various components of haemostatic systems*

1.1: Composition of blood plasma

Water, plasma proteins, inorganic constituents, respiratory gases, organic constituents other than protein (include internal secretions, antibodies and enzymes)

1.2: Erythrocytes

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

1.3: Hemoglobin

Structure, formation and degradation; variants of hemoglobin (foetal, adult), abnormalities in Hemoglobin (Sickle cell and Thalassemia)

1.4: Leucocytes

Types of leucocytes and function, total count and variation in number; leukemia and its types

1.5: Thrombocytes

Structure of thrombocytes, factors and mechanism of clotting, failure of clotting mechanism

1.6: Haematopoiesis

Erythropoiesis, leucopoiesis and thrombopoiesis

1.7: Blood volume

Total quantity and regulation; haemorrhage

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

Objective:

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

Desired outcome:

- *Learners shall get familiar with different terminologies and diagnostic tests performed in a pathological laboratory.*
- *Learners will be acquainted with diagnostic approaches in hematological disorders*
- *Learners will be better equipped for taking any further pathological course or working in a diagnostic laboratory.*

2.1: Introduction to Applied Haematology

Scope and brief introduction of basic branches: clinical, microbiological, oncological and forensic hematology

2.2: Diagnostic techniques used in haematology

2.2.1: Microscopic examination of blood: For detection of blood cancers (lymphoma, myeloma), infectious diseases (malaria, leishmaniasis), hemoglobinopathies (sickle cell, thalassemia)

2.2.2: Coagulopathies: Diagnostic methods (hemophilia and purpura)

2.2.3: Microbiological examination: Blood culture: Method and application in diagnosis of infectious diseases (Typhoid and TB)

2.2.4: Biochemical examination of blood:

Liver function tests: AST, ALT, Total bilirubin, Direct bilirubin, LDH and Alkaline phosphatase

Kidney function tests**:** 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.

2.2.5: Blood Bank: Collection, storage & preservation of blood components, anticoagulants

Unit III: Basic Immunology (15 L)

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:

- *Learners would comprehend the types of immunity and the components of immune system.*
- *Learners would realize the significant role of immune system in giving resistance against diseases.*

3.1: Overview of Immunology

3.1.1: Concept of immunity**-**Antibody mediated and cell mediated immunity

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

3.1.3: Adaptive or Acquired 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 node and spleen

3.3: Antigens

Definition, properties of antigens; 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 **(15 L)**

Objective:

- *To introduce to the learner immune related pathologies*
- *To introduce the concept of vaccines and vaccination.*
- *To familiarise the learner to immunological perspectives of organ transplant and tumour treatment.*

Desired outcome:

- *Learners shall understand immune related pathologies and the principles and applications of vaccines.*
- *Learners 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 - Countercurrent, Laurel's Rocket and crossed immunoelectrophoresis

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: Brief history of vaccination, 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 mediated graft rejection, Antibody mediated graft rejection; Precautions against graft rejection

Practical Syllabus for Semester V
(Course codes: USZOP05)

COURSE 11

01. Enumeration of Erythrocytes – Total Count.
02. Enumeration of Leucocytes – Total Count.
03. Differential count of Leucocytes
04. Erythrocyte Sedimentation Rate by suitable method – Westergren or Wintrobe method.
05. Estimation of haemoglobin by Sahli's acid haematin method.
06. Determination of serum LDH.
07. Estimation of total serum/ plasma proteins by Folin's method.
08. Estimation of serum/ plasma total triglycerides by Phosphovanillin method.
09. Latex agglutination test – Rheumatoid Arthritis.

T.Y.B.Sc. Zoology
Semester VI (Theory)
Course Code: USZO601
Course 15

Unit I: Enzymology (15 L)

Objective:

- *To introduce to the learner the basic concepts of enzyme biochemistry and to make the learner realize the power and application of enzymes in basic and applied science.*

Desired outcome:

- *Learners shall be able to understand basics of enzyme structure and function.*
- *Learners will be able to comprehend variations in enzyme activity and kinetics.*
- *Learners shall appreciate the enzyme assay procedures and the therapeutic application of enzymes.*

1.1: Introduction and Nomenclature

Definition; Concept of activation energy; Nomenclature and classification (based on Enzyme Commission) of enzymes; Co-factors and Co-enzymes.

1.2: Enzyme Action

Mechanism of enzyme action; Factors affecting enzyme activity - pH and temperature; Enzyme structure (lysozyme and serine protease) .

1.3: Enzyme kinetics

Derivation of Michaelis-Menten equation and Lineweaver-Burk plot; Concept and significance of K_m, V_{max} and K_{cat}; Modulation of enzyme activity with reference to GDH.

1.4: Enzyme inhibition

Enzyme inhibitors, competitive and non-competitive inhibitors and their kinetics; therapeutic applications of enzyme inhibitors.

1.5: Regulation of enzyme activity

Allosteric regulation and regulation by covalent modification of enzymes; Isozymes (LDH)

1.6: Applications

Clinical significance and industrial applications of enzymes

Unit II: Homeostasis (15 L)

Objective:

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

Desired outcome:

- *Learners shall comprehend the adaptive responses of animals to environmental changes for their survival.*

2.1: Homeostasis

External and internal environment; Acclimation and acclimatization; Body clock- Circadian & Diurnal rhythm

2.2: Thermoregulation

Endothermy, ectothermy (relation between temperature and biological activities); Temperature balance; Heat production - shivering and non-shivering thermogenesis; Brown fat - special thermogenic tissue in mammals, Mechanisms of heat loss; Adaptive response to temperature - daily torpor, hibernation, aestivation

2.3: Osmotic and Ionic regulation

Maintaining 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, Salt glands, Role of kidney in ionic regulation, Metabolic water

Unit III: Endocrinology (15 L)

Objective:

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

Desired outcome:

- *Learners shall be able to understand the types & 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 (15 L)

***Objective**:*

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

***Desired outcome**:*

- *The learners shall understand the significance of tissue culture as a tool in specialized areas of research*
- *The learners will appreciate its applications in industries like biotechnology, in fields such as in vitro fertilization and replacement of animals in medical and toxicology experiments.*

4.1: Introduction to animal cell culture

4.1.1: Advantages of tissue culture – control of the environment, characterization and homogeneity of sample, economy, scale and mechanization, *in vitro* modelling of *in vivo* conditions

4.1.2: Limitations of tissue culture – expertise, quantity, dedifferentiation and selection, origin of cells, instability

4.2: Aseptic techniques

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

4.2.2: Sterile handling – swabbing, capping, flaming, handling bottles and flasks, pipetting, pouring

4.3: Culture media

4.3.1: Physicochemical properties – pH, CO_2 and bicarbonate, buffering, O_2, osmolality, temperature, viscosity, surface tension and foaming

4.3.2: Types of media – Natural and Artificial media

4.3.3: Serum – protein, growth factors, hormones, nutrients and metabolites, lipids, minerals and inhibitors

4.3.4: Balanced Salt Solutions

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

4.4: Cell lines

4.4.1: Primary and established cell lines and their characters.

4.4.2: Preparation of cells/organs for culture

4.4.3: Coverslip, Flask and Tube culture

4.4.4: Hybridoma technology- an example of application of animal cell culture

Practical Syllabus for Semester VI
(Course codes: USZOP06)

COURSE 15

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 gel electrophoresis
6. Histology of glands: T.S. of pituitary, thyroid, parathyroid, pancreas, adrenal, ovary, testis.
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.

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

Skeleton of Practical Examination Question Paper

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

Q-1. Enumeration of Erythrocytes – Total Count. 15

OR

Q-1. Enumeration of Leucocytes – Total Count.

OR

Q-1. Differential count of Leucocytes

Q-2. Estimation of total plasma proteins by Folin's method. 10

OR

Q-2 Estimation of serum/ plasma total triglycerides by Phosphovanillin method.

Q-3. Estimation of haemoglobin by Sahli's acid haematin method. 10

OR

Q-3 Erythrocyte Sedimentation Rate by suitable method – Westergren or Wintrobe method.

OR

Q-3. Determination of serum LDH.

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

Q-5. Viva voce. 05

Q-6. Journal. 05

T. Y. B.Sc. Zoology
Semester V (Practical)
Course 14
Course Code: USZOP06

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 Trypsinization and vital staining using Trypan blue stain

Q.2 Separation of LDH isozymes by agarose gel electrophoresis **10**

OR

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

OR

Q.2 Demonstrate the technique of aseptic transfer.

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, ovary, testis. (Any 4)

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

Q.4 Viva voce **05**

Q.5 Journal **05**

Learners' space - **Semester V**

Unit I

1. Make a study of the latest medical applications of hemopoietic cells.

2. Prepare a report on thrombosis, its causes, risk factors, symptoms and prevention.

3. Other than haemophilia, there are many other coagulation factor disorders. Explore this area.

Unit II

1. Investigate the traditional and newer methods of grouping and cross matching of blood.

2. Study the intricacies of organ transplantation.

Unit III

1. Autoimmune diseases are on the rise. Explore the reasons, types as well as its mechanisms.

2. What is hypersensitivity? Distinguish between the different types.

Unit IV

1. Make a report on bone marrow transplantation including its need, the diseases that benefit from it, types of transplantation, type matching and its limitations.

2. Explain the application of radiation technology in vaccine development.

Learners' space - **Semester VI**

Unit I

1. Elucidate on the Nobel Priz winning research work in the field of enzymology.

2. Study of Eadie- Augustinsson plot and Hanes-Woolf plot of enzyme kinetics.

Make a report of isoenzymes (other than LDH) and their role in human body.

Unit II

1. Kangaroo rats do not need to drink water at all. What could be the physiology behind this?

2. Give an account on:

i. Allen's rule

ii. Bergman's rule

iii. Gloger's rule

iv. Jordan’s rule

v. Rensch’s rule

Unit III

1. Review the mechanism and role of hormones like ecdysone and juvenile hormone in invertebrates.

2. Pineal gland has received attention as a ‘mystery gland’. Find the reasons for it.

3. Prepare a report on therapeutic applications of hormones.

Unit IV

1. Present an account on recent advances in animal tissue culture.

2. ‘HeLa’ cells make the oldest immortal lhuman cell line. Trace its history and significance.

T. Y. B. Sc. Zoology
Semester V (Theory)
Course 12
Course Code: USZO502

Unit I: Mammalian Histology (15 L)

Objective:

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

Desired outcome:

- *Learners 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 learners 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 learners 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, subacute toxicity, subchronic 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).

2.2: 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 (15 L)

Objective:

- *To introduce the learners 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:

- *Learners 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 (15 L)

Objective:

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

Desired outcome:

- *The learners 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 tests

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

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Practical Syllabus for Semester V

Course Code: USZOP05

Course 12

1. Study of mammalian tissues:

i. V.S. of Tooth

ii. T.S. of Stomach

iii. T.S. of small intestine

iv. 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) :

i. Vitiligo

ii. Psoriasis

iii. Bed sores

iv. Necrosis

v. Oedema

4. Study and interpretation of pathological reports: Blood, Urine and Stool (feces)

5. To study the effect of CCl4 on the level of enzyme activity in liver on aspartate and alanine amino transferase, alkaline phosphatase (*in vitro* approach)

6. Following biostatistics practicals will be done using data analysis tool of Microsoft Excel (DEMONSTRATION in regular practicals) & manually:

1. Problems based on Z test
2. Problems based on t test
3. Problems based on Chi square test
4. Correlation, regression analysis using given data demonstration only.
5. Problems based on ANOVA – demonstration only.

T. Y. B. Sc. Zoology
Semester VI (Theory)
Course 16
Course Code: USZO602

Unit I: Molecular Biology (15 L)

Objective:

- *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/mutagens/mutagenic agents/DNA damage

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 learners 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: Separation and detection techniques:
Blotting techniques: Southern blotting, Northern blotting and Western blotting
Applications of blotting techniques

Unit III: Human Genetics (15 L)

Objective:

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

Desired outcome:

- *The learners 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 chorio-villus sampling, Banding techniques (G, C, Q), FISH, Protein truncation test (PTT),

3.3.2: Genetic counselling: Psycho-social aspects for the individual and the family in connection with genetic investigations

Unit IV: Bioinformatics (15 L)

Objectives:

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

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 data bases (UniProtKB, PIR, PDB)
Secondary sequence databases:
Derived databases - PROSITE, BLOCKS**,**Structure databases and bibliographic databases

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(5 L)

4.4.1: Evolutionary studies: Concept of phylogenetic trees convergent and parallel evolution

4.4.2: Pharmacogenomics: Discovering a drug: Target identification

4.4.3: Protein Chips and Functional Proteomics: Different types of protein chip (detecting and quantifying), applications of Proteomics

4.4.4: Metabolomics: Concept and applications

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Practical Syllabus for Semester VI
(Course codes: USZOP06)

COURSE 16

1. Isolation & Estimation of RNA by Orcinol method.
2. Isolation & 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 related to Restriction endonucleases.
6. Karyotype (Idiogram) analysis for the following syndromes with comments on numerical & 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

Interpretation of genetic formula: Deletion, duplication, inversion and translocation.

7. Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells.

8. Exploring BLAST tool (nucleotide sequence comparison).

9. Exploring the integrated database system at NCBI server and querying (Querying a nucleotide sequence, querying a protein sequence, use of operators (AND, OR & NOT).

10. Exploring bibliographic database PubMed (Data mining-Downloading a research paper on subject of interest, use of operators (AND, OR & NOT).

Skeleton Practical Exam Question Paper Semester V

T. Y. B. Sc. Zoology

Semester V (Practical)

Course Code USZOP05

Time: 9:30 a.m. to 2:30 p.m. **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 blocks, trim and mount it on the block holder for section cutting. **(06)**

OR

Q.2 Trim the given block, mount it on the block holder, cut the sections and form the ribbons on slide. **(06)**

OR

Q.2 Dewax the ribbon on the slide and stain the section with hematoxylin/ eosin stain and comment. **(06)**

Q.3 Identify and describe a, b, c, d, e **(10)**

a and b - Study of mammalian tissues (V.S. of Tooth, T.S. of Stomach, T.S. of Intestine , T.S. of Liver)

c, d and e - Identification of following diseases or conditions (from slides or pictures) – Vitiligo, Psoriasis, Bed sores, Necrosis, Oedema

Q.4.Interpret the pathological report – blood / urine / stool. **(04)**

Q.5 Problems in Biostatistics (any two) **(10)**

Q.6. Journal and Viva. **(10)**

Skeleton of Practical Examination Question Paper
T.Y.B.Sc Zoology
Semester VI (Practical)
COURSE

(Course codes: USZOP06)

Time : 9.30 am – 2.30 pm **Total Marks : 50**

Q1.A Isolation & Estimation of RNA by Orcinol method. **(10)**

OR

Q1.A Isolation & Estimation of DNA by Diphenylamine method. **(10)**

Q1.B Separation of Genomic DNA by Agarose gel electrophoresis. **(05)**

OR

Q1.B Colorimetric estimation of proteins from given sample by Bradford's method **(05)**

Q2. Analyze the given syndrome and comment on numerical and structural variations in chromosomes. **(05)**

OR

Q2. Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells. **(05)**

Q3. Problems related to Restriction endonucleases and Bioinfomatics. (One each) **(10)**

Q4. Submission of Bioinfomatics Project. **(05)**

Q5 Journal. **(10)**

Q6. Viva **(05)**

Learners' Space: Unit –IMammalian Histology (Semester-V)

1. What do you mean by histopathology? Which cytological techniques are 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 vertebrate
1.	Ectoderm		
2.	Endoderm		
3.	Mesoderm		
4.	Dual origin		

3. What are the different types of stains used in temporary and permanent preparation of slides?
4. How are post mortem changes prevented in histological preparation of experimental animals?

Learners' Space: Unit-IIToxicology

1.What do you mean by sub-lethal dose or sub-lethal concentration of a toxicant used in toxicity
evaluation? How it is determined?
2. What is the significance of probit analysis? Comment on Finney method of toxicity evaluation.
3. Find the differences between bioaccumulation, biotransformation and bio-magnification in the
trophic levels. Do search for bioremediation against pollutants.
4. What are the various routes of intoxication in vertebrate animals?

Learners' Space: Unit-III General Pathology

1. Enlist the common inflammatory diseases.
2. Define- Metastasis and Neoplasia
3. How is biopsy done? Give its significance.
4. 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		

Learners' Space: Unit- IV Biostatistics

1. What is standard error? How is it applied in biological data?
2. Explain various types of correlations possibilities in biological events.
3. Differentiate between primary and secondary data.
4. Study computer spreadsheet programme. Find software programmes for statistical tests used in biological research.

Learner's Space: Unit-I Molecular Biology (Semester-VI)

1. What do you mean by 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. What is satellite DNA? Discuss several forms of DNAs.
4. What is telomere? Give its significance.

Learner's Space: Unit-IIGenetic Engineering

1. What is chimeric DNA? Give its applications.
2. What is gene splicing?
3. What is DNA microarray? State its applications.
4. How are transgenic bacteria produced? Give commercial importance oftransgenic bacteria.

Learner's Space: Unit-III Human Genetics

1. Give interesting output of HGP?
2. Define- Silent mutation. How can gene therapy obtain relief to genetic diseases?
3. Give examples of lysosomal storage disorders.
4. What are lethal genes? What are jumping genes?

Learner's Space: Unit-IV Bioinformatics

1. Enlist the variations in BLAST and FASTA.
2. Find the structure of a protein of your choice using UNIPROT.
3. Give role of bioinformatics in clinical biology.
4. What is OMIA?

T. Y. B. Sc. Zoology

Semester based Credit and Grading System

(Proposed syllabus for Academic Year 2018-19)

Semester V

Paper-III - USZO503

Learning objectives: *To introduce the principles of taxonomy in animal kingdom and modern classification of lower groups of organisms with evolution point of view, from unicellular to multicellular organization.*

Learning outcome:

Learners will apprehend the basis of classification and modern classification up to class of the lower invertebrate animal life.

Unit 1: **Principles of Taxonomy**

1.1: Levels of Organization: (1 lectures)

1.1.1: Unicellularity, colonization of cells, multicellularity.

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

1.2: Symmetry (2 lectures)

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. one invertebrate and one vertebrate

1.2.3: Evolutionary significance of symmetry.

1.3: Coelom (2 lectures)

1.3.1: Basic concept and definition.

1.3.2: Formation of coelom.

1.3.3: Types -

a. Acoelomate –Platyhelminthes

b. Pseudocoelomate –Nemathelminthes

1.3.4: Evolutionary significance of coelom.

1.4: Metamerism (2 lectures)

1.4.1: Basic concept and definition

1.4.2: Types – a. Pseudometamerism

b.True metamerism - i) Homonomous – e.g. Annelida

ii) Heteronomous – Cephalization – e.g. Insecta

- Cephalothorax – e.g. Crustacean

1.4.3: Evolutionary significance of metamerism.

1.5: Taxonomy (4 Lectures)

1.5.1: Basic concept, definition and objectives.

1.5.2: Linnaean Hierarchy, Binomial Nomenclature.

1.5.3: Five Kingdom classification:

General characters of Kingdoms with examples –

Monera, Protista, Fungi, Plantae, Animalia .

1.6**: Kingdom Protista**
Animal like Protists -Protozoa **(4 Lectures)**

1.6.1 General characters of Protozoa
1.6.2 Classification with examples-
Phylum: Mastigophora, Sarcodina, Ciliophora and Sporozoa .
1.6.3 Morphology, life cycle, pathogenicity and control measures of *Entamoeba histolytica*

Unit II- : Kingdom: Animalia - I

Learning objectives: *To comprehend the general characters and classification of Kingdom Animalia, from porifera to Aschelminthes and specific characters of organisms.*

Learning outcome: *The learners will be familiarized with classification up to phylum Aschelminthes along with their examples.*

2.3.1: Phylum: Porifera **(3 lectures)**
a. General characters
b. Classification up to class with suitable examples:
Class - Calcarea, Hexactinellida and Demospongia.
c. Skeleton in sponges.

2.3.2: Phylum: Cnidaria **(3 lectures)**
a. General characters
b. Classification up to class with examples-
Class- Hydrozoa, Scyphozoa and Anthozoa.
c. Polymorphism in Cnidaria.

2.3.3: Phylum Platyhelminthes **(5 lectures)**
a. General characters.
b. Classification up to class with examples-
Class- Turbellaria, Trematoda, Cestoda .
c. Morphology, life cycle and Pathogenecity of *Fasciola hepatica.*

2.2.4: Phylum Aschelminthes **(4 lectures)**
a. General characters.
b. Classification up to class with examples-
Class-: Nematoda, Nematomorpha, Rotifera and Gastrotricha.
c. Diseases caused by nematodes in humans-
Ascariasis, Enterobiasis, Filariasis and Loiasis.

Unit 3: Kingdom: Animalia - II **(15 lectures)**

Learning objectives: *To introduce basic concepts of classification up to class in animal kingdom from phylum Annelida to Hemichordat and to familiarize with their characters.*

Learning outcome:
Learners will get an idea of higher groups of invertebrate animal life, their classification and their peculiar aspects.

3.1: Phylum: Annelida **(4 lectures)**

3.1.1**.** General characters.

3.1.2 Classification up to class with examples-

Class-- Polychaeta, Oligochaeta and Hirudinea.

3.1.3 Regeneration, asexual reproduction, epitoky and swarming in class Polychaeta.

3.2: Phylum: Arthropoda **(4 lectures)**

3.2.1 General characters.

3.2.2 Classification up to class with examples-

Class- Merostomata, Arachnida, Crustacea, Myriapoda, and Insecta

3.2.3 Social organization in termites.

3.3 Phylum: Onychorphora **(2 Lectures)**

3.3.1 Peripatus, a connecting link.

3.3.2 Affinities of Phylum Onychophora with following phyla --

a. Annelida,

b. Arthropoda,

c. Mollusca,

3.3.3 Peculiar Onychophoran characteristics.

3.3: Phylum Mollusca **(3 lectures**)

3.3.1 General characters.

3.3.2 Classification up to class with examples-

Class- Aplacophora, Polyplycophora, Monoplacophora, Gastropoda, Pelycypoda,

Scaphopoda and Cephalopoda .

3.3.3 Shells in Mollusca.

3.4: Phylum: Echinodermata **(3 lectures)**

3.4.1 General characters.

3.4.2 Classification up to class with examples-

Class -Asteroidea, Ophiuroidea, Echinoidea, Holothuroidea and Crinoidea.

3.4.3 Water vascular system in Starfish.

3.5 Minor phyla **(1 lecture)**

3.5.1 General characters along with examples of -

a. Phylum Acanthocephala- Acoelomate

b.Phylum Chaetognatha-- Coelomate

(Description of examples not expected)

3.6 Phylum –Hemichordata **(1 lecture)**

3.6.1 General characters and classification with examples

Class- Enteropneusta, Pterobranchia and Planctosphaeroidea.

3.7 Basic concepts of phylogeny **(1 lecture)**

Unit 4 Type study- *Sepia*
Learning objective- *To acquaint learners with the details of* Sepia *as a representative of invertebrate animals.*
Learning outcome- *Learners will get an idea of general characteristics and details of invertebrate animal systems.*

Type study- ***Sepia***
4.1: General characters and classification, Habit and habitat, External characters, mantle cavity, locomotion, economic importance. **(5 lectures)**

4.2: Digestive system, Respiratory system, Circulatory system, excretory system, nervous system, Sense organs and Reproductive system. **(10 lectures)**

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T.Y.B.Sc. USZOP503

Practical III

Semester V

1. **Levels of organization-**

   a. Symmetry: -i)Asymmetry- eg. Sponge
   ii) Radial: Bi-radial eg. Combjelly
   Pentaradial eg. Adult Brittle star
   iii) Bi- lateral -eg. Any tetrapod.

   b. Coelom: - i) Acoelomate –e.g. Tapeworm
   ii) Pseudo-coelomate- e.g. Ascaris
   iii) Coelomate –e.g. Frog

   c. Segmentation: i) Homonomous- eg. Nereis
   ii) Heteronomous- Cephalization: e.g. Honey-bee,
   Cephalothorax: -e.g. Crab

2. **Taxonomy**

   a. Kingdom- Protista:

   1) **Animal like Protists-Protozoa**

   i. Phylum: Sarcodina e.g Amoeba
   ii. Phylum: Mastigophora e.g,Noctiluca
   iii Phylum: Ciliophora e.g, Vorticella
   iv. Phylum: Sporozoa, e.g,Monocystis

   b. Kingdom Animalia

   1) Phylum- Porifera:-i) Class- Calcarea – e.g. Scypha
   ii) Class Hexactinellida – e.g. Hyalonemma
   iii) ClassDemospongia- e.g. Spongilla

   2) Phylum Cnidaria:- i) Class Hydrozoa – e.g. Vellela
   ii) Class Scyphozoa- e.g. Rhizostoma
   iii) Class Anthozoa- e.g. Corallium

   3) Phylum Platyhelminthes:-i) Class Turbellaria- e.g. Planaria
   ii) Class Trematoda - e.g. Liverfluke
   iii) Class Cestoda - e.g. Taenia solium

   4) Phylum Aschelminthes- **i)** Class Nematoda- e.g. Trichinella
   ii) Class Nematomorpha- e.g. Gordius
   iii) Class Rotifera- e.g. Mytilina
   iv) Class Gastrotricha-e.g. Chaetonotus
   v) Class Kinorhyncha-e.g. Echinoderes

   5) Phylum Annelida: - i) Class -Polychaeta- e.g. Arenicola
   ii) Class- Oligochaeta- e.g. Tubifex
   iii) Class- Hirudinea - e.g. Pontobdella

   6) Phylum Arthropoda: - i) Class- Merostomata-e.g.Limulus
   ii) Class- Arachnida- e.g. Scorpion
   iii) Class- Crustacea - e.g. Balanus

iv) Class- Myriapoda- e.g. Scolopendra
v) Class- Insecta- e.g. Coccinella

7) Phylum Onychophora e.g.Peripatus

8) Phylum Mollusca: - i) Class- Aplacophora e.g. Chaetoderma
ii) Class Polyplacophora e.g. Chiton
iii) Class Monoplacophor e.g. Neopilina
iv) Class Gastropoda e.g. Achatina
v) Class Pelycypoda e.g. Donax
vi) Class Scaphopoda e.g. Dentalium
vii) Class Cephalopoda e.g. Octopus

9) Phylum Echinodermata: i) Class Asteroidea e.g. Starfish
ii) Class Ophiuroidea e.g. Brittle star
iii) Class Echinoidea e.g. Echinus
iv) Class Holothuroidea e.g.Holothuria
v) Class Crinoidea e.g.Crinoid

10) Phylum Hemichordata: i) Class Enteropneusta e.g. Saccoglossus
ii) Class Pterobranchia e.g.Rhabdopleura
iii) Class Planctosphaeroidea e.g.Planctosphaera

3. Minor Phyla

a) Acoelomate:i) Phylum Acanthocephala e.g. Echinorhynchus
b) Coelomate: i) Phylum Chaetognatha e.g. Sagitta.

4. General Topics in Invertebrates:

a. Protozoans

Locomotion -Amoeboid locomotion-Amoeba, Ciliary locomotion-Vorticella
Flagellar locomotion- Noctiluca, Gliding locomotion-Monocystis

Reproduction-

Asexual reproduction – Binary fission- Amoeba
Sexual reproduction- Conjugation-Paramoecium

b. Sponges

Canal system:
Sycon type - Scypha, Ascon type- Leucosolenia, Leucon type -Spongilla
Sponge spicules: Monaxon,Triaxon, Tetraxon,Polyaxon

c. Insects:

Types of metamorphosis: Ametabolous- e.g.Lepisma, Hemimetabolous- e.g. Locust Holometabolous e.g. Butterfly.

5. Study tour-Visit to local fish market/Aquarium/Any other place to observe invertebrates.

Learner's space (proposed)

Paper III, Semester V

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. Find the difference between prokaryotic and eukaryotic cell.
4. How first life/ cell originated on earth?
5. List the names of places where coral reefs are found.
6. Enlist medicinal uses of leech.
7. Procure the differences between Loligo and Sepia.
8. Collect information on differences between minor phyla and major phyla.
9. What are criteria to put an animal in minor phylum?
10. Name the largest moth. Where is it found?

T. Y. B. Sc. Zoology

Course Code: USZO 603

Semester VI
Theory Paper-III

Unit 1: Phylum Chordata (**15 lectures**)

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

Learning 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** **7 lectures**

1.1.1 Difference between nonchordates and chordates.

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

1.1.3 Classification – outline giving reasons**,** with schematic diagram -

Phylum chordata**:** Group -protochordata (Acrania)

Subphylum-Urochordata – Class Ascidiacea, Thaliacea, Larvacea

Subphylum-Cephalochordata- Class Leptocardi

Group**:** Euchordata (Craniata)

Subphylum- Vertebrata: Division-Agnatha-

Class- Ostracodermii, Class- Cyclostomata

Division-Gnathostomata-

Superclass- Pisces: Class-Placodermi, Chondrichthyes, Osteichthyes

Superclass Tetrapoda:Class- Amphibia, Reptilia, Aves, Mammalia

1.2: **Protochordates** (**4 lectures)**

1.2.1: General characters of Group Protochordata,Classification up to class with examples

General characters of Subphylum Urochordata and Cephalochordata with examples

1.2.2: Retrogressive metamorphosis in Ascidian

1.**3 Euchordates** (**4 lectures**)

General characters - Group Euchordata. , Subphylum Vertebrata

Distinguishing characters -Division Agnatha and Gnathostomata.

General characters with examples- Class Ostracodermii and Cyclostomata.

Unit 2: Group Euchordata- I **(15 lectures)**

2.1: Division – Gnathostomata (**5 lectures)**

Superclass – Pisces and Tetrapoda

Superclass – Pisces- Distinguishing characters.

Class- Placodermi,Chondrichthyes and Osteichthyes-Distinguishing characters .

Examples:

a.Sharks, e.g. Hammer headed shark

b. Skates and rays, e.gs. Saw fish

c. Chimeras e.g Spotted rat fish

d. Flying fish, e.g. Exocoetus

2.2.: Dipnoi (Lung fish) - (**3 lectures)**

Distribution, habit and habitat,External and internal characters, affinities with super class Pisces, affinities and differences with class Amphibia

2..3: Migration in fish: Reasons for migration, types of migration (3 lectures)

Examples- Eel and Salmon

2.3: Superclass Tetrapoda- (**4 lectures**)

Class Amphibia -General characters,

Examples:

a. Limb-less amphibian, e.g. Ichthyophis

b. Tailed amphibian, e.g. Amphiuma

c. Tail-less amphibian, e.g. Hyla

2.3.: Neoteny and Paedogenesis in Amphibia

Unit 3: Group Euchordata II - Reptilia, Aves and Mammals **(15 lectures**

Learning objectives:

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

Learning outcome:

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

3.1: Class Reptilia: General characters. (**2 lectures)**

3.1.1, Examples

a. Extinct reptile, e.g. Ichthyosaurus
b. Living fossil, e.g. Sphenodon
c. Aquatic reptile, e.g. Chelone

d. Arboreal reptile, e.g. Chamaeleon

3.2: Class Aves- General Characters (**6 lectures)**

Examples-

a. Arboreal bird e.g Wood pecker

b. Terrestrial bird e.g. Jungle fowl

c. Swimming bird e.g. Cormorant

d. Wading bird, e.gs. Pond heron

e. Birds of prey, e.g. Owl

f. Flightless birds e.g. Emu

3.2.1 Flight adaptations in birds

3.3: Class Mammalia (5lectures)

3.3.1: General characters and examples -

a. Egg-laying mammals, e.g. Duck-billed platypus

b. Pouched mammals, e.g.Kangaroo

c. Insect eating mammals, e.g. Common shrew

d. Toothless mammals, e.g.Sloth

e. Gnawing mammals, e.g. Squirrel

g. Primates, e.g. Lemur

3.3.2 Adaptations in aquatic mammals with examples. **(2 lectures)**

Unit 4: Type study - Shark (15 lectures)

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

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

4.1 Habit & habitat, distribution, external (**3 lectures)**

characters and classification, and economic importance.

4.2) Skin, exoskeleton, endoskeleton**,** **(12 lectures)**

Digestive system, respiratory system, blood vascular System, nervous system,

receptor organs, urinogenital system, copulation, fertilization and development.

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Practical III

Semester VI

1. Group - Protochordata

Subphylum Urochordata -

a. Class Larvaceae, e.g. Oikopleura

b. Class Ascidiacea, e.g. Ciona

c. Class Thaliacea, e.g. Salpa

Subphylum Cephalochordata:

a Class Leptocardii, e.g. Branchiostoma (Amphioxus)

2. Subphylum Vertebrata:

1 Division Agnatha - Class Ostracodermi, e.g. Pharyngolepis,

Class Cyclostomata, e.g. Petromyzon

2. Division- Gnathostomata

a Superclass - Pisces:

i) Class Placodermi e.g.Bothriolepis,

ii) Class Chondrichthyes- e.g.. Rhinobates e.g. Chimaera

iii) Class- Osteichthyes -e.g.Protopterus , e.g. Catfish

b. Superclass - Tetrapoda :

i). Class Amphibia, e.g. Ichthyophis, e.g. Alytes, e.g. Triton

ii). Class Reptilia: e.g. Geochelone (Indian star tortoise),e.g Sphenodon , ex Varanus, e.g. Alligator

3. Class Aves:

E.g. Archaeopteryx, Ostrich, Penguin, Flamingo, Vulture, Hornbill

4. Class Mammalia: e.g. Duck-billed platypus, Dasyurus (Tiger cat), Dugong, Flying ,Squirrel, Gorilla.

5. Shark:

1. Study of endoskeleton of shark:

a. Axial- skull and vertebral column

b. Appendicular- pelvic and pectoral fins, pelvic and pectoral girdle.

6. Visit to local fish market/Aquarium/ zoo/ National park/Any other relevant place to observe Chordate animals.

Learner's space

PaperIII, Sem VI

1. Organise 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 its probable reasons.
4. What are benefits of frog to farmer?
5. What are the reasons of extinction of dinosaurs?
6. Enlist names of extinct birds.
7. Why 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. How is the age of the fossil decided?

USZOP503
PRACTICAL QUESTION PAPER
University of Mumbai
T.Y.B.Sc. (2018-19)
Sem V

9.30-2.30am **50 Marks**

Q.1	Identify and describe a) Symmetry / Coelom/ Segmentation (any two) b) Observe the animal (photo/existing preserved specimen) and state its Phylum giving reasons.Animal should be other then the specimens mentioned in the theory/practical syllabus and displaying characteristic features of that phylum.Note the animal need not be identified	**04** **02**
Q.2.	Identify and classify giving reasons a) Protozoa / Porifera / Cnidaria b) Platyhelminthes / Nemathelminthes c) Annelida / Arthropoda d) Mollusca / Echinodermata	**12**
Q.3	Identify, classify and describe a) Minor phyla b) Phylum Hemichordata	**03** **03**
Q.4	Identify and describe a) Locomotion / Reproduction in Protozoa b) Canal system in sponges /Spicules in sponges c) Metamorphosis in insects	**06**
Q.5	Field Report and Viva based on theory paper	**10**
Q.6	Journal	**10**

USZOP603
PRACTICAL QUESTION PAPER
University of Mumbai
T.Y.B.Sc. (2018-19)
Sem VI

Time:9.30-2.30am **50 Marks**

Q.1	Identify, classify and describe a)Eurochordata/Cephalochordata/Ostracodermii/Cyclostomata(Any two) b) Observe the animal (photo/existing preserved specimen) and state its Class giving reasons.Animal should be other then the specimens mentioned in the theory/practical syllabus and,displaying characteristic features of that Class.Note: The animal need not be identified	**06**
Q.2.	Identify and classify giving reasons a)Pisces b) Amhibia c)Reptilia d)Aves e)Mammal	**15**
Q.3	Identify,Sketch and label/Identify and describe the marked portion in given diagram a) Skull/Vertebra of Shark b) Fin(Pectoral Pelvic) c) Girdle of Shark(Pectoral Pelvic	**09**
Q.4	Field Report and Viva based on theory paper	**10**
Q.5	Journal	**10**

T.Y.B.Sc. Zoology
Semester V (Theory)
Course 14
Course Code: USZO504
Integumentary system, Human Osteology and Limb Muscles and Developmental Biology ofChick

Unit 1: Integumentary system and derivatives (15 lectures)

Objective:

To introduce the learners to understand different integumentary structures andderivatives in the vertebrates and to acquaint learners with special derivatives ofintegument.

Desired outcome:

Learners will be able to understand the importance of epidermal and dermalderivatives and their functions.

1.1: Basic structure of integument (1 lecture)

Epidermis and dermis.

1.2: Epidermal derivatives of Vertebrates (6 lectures)

Hair, hoof, horn, claw, teeth, beak, epidermal scales (large scales, small scales,modified scales - spine), glands - types and functions (mucous, serous, ceruminous,
poison, uropygial, salt), type of feathers.

1.3: Dermal derivatives of Vertebrates (4 lectures)

Scales in fish; scutes in reptiles and birds; dermal scales in mammals - Armadillo,
Antler -Caribou

1.4: Special derivatives of integument (4 lectures)

Wart in toad, rattle in snake, whale bone in baleen whale,kneepads in camel.

Learners space:

1) Find out the difference between holocrine, merocrine and apocrine glands.
2) When you look at yourself in a mirror, nearly everything you see is a part of theintegumentary system. It consists of your skin, hair, nails and various glands, such assweat and oil glands.Prepare a chart to check the hygiene status of your ownintegumentary system.
3) What is the difference between plastic and cosmetic surgery?
4) What is skin cancer? What are the preventive measures?
5) What is the ABCD rule for recognizing melanoma?
6) What is cyanosis?
7) Before thinking about getting a tattoo, list the risks involved.
8) Comment on birthmarks and how they are formed?
9) What is biological clock/rhythm? Find the correlation between melanin secretionand sleep?

Unit 2: Human Osteology (15 lectures)

O*bjective:*

To introduce the learners to different bones of human skeleton and theirimportance.

Desired outcome:

Learners will be able to understand the structure, types and functions of humanskeleton.

2.1: Introduction (2 lectures)

Bone structure, physical properties, chemical composition andfunctions of bones.

2.2: Axial skeleton (8 lectures)

2.2.1: Skull: General characteristics of skull bones

a) Cranial bones b) Facial bones

2.2.2: Vertebral column: General characteristics of a vertebra, structure of different typesof

vertebrae (cervical, thoracic, lumbar, sacrum & coccyx).

2.2.3: Ribs and sternum (Thorax): General skeleton of ribs and sternum.

2.2.4: Hyoid bone: Structure and function.

2.3: Appendicular skeleton (5 lectures)

2.3.1: Pectoral girdle and Pelvic girdle.

2.3.2: Bones of forelimbs and hindlimbs.

Learners space:

1) What is forensic osteology?
2) What is human osteoarchaeology?
3) Which are the sexually dimorphic bones in humans?
4) Find the importance of osteology in understanding human evolution and taxonomy.
5) What is osteoporosis?
6) What is the correlation between age, nutrition and growth of bones?
7) Collect the information about types of fractures and their first aid measures.

Unit 3: Muscles of long bones of Human limbs 15 lectures)

Objectives:

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

Desired outcome:

Learners will be able to understand the types of long limb muscles, its arrangementand their role in body movements.

3.1: Introduction and types of long limb muscles (1 lecture)

3.1.1 Flexors, Extensor, Rotator, Abductors, Adductors

3.2: Muscles of forelimbs (6 lectures)

3.2.1. Muscles that move the arm (Humerus)-Triceps Brachii,Biceps Brachii, Brachialis, Brachioradialis,

3.2.2. Muscles that move the forearm (Radius-ulna) - Flexor carpi radialis, Flexor carpiulnaris, Extensor carpi ulnaris
3.2.3. Muscles that move the wrist, hand and fingers - Flexor digitoriumsuperficialis, Extensor carpi radialis, Extensor digitorum

3.3: Muscles of hindlimbs (6 lectures)
3.3.1. Muscles that move the thigh (Femur) - Sartorius, Adductor group, Quadriceps group-
Rectus femoris, Vastus lateralis, Vastusmedialis, 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, Fibularistertius
3.3.3. Muscles that move the ankle, foot and toes - Tibialis anterior, Extensor digitorum longus, Fibularis muscles

3.4: Muscle injuries (1 lecture)
Injury in buttock - Gluteus maximus and Gluteus medius, knee- Quadriceps group, leg and foot while running.

3.5: Muscle syndromes (1 lecture)
Shin splint syndrome, Plantar fasciitis and Stress fractures.

Learners space:
1) Find out the following:
   a) How much do the muscles contribute towards your total body weight?
   b) Smallest muscle,strongest muscle and the muscle that is never tired in our body.
   c) How many muscles are required for taking one step?
2) What are the different shapes of the skeletal muscles?
3) Find out the following terms: myofiber, sarcolemma, sarcoplasm, sarcoplasmic reticulum,sarcosome, sarcomere.
4) Role of important nutrients for body building.
5) Name the muscles acting during quite, deep and forced respiration?
6) Collect the information regarding muscles involved in facial expressions?
7) Name three muscles or muscle groups used as sites for intramuscular injections.Which isthe most often used in babies?
8) What are the important differences in the effect of exercises on muscles of a marathonrunner and a weight lifter?

Unit 4: Developmental biology of Chick (15 lectures)

Objective:
To introduce to the learners the basics of developmental biology with reference tochick as a model and also understand experiments related to it.

Desired outcome:
Learners will be able to understand the processes involved in embryonic developmentand its application.

4.1: Introduction to Developmental Biology (5 lectures)
4.1.1. Basic concept and principles of developmental biology - morphogenesis, organogenesis, fate maps, cell adhesion, cell affinity and cell differentiation.

4.2: Development of Chick embryo (10 lectures)
4.2.1. Structure of Hen's egg, fertilization, cleavage, blastulation and 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

Learners space:

1) What are the different theories of experimental embryology?
2) Collect the brief information regarding the human embryogenesis?
3) What is Recapitulation theory?
4) What is French flag model in developmental biology?
5) Complete the following table:

Drosophila body Patterning		
Category of genes	**Name of genes**	**Role of gene**
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 (homeobox) genes		Establishes segmental identity

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Muscles of Long Bones of Human Limbs

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T.Y.B.Sc. Zoology
Semester V (Practical)
Course 14
(Course code: USZO504)

1) Study of integumentary systems and its derivatives - 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 - Girdles and Limb bones.
4) Study of muscles of forelimbs - Biceps Brachii, Brachialis, Brachioradialis.Triceps Brachii,Flexor carpi radialis, Flexorcarpi ulnaris, Extensor carpi ulnaris.

5) Study of muscles of hindlimbs.- Sartorius, Adductor group, Quadriceps group- Rectus femoris, Vastus lateralis, Vastus medialis, Hamstring group (Biceps femoris, Semimembranosus, Semitendinosus),Fibularis longus, Gastrocnemius, Tibialis anterior, Soleus, Extensor digitorum longus, Fibularistertius.

6) Study of ontogeny of chick embryo using permanent slides -18 hrs., 24 hrs., 33 hrs., 48hrs.and 72 hrs.

7) Prepare temporary mounting of chick embryo up to 48 hrs.of incubation(demonstration).

T.Y.B.Sc. Zoology
Semester VI (Theory)
Course 18
Course Code: USZO604
Environment and Wildlife management, Bioprospecting, Zoopharmacognosy and Zoogeography

Unit 1: Environment management (15 lectures)

Objective:

To introduce the learners to understand the importance of different factors ofenvironment and its management.

Desired outcome:

Learners will understand the different factors affecting environment, itsimpact and environment management laws.

1.1: Natural resources and their classification (2 lectures)

Forest resources, water resources (surface and ground), mineral resources,energy resources: renewable and non-renewable resources.

1.2: Exploitation and modification of natural resources (2 lectures)

Impact on climate, flora and fauna.

1.3: Waste Management (2 lectures)

3R's (Reduce, Reuse & Recycle) of solid waste, e-waste, hazardous waste.

1.4: Water Management (4 lectures)

Rain water harvesting, watershed management, effluent treatment,recycling plants, control and treatment of sewage water.

1.5: Rules and Acts of Environment Management (5 lectures)

Environment Protection Act, Air (Prevention and Control of Pollution) Rules-1982, Water (Prevention and Control of Pollution) Rules-1978, Hazardous Wastes (Management and Handling) Rules-1989, EIA(Environmental Impact Assessment), Role of Central and State Government(Pollution Control Board) and NGOs.

Learners space:

1) Find out the role of an ISO 14001 environmental management system?
2) What is environmental audit?
3) What is carbon footprint?
4) Collect information on life cycle assessment (LCA) as an environmentalmanagement tool?
5) Collect the information about institutes those provide environmental managementeducation?
6) Find out the role of industries such as TATA steel in environmentalmanagement?
7) What are the benefits of environmental monitoring for an industry?

Unit 2: Wildlife management **(15 lectures)**

Objective:

To introduce the learners to the importance of wildlife conservation.

Desired outcome:

Learners will be able to understand the wildlife habitat projects for animalprotection.

2.1: Habit, habitat, territory and niche of wild animals **(2 lectures)**

Herbivores, carnivores, solitary, pack and herd.

2.2: Threats to wildlife **(6 lectures)**

Diseases (zoonosis and reverse zoonosis), competition, hunting andpoaching, encroachment, deforestation, tourism, overgrazing, humananimal conflict and climate change.

2.3: Wildlife conservation: Techniques and methods **(7 lectures)**

Ex-situ conservation (Zoos, cryogenics, seedbank, germplasm and genebank), in-situ conservation (Bio-reserves, Sanctuaries and National Parks).

Learners space:

1) What is the difference between wildlife conservation and wildlife management?
2) Comment on ethics of Wildlife Management and Conservation.
3) What is WTI and its role in wildlife research and management?
4) Comment on Sustainable Wildlife Management (SWM).
5) Which ministry works for wildlife management in India?

Unit 3: Bioprospecting and Zoopharmacognosy **(15 lectures)**

Objective:

To introduce the learners to understand prospecting in biology and importance ofpharmacognosy.

Desired outcome:

Learners will understand the paradigms of discovery and commercialization ofbiological resources andknowledge gained by self medication by animals.

3.1: Bioprospecting **(7 lectures)**

3.1.1. Traditional and modern bioprospecting
3.1.2. Economic value of bioprospecting
3.1.3. Bioprospecting and conservation
3.1.4. Advantages and disadvantages

3.2: Zoopharmacognosy **(8 lectures)**

3.2.1: Definition and types
3.2.2: Self-medication and its mechanism
3.2.3: Methods of self-medication through- Ingestion- ants and mammals,Geophagy- invertebrates and birds
3.2.4: Absorption and adsorption
3.2.5: Applications – birds, mammals, social and trans-generational aspects
3.2.6: Contribution to human medicines.

Learners space:

1) What is Convention on Biological Diversity (CBD)?
2) Find the following:
   a) Bioprospecting and Maya ICBG controversy.
   b) Contribution of BabuKalunde in self-medication.
3) Link the study of human evolution with Zoopharmacognosy.

Unit 4: Zoogeography (15 lectures)

O*bjective:*

To introduce learners to a branch of science dealing with the geographic distributionof animals.

Desired outcome:

The learners will become acquainted with how and why different animal species aredistributed around the globe.

4.1: Introduction (2 lectures)

Plate tectonics and continental drift theory.

4.2: Animal distribution and barriers (7 lectures)

4.2.1: Patterns of animal distribution – continuous, discontinuous, isolation andbipolarity.

4.2.2: Barriers of distribution –Topographic, climatic, vegetative, large watermasses, 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 (6 lectures)

4.4.1: Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic andAntarctic.

Learners space:

1) What is Wallace's Line? Describe its fauna.
2) What is Weber's line?
3) How zoogeography leads to the speciation?
4) List the animal species which exhibit homing instincts.

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Wildlife management

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Bioprospecting and Zoopharmacognosy

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T.Y.B.Sc. Zoology
Semester VI (Practical)
Course 18
(Course code: USZO604)

1. Estimation of phosphates from sample water.
2. Estimation of BOD and COD from sample water.
3. Estimation of Nitrates from sample water.
4. Estimation of acidity and alkalinity of sample water by methyl orange and phenolphthalein indicator.
5. Comparative study of sound intensity in different places by Decibel meter.
6. Study of threatened animal species inhabiting Indian continent with reasons for decline- Great Indian bustard, One-horned rhinoceros, Royal Bengal tiger, Blackbuck, lion tailed macaque, Nilgiri Thar, Asiatic lion, Snow leopard, Gharial, and Gangetic dolphin.
7. Study of Zoopharmacognosy in ants, cats, elephants and dogs.
8. Indicate the distribution of fauna in the world map w.r.t. to its realm and comment on the pattern of distribution.
9. Study tour/Visit to Zoo/Sanctuary/National park/Research institute.

T.Y.B.Sc. Zoology
Semester V (Practical)
Course 13 and Course 14
Course Code: USZO505
Skeleton of Practical Examination
Question Paper

Time: 9:30 a.m. to 2:30 p.m. **Total Marks: 50**

Q.1] Identify and describe [18]

a) Based on V.S. of skin
b) Based on forelimb muscle
c) Based on hindlimbs muscle
d) Based on osteology - human axial skeleton
e) Based on osteology - human appendicular skeleton
f) Based on chick embryology

Q.2] Viva-voce based on practical [02]

Q.3] Journal [05]

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Questions of Paper 3 to be added (25 marks)

T.Y.B.Sc. Zoology
Semester VI (Practical)
Course 17 and Course 18
Course Code: USZO606
Skeleton of Practical Examination
Question Paper

Time: 9:30 a.m. to 2:30 p.m. **Total Marks: 50**

Q.1] Estimation of phosphates/nitrates from sample water [08]

OR

Estimation of BOD/COD from sample water

OR

Estimation of acidity/alkalinity of sample water by methyl orange and phenolphthalein indicator.

Q.2] Identification [06]

a) and b) Identify and describe giving reason for decline (Great Indian bustard, Onehorned rhinoceros, Royal Bengal tiger, Blackbuck, lion tailed macaque, Nilgiri Thar, Asiatic lion, Snow leopard, Gharial, and Gangetic dolphin)

c) Zoopharmacognosy (any one- ants, cats, elephants and dogs)

Q.3] Identify the given realm of world map and comment on its fauna. [03]

Q.4] Excursion/visit report and viva based on it. [05]

Q.5] Journal [03]

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