



Resolution No.: _____

This Syllabus is to be implemented from the Year 2023-2024

Bharatiya Vidya Bhavan's

**M. M. College of Arts, N.M. Institute of Science, H.R.J.
College of Commerce. (Bhavan's College) Autonomous**

(Affiliated to University of Mumbai)



Syllabus for: T.Y.B.Sc.

Program: B.Sc.

Program Code: BH.BSc.

Course Code: (BH.USZO)

**Choice Based Credit System (CBCS)
With effect from academic year 2023-2024**



PROGRAM OUTCOMES

PO	PO Description
	A student completing Bachelor's Degree in science program will be able to:
PO 1	Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more other disciplines that form a part of an undergraduate program of study. This programme helps students in building a solid foundation for further higher studies and research.
PO 2	Critical Thinking & Competency in Skills: Take informed actions after identifying the assumptions that frame our thinking and actions. Critically evaluate practices, policies, and theories by following a scientific approach to knowledge development. Obtain proficiency in analytical reasoning, critical understanding, analysis, and synthesis in order to solve theoretical and practical problems. This can orient students towards applications of their subject in other disciplines and, can also be utilized in modeling and solving real-life problems.
PO 3	Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; communicate with others using appropriate media; confidently share one's views and express herself/ himself; demonstrate the ability to listen carefully; and present complex information in a clear and concise manner to different groups.
PO 4	Social Interaction: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group and act together as a group or a team in the interests of a common cause. Elicit views of others, mediate disagreements, and help reach conclusions in group settings.
PO 5	Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
PO 6	Interdisciplinary and Research Skills: A sense of inquiry and capability for asking relevant/ appropriate questions, Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, interpret and draw conclusions from data, ability to plan, execute and report the results of an experiment or investigation which will enable them to apply one's learning to real-life situations.
PO 7	Proficiency in Employments: This programme will help students to enhance their employability for Government jobs, related to science, data analysis jobs, and jobs in various other public and private enterprises.



PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree in B.SC. program in the subject of ZOOLOGY will be able to:
PSO 1	To gain knowledge of the basic concept of classification and they will be able to identify the invertebrates by applying the knowledge of general characters.
PSO 2	To study the treasure of Biodiversity and, its importance and to create awareness about its conservation.
PSO 3	To grasp the concept of interdependence and interactions of physical, chemical, and biological factors in the environment lead to a better understanding of the implications of the loss of fauna specifically human beings, to understand the importance of conservation of all flora and fauna.
PSO 4	To understand the increasing complexity of respiratory, locomotory, and nutritional physiology in the evolutionary hierarchy. and also, be able to correlate the habit and habitat with respiratory, locomotory, and nutritional structures.
PSO 5	Understand recent advances in the subject and their applications for the betterment of mankind; and that the young minds would be tuned to think out of the box.
PSO 6	To apply their knowledge of how to work safely in the laboratory and avoid the occurrence of accidents (mishaps) which will boost their scholastic performance and economy in the use of materials/chemicals during practical sessions.
PSO 7	To get an idea of the basic characteristics of phyla and the organisms. And to identify the organisms based on their External features.
PSO 8	To get an idea about the origin of life and to get acquainted with various theories put forth.
PSO 9	To get an idea about the developmental process through evolutionary evidence.
PSO 10	To understand the increasing complexity of excretory, osmoregulatory, and reproductive physiology in evolutionary hierarch and to correlate the habit and habitat with excretory, osmoregulatory, and reproductive structures.
PSO 11	Understand and apply the principles of inheritance, the concept of multiple alleles, linkage, and crossing over.
PSO 12	To select and operate suitable instruments for the studies of different components of Zoology of this course and also of higher classes including research.



PROGRAM OUTLINE

SEMESTER	COURSE CODE	COURSE TITLE	CREDITS	
SEMESTER V	BH. USZO501	Invertebrates and Special Features	2.5	
	BH. USZO502	Haematology and Immunology	2.5	
	BH. USZO503	Histology, Toxicology, Pathology and Biostatistics	2.5	
	BH. USZO504	Anatomy, Research and Developmental Biology	2.5	
	PRACTICALS			
	BH. USZOP5	Based on BH. USZO501 & BH. USZO502		03
	BH. USZOP6	Based on BH. USZO503 & BH. USZO504		03
	TOTAL CREDITS			16
SEMESTER VI	BH. USZO601	Vertebrates and Special Features	2.5	
	BH. USZO602	Physiology and Tissue Culture	2.5	
	BH. USZO603	Genetics and Bioinformatics	2.5	
	BH. USZO604	Environmental Biology and Zoopharmacognosy	2.5	
	PRACTICALS			
	BH. USZOP7	Based on BH. USZO601 & BH. USZO602		03
	BH. USZOP8	Based on BH. USZO603 & BH. USZO604		03
	TOTAL CREDITS			16



DETAILED SYLLABUS – SEMESTER V and VI

PREAMBLE

As Bhavans College has received academic autonomy, we have made an attempt to revise the TY BSC syllabus to make it more appropriate to fore students and their future. Zoology has emerged as a progressive subject in the last decade with innovations in curricular designing and unique initiatives which attracted students.

Experiments such as Need Based Flexi Syllabus, and Open Unit to include the latest topics any time before revision of syllabus. The fundamental challenge, however, was to design curricula without dissections, the backbone of the subject. We Zoologists though are firmly against cruelty to animals and practice conservation, had to take it with a pinch of salt that the dead table fish from the market and pests were also banned from dissection.

Apart from a project in the Applied Component such students may present a research project under the guidance of a teacher from their college or any other college or from the industry or may do so on their own which shall be evaluated by the examiners at the time of the practical examinations and that the performance shall be considered separately as additional optional credits, based on the free choice of the student and if permitted by the authorities then the same could be transferred to the other / higher programs if desired. It's a modest attempt to bring a choice-based credit system with an option of transfer in the mainstream academics of the University on the lines of the pioneering effort successfully launched in the subject of NCC, when introduced as an elective in academics. Care has also been taken to include a topic on muscles which was much neglected so far in anatomy. The possibility cannot be ruled out that it may give further impetus to Zoology students to enter the career of Gym and Fitness. This niche of students shall have the upper hand over other personnel in the fitness industry in passing international exams since they already have knowledge of physiology to a desired extent.



DETAILED SYLLABUS

Programme: T.Y.B.Sc				Semester: V	
Course: Non chordates and distinctive features				Course Code: BH.USZO501	
Teaching Scheme				Evaluation Scheme (Theory)	
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
04	04	--		(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Basis of classification of Invertebrates				15
2	Distinctive features of Porifera, Cnidaria, Platyhelminthes and Nematoda				15
3	Distinctive features of Phylum Annelida, Arthropoda and Mollusca				15
4	Distinctive features of Phylum Echinodermata, Hemichordata and Minor phyla				15
Total					60
Detailed syllabus					
Units	Detailed descriptions				Lecture period /unit
Unit 1	Basis of classification of Invertebrates				15 lectures
Objective	<i>To introduce the basis of the classification of invertebrates with an evolution point of view.</i>				
Desired outcome	<i>Learners will apprehend the basis of classification and some peculiar features of lower invertebrate animals.</i>				
	<p>1.1.Symmetry: Asymmetry, Radial, Bilateral</p> <p>1.2 Coelom: Acoelomate, Pseudo coelomate, Coelomate</p> <p>1.3 Germ layer: Diploblastic, Triploblastic</p> <p>1.4 Segmentation: Pseudo segmentation, Metamerism</p> <p>1.5 Significance of cephalisation</p>				



	1.6 Importance of classification in biological studies	
Unit 2	Distinctive features of Phylum Porifera, Cnidaria, Platyhelminthes and Nematoda	15 lectures
Objective	<i>To comprehend the distinctive characters of organisms belonging to Phylum Porifera to Nematoda</i>	
Desired outcome	<i>The learners will be familiarized with the organization in lower invertebrates and larval stages of Fasciola hepatica</i>	
	<p>2.1 Canal system in Porifera: Ascon, Sycon, Leucon type</p> <p>2.2 Spicules and Gemmules in Sponge</p> <p>2.3 Types of cells in Cnidaria,</p> <p>2.4 Reproduction and larval stages in Fasciola hepatica</p> <p>2.5 Psuedocoelomate organism and parasitic adaptations in Ascaris</p>	
Unit 3	Distinctive features of Phylum Annelida, Arthropoda and Mollusca	15 lectures
Objective	<i>To comprehend the distinctive characteristics of organisms belonging to Phylum Annelida to Mollusca .</i>	
Desired outcome	<i>Learners will get an idea of higher groups of invertebrate animal life, mode of feeding and economic importance.</i>	
	<p>3.1 Metamerism in Annelida, Morphology of Neries</p> <p>3.2 Types of mouth parts in Insects; Biting and Chewing, Piercing and Sucking, Sponging and Lapping, Siphoning type with suitable examples.</p> <p>3.3 Importance on Entomology</p> <p>3.4 Economic importance of Mollusca w.r.t Pelecypoda and Gastropoda, Cephalopoda. Formation of pearl in oyster and it's economical uses</p>	
Unit 4	Distinctive features of Phylum Echinodermata, Hemichordata and Minor phyla	15 lectures
Objective	<i>To comprehend the distinctive characters of organisms belonging to Phylum Echinodermata to Minor phyla</i>	
Desired outcome	<i>Learners will get an idea of morphology and peculiar characters of the organisms and the connecting link from the evolutionary point of view</i>	



	<p>4.1 Water vascular system of starfish</p> <p>4.2 Morphology of <i>Balanoglossus</i></p> <p>4.3 Minor Phyla: a) <i>Acanthocephala (Moniliformis)</i> b) <i>Onychophora (Peripatus)</i> c) <i>Chaetognatha (Sagitta)</i></p> <p>4.4 Peripatus: A connecting link- Affinities with Phylum Annelida, Arthropoda and Mollusca</p>	
Total	60 Lectures	<p>Reference Books:</p> <ol style="list-style-type: none"> 1. A manual of Zoology - Part I, Invertebrata; Ayyar, M. Ekambaranath 2. Invertebrate Zoology - Volumes of different Phyla; Hyman L.H. 3. Instant Notes in Animal Biology by Richard D. Jurd. 4. Introduction to Zoology - Vol I: K. K. Chaki, G. Kundu and S. Sarkar, New Crystal Book Agency. 5. Modern text book of Zoology - Invertebrates; Eleventh; Edition Professor R.L. Kotpal; Rastogi publication 6. Invertebrate Zoology by E. L. Jordan & P. S. Verma Rev. edition, 2009, Chand publications 7. Invertebrate Zoology by P. S. Verma, edition, 2009, Chand publications 8. Zoology for degree students, Non chordates by V.K. Agarwal 2011, S. Chand Publication 9. Zoology for Degree Students, B.Sc. First Year, by V. K. Agarwal, Pub. S. Chand Coy. 10. B. Sc. Zoology, Invertebrate Zoology by V.K. Aggarwal 2017, S. Chand publications 11. Invertebrate Zoology by Fatik Baran 2012, PHI Learning 12. A Textbook of Invertebrates by N.C. Nair et al. 2010 Saras publications 13. Practical Zoology: Invertebrate, by S. S. Lal, 2016 14. Invertebrate Zoology by Ruppert, Fox, Barnes, 7th edition, 2003 publications Cengage Learning 15. Invertebrate Zoology by D.T. Anderson 2nd edition 2002, publications Oxford 16. Invertebrates by Richard C. Brusca et. al, 3rd edition 2016, publications Oxford 17. Biology of the invertebrates by Jan A. Pechenik, 7th edition, 2014 publications McGraw Hill 18. An introduction to the invertebrates by Janet Moore, 2nd edition 2006, publications Cambridge 19. Protozoology, by S. V. Nikam & S. T. Tanveer ed. 2011, Pub. Oxford Book Company (N.B.: This book includes Phylum Sarcomastigophora)



PRACTICALS

PAPER 1: INVERTEBRATES AND SPECIAL FEATURES (BH. USZOP501)

1. Study of types of symmetry, coelom, segmentation:
 - a. Symmetry- Asymmetry: Amoeba; Radial: Earthworm, Bilateral: Frog
 - b. Coelom- Acoelomate: Platyhelminthes; Pseudocoelomate: Nematoda; Coelomate: Annelida
 - c. Segmentation- Pseudo segmentation: *Ascaris*; Metamerism: Earthworm.
2. a) Study of canal system in sponges- Ascon, Sycon, Leucon type.
b) Spicules and gemmules in sponges.
3. Study of Liverfluke larvae- Miracidium, Sporocyst, Redia, Cercaria, metacercaria.
4. Study of mouthparts in Insect- Biting and chewing (Cockroach), Piercing and sucking (Mosquito) , Sponging and lapping (Housefly) ,Chewing and lapping (Honey bee).
5. Study of Water vascular system in starfish.
6. Identification of Pelecypoda, Gastropoda, Cephalopoda.
7. Observation of morphology of *Balanoglossus*.
8. Identification of specimen of minor phyla- Acanthocephala (*Moniliformis*), Onychophora (*Peripatus*) , Chaetognatha (*Sagitta*).



Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. USZO501

Time: 10 am to 2 pm

Total Marks: 50

- | | |
|---|-------------|
| Q.1 Draw a neat, labeled diagram of Ascon/ Sycon/ Leucon type of canal system and explain the route with a schematic diagram | 08 M |
| Q.2 Explain the different mouth parts: Biting and chewing / Piercing and sucking/ Sponging and lapping/ Chewing and lapping type with a neat , labeled diagram (Any 2) | 06M |
| Q.3 Identify and describe w.r.t. -
a) Symmetry / Coelom / Segmentation
b) Spicules / Gemmules
c) Liver Fluke larva
d) Water vascular system in star fish
e) Sepia / Loligo / Octopus (identification and economic importance)
f) Balanoglossus
g) Minor phyla (any one example) | 21M |
| Q.4 Field visit report | 05 M |
| Q.5 Viva | 05 M |
| Q.6 Journal | 05 M |



DETAILED SYLLABUS

Programme: T.Y.B.Sc				Semester: V	
Course: Haematology and Immunology				Course Code: BH. USZO502	
Teaching Scheme				Evaluation Scheme (Theory)	
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
4	4	--		(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Basic Haematology				15
2	Applied Haematology				15
3	Basic Immunology				15
4	Applied Immunology				15
Total					60
Detailed syllabus					
Units	Detailed descriptions				Lecture period /unit
Unit 1	Basic Haematology				15 lectures
Objectives	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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				



	<p>1.2: Haematopoiesis: Erythropoiesis, leucopoiesis and thrombopoiesis</p> <p>1.3: Erythrocytes: Structure and functions, abnormalities in structure, total count, variation in number; ESR; types of anaemia</p> <p>1.4: Haemoglobin: Structure, formation and degradation; variants of haemoglobin (foetal, adult), abnormalities in haemoglobin (sickle cell and thalassaemia)</p> <p>1.5: Leucocytes: Types and functions, total count and variation in number; leukaemia and its types</p> <p>1.6: Thrombocytes: Structure, factors and mechanism of clotting, failure of clotting mechanism</p> <p>1.7: Blood volume: Total quantity and regulation; hemorrhage</p>	
Unit 2	Applied Haematology	15 lectures
Objectives	<ul style="list-style-type: none"> <i>To introduce to the learner the basics of applied haematology and to impart knowledge of diagnostic techniques used in pathology.</i> 	
Desired Outcome	<ul style="list-style-type: none"> <i>The learner will be familiar with the terminology used and diagnostic tests performed in a pathological laboratory.</i> <i>The learner shall be acquainted with diagnostic approaches in haematological disorders.</i> <i>The learner will be better equipped for further pathological course or working in a diagnostic laboratory.</i> 	
	<p>2.1: Introduction and scope of Applied Haematology: Clinical, microbiological, oncological and forensic haematology</p> <p>2.2: Clinical significance of Diagnostic Techniques</p> <p>2.2.1: Microscopic examination of blood:</p> <ul style="list-style-type: none"> Blood cancer (lymphoma, myeloma), Infectious diseases (malaria, leishmaniasis), Haemoglobinopathies (sickle cell anaemia, thalassaemia) <p>2.2.2: Coagulopathies: Haemophilia and purpura</p> <p>2.2.3: Biochemical examination of blood:</p> <ul style="list-style-type: none"> 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 3	Basic Immunology	15 lectures
Objectives	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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. 	
	<p>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 defense - physical and chemical barriers; Second line of defense - 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</p> <p>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</p> <p>3.3: Antigens: Definition and properties; haptens.</p> <p>3.4: Antibodies: Definition, basic structure, classes of antibodies - IgG, IgA, IgM, IgD and IgE.</p> <p>3.5: Antigen processing and presentation 3.5.1: Endogenous antigens - cytosolic pathways 3.5.2: Exogenous antigens - endocytic pathways</p>	
Unit 4	Applied Immunology	15 lectures
Objectives	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> The learner shall understand immunopathology and the principles and applications of vaccines. The learner will develop basic understanding of immunology of organ 	



	<i>transplantation.</i>
	<p>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</p> <p>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) Covid vaccine</p> <p>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</p>

Reference Books:

1. Human Physiology - Volume 1; C.C. Chatterjee.
2. Essentials of Haematology; Shirish M. Kawthalkar; Jaypee Brothers.
3. Williams Hematology; Kenneth Kaushansky, Marshall A. Lichtman, E. Beutler, Thomas J. Kipps, Josef Prchal, Uri Seligsohn.
4. Essential Haematology; Victor Hoffbrand, Paul Moss, John Pettit.
5. Principles of Anatomy & Physiology; Thirteenth Edition; Gerard J. Tortora & Bryan Derrickson; Biological Science Textbooks, Inc.; 2012.
6. Biochemistry; Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013.
7. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006.
 Essentials of Haematology; Second Edition; Kawthalkar Shirish M.; Jaypee; 2013. Medical



Biochemistry by C. Jaypee; 2012.

8. Immunology - Introductory Textbook; Shetty N.; New Age International; 2005.
9. Immunology - Essential and Fundamental; Pathak S., & Palan U.; Science Publishers; 2005.
10. Immunology: A textbook; Rao C. V.; Alpha Science Int'l Ltd.; 2005.
11. Ananthanarayan and Paniker's textbook of Microbiology; C. J. Paniker (Ed.); Ananthanarayan R.; Orient Blackswan; 2005.
12. Textbook of Immunology; Haleem Khan, Rajendra Sagar, Sadguna.
13. Kuby Immunology; Sixth Edition; Thomas J. Kindt, Richard A. Goldsby, Barbara Osborne & Janis Kuby; W.H. Freeman; 2007.

PRACTICALS

PAPER 2 : HAEMATOLOGY AND IMMUNOLOGY (BH. USZO502)

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.



Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. USZO502

Time: 10 am to 2 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	
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.	08
OR	
Q.2 Estimate serum/plasma total triglycerides by Phosphovanillin method.	
Q.3 Estimate haemoglobin by Sahli's acid haematin method.	07
OR	
Q.3 Record Erythrocyte Sedimentation Rate by Westergren / Wintrobe method.	
OR	
Q.3 Determine serum LDH by colorimetric/spectrophotometric method.	
Q.4 Perform Latex agglutination test - Rheumatoid Arthritis.	10
OR	
Q.4 Record bleeding / clotting time and comment on clinical significance.	
Q.5 Viva voce	05
Q.6 Journal	05



DETAILED SYLLABUS

Programme: T.Y.B.Sc				Semester: V	
Course: Histology, Toxicology, Pathology and Biostatistics				Course Code: BH. USZO503	
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
4	4	--	6	(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Mammalian Histology				15
2	Toxicology				15
3	General Pathology				15
4	Biostatistics				15
	TOTAL				60

Detailed syllabus

Units	Detailed descriptions	Lecture period /unit
Unit 1	Mammalian Histology	15 lectures
Objectives	<ul style="list-style-type: none"> <i>To familiarize the learner with the cellular architecture of the various organs in the body.</i> <i>To make the learner understand the need and importance of different types of tissues in the vital organs and their functions.</i> 	
Desired Outcome	<ul style="list-style-type: none"> <i>Learners would appreciate the well-planned organization of tissues and cells in</i> 	



	<i>the organ systems.</i>	
	<p>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</p> <p>1.2: Digestive System</p> <p>1.2.1: Vertical section (V.S.) of tooth; hard tissue - dentine and enamel; soft tissue - dentinal pulp and periodontal ligaments</p> <p>1.2.2: Transverse section (T.S.) of tongue - mucosal papillae and taste buds</p> <p>1.2.3: Alimentary canal - Transverse section (T.S.) of stomach, small intestine and large intestine of mammal.</p> <p>1.2.4: Glands associated with the digestive system - Transverse section (T.S.) of salivary glands and liver.</p>	
Unit 2	Toxicology	15 lectures
Objectives	<ul style="list-style-type: none"> • <i>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.</i> • <i>It also intends to develop amongst students an introductory understanding of regulatory affairs in toxicology.</i> 	
Desired Outcome	<ul style="list-style-type: none"> • <i>The course will prepare learners to develop a broad understanding of the different areas of toxicology.</i> • <i>It will also develop critical thinking and assist students in preparation for employment in the pharmaceutical industry and related areas.</i> 	
	<p>2.1: Basic toxicology</p> <p>2.1.1: Introduction to toxicology - brief history, different areas of toxicology, principles and scope of toxicology</p> <p>2.1.2: Toxins and Toxicants - Phytotoxins (caffeine, nicotine), Mycotoxins (aflatoxins), 19 Zootoxins (cnidarian toxin, bee venom, scorpion venom, snake venom)</p> <p>2.1.3: Characteristics of Exposure - Duration of exposure, Frequency of exposure, Site of exposure and Routes of exposure</p> <p>2.1.4: Types of Toxicity - Acute toxicity, Sub-acute toxicity, Sub-chronic toxicity and</p>	



	<p>Chronic toxicity</p> <p>2.1.5: Concept of LD₅₀, LC₅₀, ED₅₀.</p> <p>2.1.6: Dose Response relationship - Individual / Graded dose response, Quantal dose response, shape of dose response curves, Therapeutic index, Margin of safety.</p> <p>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)</p> <p>2.1.8: Target organ toxicity:</p> <p>(i) Hepatotoxicity: susceptibility of the liver, types of liver injury, examples of hepatotoxicants;</p> <p>(ii) Neurotoxicity: vulnerability of nervous system, examples of neurotoxicants;</p> <p>(iii) Nephrotoxicity: susceptibility of kidney, examples of nephrotoxicants</p> <p>2.2: Regulatory toxicology</p> <p>2.2.1: OECD guidelines for testing of chemicals (an overview)</p> <p>2.2.2: CPCSEA guidelines for animal testing centre, ethical issues in animal studies</p> <p>2.2.3: Animal models used in regulatory toxicology studies and Alternative methods in toxicology (in vitro tests).</p> <p>2.3: Forensic Toxicology-</p> <p>2.3.1 Introduction and development of forensic toxicology, definition, branches of forensic toxicology, significance.</p> <p>2.3.2 Scope, duties and responsibilities of a forensic toxicologist and analysis report.</p>	
Unit 3	General Pathology	15 lectures
Objectives	<ul style="list-style-type: none"> • <i>To introduce the learner to basics of general pathology.</i> • <i>To impart knowledge of retrogressive, necrotic, pathological conditions in the body.</i> • <i>To explain the repair mechanism of the body.</i> 	
Desired Outcome	<ul style="list-style-type: none"> • <i>Learners will be familiar with various medical terminologies pertaining to pathological conditions of the body caused due to diseases.</i> 	
	3.1: General Pathology: Introduction and scope	



	<p>3.2: Cell injury: Mechanisms of cell injury: ischemic, hypoxic, free radical mediated and chemical</p> <p>3.3: Retrogressive changes: Definition, cloudy swelling, degeneration: fatty, mucoid and amyloid (causes and effects)</p> <p>3.4: Disorders of pigmentation: Endogenous: Brief ideas about normal process of pigmentation, melanosis, jaundice (causes and effects)</p> <p>3.5: Necrosis: Definition and causes; nuclear and cytoplasmic changes; types: coagulative, liquefactive, caseous, fat and fibroid</p> <p>3.6: Gangrene: Definition and types - dry, moist and gas gangrene</p>	
Unit 4	Biostatistics	15 lectures
Objectives	<ul style="list-style-type: none"> <i>To make learners familiar with biostatistics as an important tool of analysis and its applications.</i> 	
Desired Outcome	<ul style="list-style-type: none"> <i>The learner will be able to collect, organize and analyze data using parametric and non-parametric tests.</i> <i>They will also be able to set up a hypothesis and verify the same using limits of significance.</i> 	
	<p>4.1: Probability Distributions: Normal, Binomial, Poisson distribution, Z-transformation, p-value, Probability - Addition and multiplication rules and their applications</p> <p>4.2: Measures of Variation: Variance, standard deviation, standard error</p> <p>4.3: Testing of Hypothesis: Basic concepts, types of hypothesis: Null hypothesis and Alternate hypothesis, Levels of significance and testing of hypothesis</p> <p>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</p> <p>4.5: Correlation: Correlation coefficient and its significance</p>	
<p>Reference Books:</p> <ol style="list-style-type: none"> A Textbook of Histology; Mathur Ramesh; Anmol Pub. A Textbook of Histology and A Practical Guide; Gunasegaran J.P.; Elsevier A Textbook of Histology; Khanna D.R.; Sonali Pub. Practical Zoology; Second Edition; Dr. K.C. Ghose&Dr. B. Manna; New Central Book Agency Pvt. Ltd. , Kolkata; 1999. Casarett and Doulls Toxicology - The basic science of poisons; Edited by Curtis Klaassen; McGraw-Hill; 2001. Toxicological testing handbook - Principles, applications and data interpretation; David Jacobson-Kram and Kit Keller; CRC Press; 2006. 		



7. Principles and methods of toxicology; A. Wallace Hayes; CRC Press; 2007.
8. Toxicology - principles and methods; M.A. Subramanian; MJP Publishers, Chennai; 2004.
9. Clinical Pathology; Guru G.; NCERT; 1988.
10. Clinical Pathology; Batra Neelam; Vikas Publishing House Pvt. Ltd.; Nov. 1982.
11. Essentials of General Pathology; Dr. Sudha Shivraj, Dr. Satish Kumar Amarnath, Dr. Sheela Devi; Exclusively distributed by CBS Publishers & Distributors. Textbook of Pathology; Harsh Mohan; Jaypee Publishers.
13. Biostatistics - The Bare Essentials; Third Edition; Geoffrey R. Norman, David L. Streiner; B.C. Decker, Inc., Hamilton; 2008.
14. Fundamentals of Biostatistics; Second Edition; Veer Bala Rastogi; Ane Books Pvt. Ltd., New Delhi; 2009 (Reprint 2010).
15. Fundamentals of Biostatistics; Second Revised Edition; Irfan Ali Khan and Atiya Khanum; Ukaaz Publications, Hyderabad; 2004

PRACTICALS

PAPER 3: HISTOLOGY, TOXICOLOGY, PATHOLOGY AND BIOSTATISTICS (BH. USZO503)

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 CCl₄ on the level of enzyme activity in liver on aspartate and alanine amino transferase, alkaline phosphatase (*in vitro* approach).
5. Study and interpretation of abnormal pathological reports: Blood (CBC), Urine (Routine) and Stool (Routine).
6. Following biostatistics practicals will be done using data analysis tool of Microsoft Excel (DEMONSTRATION in regular practicals) and 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)



Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. UZO503

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 (<i>in vitro</i> approach)	08
Q.2	From the infiltrated tissue prepare block, trim and mount it on the block holder	07
	OR	
Q.2	Mount the ribbon on slide from the given block.	
	OR	
Q.2	Stain the given histological slide and identify the tissue.	
Q.3	Identify and describe a, b, c, d.	08
	a) & b) based on study of mammalian tissues	
	c) & d) based on diseases or conditions	
Q.4	Interpret the pathological report - blood / urine / stool.	06
Q.5	To analyze report of criminal and non-criminal (any two).	04
Q. 6	Problems in Biostatistics (Any one)	07
Q.7	Viva voce	05
Q.8	Journal	05



Programme: T.Y.B.Sc				Semester: V	
Course: Anatomy, Research and Developmental Biology				Course Code: BH. USZO504	
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
4	4	--	6	(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Integumentary system and derivatives				15
2	Human Osteology & Muscles				15
3	Scientific Attitude Methodology, Scientific Writing and Ethics in Scientific Research				15
4	Developmental biology of Chick				15
	Total				60

Detailed syllabus

Units	Detailed descriptions	Lecture period /unit
Unit 1	Integumentary system and derivatives	15 lectures
Objectives	<ul style="list-style-type: none"> To introduce the learner to understand different integumentary structures and derivatives in the vertebrates and to acquaint learners with special derivatives of 	



	<i>integument.</i>	
Desired Outcome	<ul style="list-style-type: none"> Learner will be able to understand the importance of various types of epidermal and dermal derivatives along with their functions. 	
	<p>1.1: Basic structure of integument: Epidermis and dermis</p> <p>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</p> <p>1.3: Dermal derivatives of Vertebrates: Scales in fish; scutes in reptiles and birds; dermal scales in mammals - Armadillo, Antler - Caribou</p> <p>1.4: Special derivatives of integument: Wart in toad, rattle in snake, whale bone in baleen whale, kneepads in camel.</p>	
Unit 2	Human Osteology & Muscles	15 lectures
Objectives	<ul style="list-style-type: none"> To introduce the learner to different bones of human skeleton and their functional importance. 	
Desired Outcome	<ul style="list-style-type: none"> Learner will be able to understand the structure, types and functions of human skeleton. To study muscle injuries and syndromes. 	
	<p>2.1: Introduction: Bone structure (Histology), general functions of bones, Cartilage: General structure, functions</p> <p>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.</p> <p>2.3: Appendicular skeleton 2.3.1: Pectoral girdle and bones of forelimbs 2.3.2: Pelvic girdle and bones of hind limbs</p> <p>2.4 Muscles 2.4.1 Introduction and types of long limb muscles 2.4.2 Flexors, Extensor, Rotator, Abductors, Adductors</p>	



	2.4.3 Muscle Injury, Degeneration & Regeneration	
Unit 3	Scientific Attitude Methodology, Scientific Writing and Ethics in Scientific Research	15 lectures
Objectives	<ul style="list-style-type: none"> To inculcate scientific temperament in the learner. 	
Desired Outcome	<ul style="list-style-type: none"> The learner would develop qualities such as critical thinking and analysis. The learner will imbibe the skills of scientific communication and he/she will understand the ethical aspects of research 	
	<p>3.1 Introduction to Research Methodology: Meaning of Research, Objectives of Research, Types of Research, Significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process.,HI index</p> <p>3.2 Application of knowledge: Differential research, Basic research, Applied research, Translational research with examples. Literature review</p> <p>3.3 Methodology and execution (appropriate controls, sample size, technically sound, free from bias, repeat experiments for consistency), documentation of data, data analysis and interpretation, results and conclusions</p> <p>3.4 Scientific writing: Structure and components of a research paper: (preparation of manuscript for publication of research paper- title, authors and their affiliations, abstract, keywords and abbreviations, introduction, material and methods, results, discussion, conclusions, acknowledgement, bibliography; figures, tables and their legends.</p> <p>3.5 Dissemination of data: Reporting results to scientific community; Publication in peer-reviewed journals, reports, oral presentation and poster presentation.</p>	
Unit 4	Developmental biology of Chick	15 lectures
Objectives	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Learner will be able to understand the processes involved in embryonic development and practical applications of studying chick embryology. 	
	<p>4.1: Introduction to Developmental Biology: Basic concept and principles of developmental biology - morphogenesis, organogenesis, fate maps, cell adhesion, cell affinity and cell differentiation.</p> <p>4.2: Development of Chick embryo</p>	



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 - **Ectodermal, endodermal and mesodermal derivatives.**
 18hours, 24 hours, 36 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

Reference Books:

1. Comparative Anatomy of the Vertebrates; Ninth Edition; Kent, G.C. and Carr R.K.; The McGraw-Hill Companies; 2000.
2. Text book of Chordates; Saras publication.
3. Modern text book of Zoology; Prof. R.L. Kotpal.
4. Integumentary system and its derivatives; Samuel D. Hodge.
5. Atlas of Human Anatomy - Vol I; R.D. Sinelnikov; Mr. Publishers Moscow.
6. A Guide of Osteology (for medical students); Prakash Kendra, Lucknow.
7. Text Book of Comparative Anatomy and Physiology; Tortora.
8. Human Osteology - Tim D White.
9. Text Book of Human Osteology - Singh Inderbir. Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi; 1978.
10. Human Anatomy - John W. Hole, Jr., Karen A. Koos, Publisher: W. C. Brown Publisher, USA. Principles of Anatomy and Physiology - Gerard T. Tortora and Sandra Reynolds Grabowski. Publisher: Harpers Collins College Publishers (7th Edition)
11. Developmental biology - Gilbert.
12. Development of Chick - Patten. Developmental Biology - Wolpert.
13. Text book of Embryology - N. Arumugam.
14. Chicken Development - Embryology; W.H. Freeman & B. Bracegirdle. Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd. Kolkata; 1999.
15. Research Methodology, Methods and Techniques- by C.R. Kothari, Wiley Eastern Ltd. Mumbai
16. Practical research planning and design 2ndedition- Paul D Leedy, Macmilan Publication

PRACTICALS

PAPER 4 : ANATOMY AND DEVELOPMENTAL BIOLOGY (BH. USZO504)

1. Study of integumentary systems - V. S. of Skin of Shark, Frog, Calotes, Pigeon and Human



2. Study of Human Axial Skeleton - Skull (whole) and Vertebral column (axis, atlas, typical cervical, typical thoracic, typical lumbar, sacrum, coccyx)
3. Study of Human Appendicular Skeleton - Pectoral and pelvic girdle with limb bones.
4. Study of ontogeny of chick embryo using permanent slides - 18 hours, 24 hours, 33 hours, 48 hours and 72 hours.
5. Preparation of temporary mounting of chick embryo up to 48 hours of incubation.
6. Preparation of Power Point Presentation based on research paper.

Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. USZO504

Time: 9.30 am to 2.30 pm

Total Marks: 50

Q.1 Make a temporary mounting of chick embryo (up to 48 hours)	08
Q.2 Identify and describe	24
a) and b) Based on integumentary system	
c) and d) Based on osteology - human axial skeleton	
e) and f) Based on osteology - human appendicular skeleton	
i) and j) Chick embryo up to 72 hours	
Q.3 Power point presentation	04
Q.4 Assignments on 10 research papers and viva based on.	04
Q.5 Viva-voce	05
Q.6 Journal	05



T.Y.B.Sc SEMESTER VI

Programme: T.Y.B.Sc				Semester: VI	
Course: Chordates and distinctive features				Course Code: BH. USZO601	
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
		-	6	(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Basis of classification of Chordata				15
2	Distinctive features of Phylum: Pisces and Amphibia, Reptilia				15
3	Distinctive features of Phylum: Aves, Mammalia & study of phylogeny				15
4	Type study of shark				15
Total					60
Units	Description				Lecture periods / unit
Unit 1	Basis of classification of Chordata				15 lectures
Objective	<i>To introduce basic concepts of modern Chordate classification with evolution point of view and to understand the in higher animal kingdom.</i>				
Desired outcome	<i>Learners will apprehend the basis of classification of Chordata and some peculiar features of vertebrate animals.</i>				



	<p>1.1 General organization of Chordata:</p> <p>1.2 Class Urochordata and Cephalochordata and Vertebrata: class Pisces, Amphibia, Reptilia, Aves Mammalia with suitable examples.</p> <p>1.3 General characters of Agnathostomata and Gnathostomata.</p> <p>1.4 Difference between Chondrichthyes and Osteichthyes with examples.</p>	
Unit 2	Distinctive features of Phylum: Pisces and Amphibia, Reptilia	15 lectures
Objective	<i>To introduce the learners to the distinguishing characters of classes Reptilia, Aves and Mammalia and their adaptive features with reference to their habitat.</i>	
Desired outcome	<i>Learners will understand the characteristic features and examples of class of Reptilia, Aves and Mammalia.</i>	
	<p>2.1 Types of scales and tail fins in fish. Feeding mechanism in plankton feeder, herbivore and carnivore fish with suitable examples.</p> <p>2.2 Transition of amphibians from water to land, Tadpole larva, and Parental care in Amphibia.</p> <p>2.3 Identification of venomous and non-venomous snakes. Special characteristics of Chameleon, Conservation of turtles.</p>	
Unit 3	Phylum: Aves, Mammalia and study of phylogeny	15 lectures
Objective	<i>To introduce the learners to the distinguishing characters of classes Reptilia, Aves and Mammalia and their adaptive features with reference to their habitat. Also, the concept of phylogeny</i>	
Desired outcome	<i>Learners will understand the characteristic features and examples of class of Reptilia, Aves and Mammalia and will understand the concept of phylogeny and it's significance in evolutionary studies</i>	
	<p>3.1 Air sacs in bird and types of nests in birds- Cup nest, Adherent nest, Earth hole nest, Ground and mound nest, Scrape nest</p> <p>3.2 Scope of Ornithology</p> <p>3.3 Economic importance of mammals.</p> <p>3.4 Study of Phylogeny and construction of Tree of Phylogeny of vertebrates.</p>	



Unit 4	Type study of Shark	15 lectures
Objective	<i>To study in depth one vertebrate animal type i. e. general characteristics and salient Features of animal type - shark.</i>	
Desired outcome	<i>Learners will get an idea of vertebrate animal life after studying one representative animal- Shark.</i>	
	4.1 Type study: Shark. 4.1.1 Classification, External characters ,Habit & habitat, Economic importance 4.1.2 Digestive ,Respiratory ,Reproductive, Blood vascular ,Nervous and Urinogenital system	
Total		60 Lectures

Reference Books:

1. Modern text book of Zoology - Vertebrates; Professor R.L. Kotpal; Rastogipublication; Third Edition 2012.
2. Vertebrate Zoology for Degree students; V. K. Agarwal; S. Chand Publication; 2012.
3. Fundamentals of Zoology, Dr. K. C. Ghosh and Dr. B. Manna, New Central book Agency (P) Ltd.
4. Chordate Zoology Volume II, Prof. N. Arumogam. Saras Publication.
5. Chordate Anatomy Mohan P. Arora, Himalaya Publishing House, First edition.
6. The life of Vertebrates; J.Z. Young; ELBS - Oxford University Press; Third edition, 2006
7. Textbook of chordate Zoology, Vol. II, G.S. Sandhu, H. Bhaskar; Campus Book International, First edition, 2005.
8. Introduction to Zoology - Vol II: K. K. Chaki, G. Kundu and S. Sarkar, New Crystal Book Agency.
9. URL for search on net: <https://www.amazon.com/Protozoology-Susheel-Vilas-Nikam/dp/9350300044>.
10. Chordate Zoology by E. L. Jordan and P. S. Verma, edition,2009, Chand publications.
11. Chordate Zoology by P. S. Verma, edition,2009, Chand publications.
12. Modern Textbook of Zoology Vertebrates by R.L. Kotpal, edition Jan 2015, Rastogi publications.
13. Practical Zoology: Vertebrate, by S. S. Lal, 2015.
14. A Textbook of Invertebrate Zoology & Cell Biology, by V. S. Kanwate, A. N. Kulkarni et al.ed. Alka Prakashan.
15. 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.



PRACTICALS

PAPER 1: Vertebrates and special features (BH. USZO601)

1. Study of scales in fish - Placoid ,Cycloid ,Ctenoid
2. Study of tail fins in fish- Protocercal , Homocercal ,Heterocercal
3. Observation of morphology of Chondrichthyes (Shark) and Osteichthyes (Mackerel) fish
4. Study of parental care in amphibia - Caecilian, Midwife toad
5. Study of types of nests in birds - Cup nest , Adherent nest , Earth hole nest , Ground and mound nest, Scrape nest
6. Observation of skin derivatives of mammals - Hair, Nail, Sweat gland , Sebaceous gland
7. Study of types of mammals -Egg laying (Duckbilled Platypus), Marsupial (Kangaroo)
Viviparous (Rat)

Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. USZO601

Time: 10 am to 2 pm

Total Marks: 50

- | | |
|--|------|
| Q.1 Mounting of scales in fish, sketch, label and write characters.
(any 2 – placoid, cycloid, ctenoid) | 09M |
| OR | |
| Q.1 Identify, sketch and label tail fins from the given specimen (any 2) | |
| Q.2 Explain the morphology of a Chondrichthyes / Osteichthyes fish with the help of the given specimen | 06 M |
| Q.3 Construct the tree of phylogeny using the given data and explain it. | 05 M |
| Q.4 Identify and describe | 15 M |
| a)Parental care in amphibia | |
| b) Nest | |
| c) and d) Skin derivative of mammal | |
| e) and f) Type of mammal | |
| Q.5 Field visit report | 05 M |
| Q.6 Viva | 05 M |
| Q.7 Journal | 05 M |



DETAILED SYLLABUS

Programme: T.Y.B.Sc				Semester: VI	
Course: Physiology and Tissue Culture				Course Code: BH. USZO602	
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
		-	6	(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Enzymology				15
2	Homeostasis				15
3	Endocrinology				15
4	Animal Tissue Culture				15
	Total				60

Detailed syllabus

Units	Detailed descriptions	Lecture period /unit
Unit 1	Enzymology	15 lectures
Objectives	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> The learner shall understand fundamentals of enzyme structure, action and kinetics. The learner shall appreciate the enzyme assay procedures and the therapeutic 	



	<i>applications of enzymes.</i>	
	<p>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</p> <p>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 Km, Vmax and Kcat</p> <p>1.3: Enzyme Inhibition: Competitive and non-competitive inhibitors and their kinetics; therapeutic applications of enzyme inhibitors</p> <p>1.4: Regulation of Enzyme Activity: Allosteric regulation and regulation by covalent modification of enzymes; Isozymes (LDH)</p> <p>1.5: Industrial applications of enzymes: Food and detergents.</p>	
Unit 2	Homeostasis	15 lectures
Objectives	<ul style="list-style-type: none"> To introduce to the learner, the concept of homeostasis-thermoregulation and osmoregulation 	
Desired Outcome	<ul style="list-style-type: none"> The learner shall comprehend the adaptive responses of animals to environmental changes for their survival. 	
	<p>2.1: Homeostasis 2.1.1: External and internal environment; Acclimation and acclimatization 2.1.2: Body clock - Circadian & Diurnal rhythm</p> <p>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</p> <p>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</p>	
Unit 3	Endocrinology	15 lectures
Objectives	<ul style="list-style-type: none"> To introduce to the learner, the details of endocrine glands and its disorders. 	



Desired Outcome	<ul style="list-style-type: none"> <i>The learner shall understand the types and secretions of endocrine glands and their functions.</i> 	
	<p>3.1: General organization of mammalian endocrine system</p> <p>3.2: Hormones: Classification, properties, mechanism of hormone action</p> <p>3.3: Histology, functions and disorders of the following endocrine glands:</p> <ul style="list-style-type: none"> (i) Pituitary (ii) Thyroid (iii) Parathyroid (iv) Pancreas (v) Adrenal 	
Unit 4	Animal Tissue Culture	15 lectures
Objectives	<ul style="list-style-type: none"> <i>To introduce to the learner the fundamental concepts of tissue culture and guide them progressively to certain areas of animal tissue culture.</i> 	
Desired Outcome	<ul style="list-style-type: none"> <i>The learner shall understand the significance of tissue culture as a tool in specialized areas of research.</i> <i>The learner will appreciate its applications in various industries.</i> 	
	<p>4.1: Aseptic techniques</p> <p>4.1.1: Sterilization - basic principles of sterilization, importance of sterility in cell culture</p> <p>4.1.2: Sterile handling - swabbing, capping, flaming, handling bottles and flasks, pipetting, pouring</p> <p>4.2: Culture media</p> <p>4.2.1: Types of media - Natural and Artificial media</p> <p>4.2.2: Balanced Salt Solutions</p> <p>4.2.3: Complete Media - amino acids, vitamins, salts, glucose, oxygen supplements, hormones and growth factors, antibiotics</p> <p>4.2.4: Factors influencing cell culture - surface tension and foaming, viscosity, temperature, osmolality, pH, CO₂, bicarbonate and O₂</p> <p>4.3: Advantages of tissue culture - control of the environment, <i>in vitro</i> modelling of <i>in vivo</i> conditions</p> <p>4.4: Limitations of tissue culture</p> <p>4.5: Culture techniques</p> <p>4.5.1: Preparation of cells / organs for culture</p> <p>4.5.2: Cover slip, Flask and Tube culture</p> <p>4.5.3: Primary and established cell lines</p> <p>4.5.4: Monoclonal antibodies</p> <p>4.5.5 Hybridoma technology</p>	



Reference Books:

1. Comparative Animal Physiology; Knut Schmidt Nielson; Cambridge Press. Comparative Animal Physiology; Prosser and Brown.
2. Comparative Animal Physiology; William S Hoar.
3. Text book of Comparative Physiology; R Nagabhushanam, Ms Kodarkar, Sarojini R. India Book House Pvt. Ltd.
4. Animal Physiology; N. Arumugam, A. Mariakuttikan; Saras Publication. Text book of Endocrinology; Williams .
5. Textbook of Endocrinology Hardcover; Dharmalingam; 2010. Endocrinology; 6th Edition; Mac Hadley , Jon E. Levine. Culture of animal cells - A manual of basic technique; R. Ian Freshney; John Wiley and Sons Publications; 2005.
6. Basic cell culture - A practical approach; J. M. Davis; Oxford University Press; Indian edition; 2005.
7. Animal cell culture - Biotechnology Series: Vol.1; Bina Mishra, B. P. Mishra, Pran P. Bhat, P.N. Bhat; Studium Press (India) Pvt. Ltd; 2011.
8. Animal cell culture - Concept and Applications; Shweta Sharma; Oxford book Company; 2012.
9. Biotechnology of Animal Tissues; Dr. P. R. Yadav and Dr. Rajiv Tyagi; Discovery Publishing House, New Delhi; 2006.
10. Endocrinology-Hormones and Human Health: Prakash S. Lohar, MJP Publishers, Chennai. 2005.

PRACTICALS

PAPER 2: PHYSIOLOGY AND TISSUE CULTURE (BH. USZO602)

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 endocrine glands: Permanent slides of T.S. of pituitary, thyroid, parathyroid, pancreas, adrenal.
7. Instruments for tissue culture - Autoclave Millipore filter, micropipette, CO2 incubator, Laminar air-flow, autoclave, Cold centrifuge. (Principle and use).
8. Packaging of glassware for tissue culture.
9. Aseptic transfer techniques.
10. Trypsinization and vital staining using Trypan blue stain.



Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. USZO602

Time: 10 am to 2 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.
- 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)
- OR**
- Q.2** Demonstrate the technique of aseptic transfer.
- Q.3** Identify and describe a, b, c, d, e 15
a to d: Permanent slides of based on histology of endocrine glands
e: Instruments for tissue culture (any one)
- Q.4** Viva voce 05
- Q.5** Journal 05



DETAILED SYLLABUS

Programme: T.Y.B.Sc				Semester: VI	
Course: Genetics and Bioinformatics				Course Code: BH. USZO603	
Teaching Scheme				Evaluation Scheme (Theory)	
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
4	4	-	6	(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Molecular Biology				15
2	Genetic Engineering				15
3	Human Genetics				15
4	Bioinformatics				15
	Total				60
Detailed syllabus					
Units	Detailed descriptions				Lecture period /unit
Unit 1	Molecular Biology				15 lectures
Objectives	<ul style="list-style-type: none"> • <i>To introduce learners to chemical and molecular processes that affect genetic material.</i> • <i>To make learners understand the concept of DNA damage and repair, and how gene control is necessary for cell survival.</i> 				
Desired Outcome	<ul style="list-style-type: none"> • <i>Learners shall get an insight into the intricacies of chemical and molecular processes that affect genetic material</i> • <i>The course shall prepare learners to recognize the significance of molecular</i> 				



	<p><i>biology as a basis for the study of other areas of biology and biochemistry.</i></p> <ul style="list-style-type: none"> <i>Learners shall also understand related areas in relatively new fields of genetic engineering and biotechnology.</i> 	
	<p>1.1: Types of mutation 1.1.1: Point mutations - substitution, deletion and insertion mutations Substitution mutations - silent, 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</p> <p>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 B1)</p> <p>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 (alkyl transferases, photoreactivation, excision repair) 1.3.3: Postreplication repair - recombination repair, mismatch repair, SOS repair</p> <p>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</p>	
Unit 2	Genetic Engineering	15 lectures
Objectives	<ul style="list-style-type: none"> <i>To introduce learners to a set of techniques to modify an organism's genome to produce improved or novel genes and organisms.</i> 	
Desired Outcome	<ul style="list-style-type: none"> <i>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.</i> 	
	<p>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,</p>	



	<p>polynucleotide kinase, phosphatases, DNA polymerases, reverse transcriptase, terminal transferase</p> <p>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)</p> <p>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</p> <p>2.2: Techniques in Genetic Engineering</p> <p>2.2.1: PCR techniques: Principle of polymerase chain reaction (PCR), Applications of PCR</p> <p>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</p> <p>2.2.3: Detection techniques: Blotting techniques - Southern blotting, Northern blotting and Western blotting Applications of blotting techniques</p>	
Unit 3	Human Genetics	15 lectures
Objectives	<ul style="list-style-type: none"> To introduce learners with genetic alterations in the human genome and their diagnosis. 	
Desired Outcome	<ul style="list-style-type: none"> The learner shall become aware of the impact of changes occurring at gene level on human health and its diagnosis. 	
	<p>3.1: Non-disjunction during mitosis and meiosis</p> <p>3.1.1: Chromosomal Aberrations: Structural: (i) Deletion: types, effects and disorders; (ii) Translocation: types: Robertsonian and non-Robertsonian disorders; (iii) Inversion: types, effects and significance; (iv) Duplication and their evolutionary significance (multigene families) Numerical: Aneuploidy and Polyploidy (Autopolyploidy and Allopolyploidy)</p> <p>3.2: Genetic Disorders</p> <p>3.2.1: Inborn Errors of Metabolism: Phenylketonuria, G-6-PD deficiency, Alkaptonuria, Albinism</p> <p>3.2.2: Single gene mutation: Cystic fibrosis</p> <p>3.2.3: Multifactorial: Breast Cancer</p> <p>3.2.4: Uniparental Disomy: Angelman Syndrome and Prader-Willi Syndrome</p> <p>3.3: Diagnosis</p> <p>3.3.1: Prenatal Diagnosis: Amniocentesis and Chorionic villus sampling, Banding techniques (G, C, Q), FISH, Protein truncation test (PTT)</p> <p>3.3.2: Genetic counselling</p>	
Unit 4	Bioinformatics	15 lectures



Objectives	<ul style="list-style-type: none"> To introduce learners to bioinformatics - a computational approach to learning the structure and organization of genomes, phylogeny and metabolism.
Desired Outcome	<ul style="list-style-type: none"> Learners shall become aware of the computational point of view of studying the genomes.
	<p>4.1: Introduction 4.1.1: Introduction to Bioinformatics and Bioinformatics web resource (NCBI, EBI, OMIM, PubMed) 4.1.2: Applications of Bioinformatics</p> <p>4.2: Databases - Tools and their uses 4.2.1: Biological databases; Primary sequence databases: Nucleic acid sequence databases (GenBank, EMBLEBI, DDBJ) Protein sequence databases (UniProtKB, PIR) Secondary sequence databases Derived databases - PROSITE, BLOCKS Structure databases and bibliographic databases</p> <p>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</p> <p>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 and Functional Proteomics: Different types of protein chip (detecting and quantifying), applications of Proteomics 4.4.4: Metabolomics: Concept and applications</p>
<p>REFERENCES</p> <ol style="list-style-type: none"> Genetics - The continuity of life; Daniel Fairbanks and Ralph Andersen; Brooks/ Cole Publishing Company; 1999. Introduction to Molecular Biology; Peter Paoella; Tata McGraw Hill; 2010. Molecular Biology; David Freifelder; Narosa Publishing House; 2008. Genetics; Robert Weaver and Philip Hedrick; McGraw Hill; 2001. iGenetics - A Molecular Approach; Third Edition; Peter J. Russell; Pearson Education, Inc. (Benjamin Cummings), San Francisco; 2010. Molecular Biology - Academic Cell Update; Update Edition; David Clark; Elsevier, Inc.; 2010. Introduction to Proteomics; Daniel C. Liebler; Humana Press; 2002. Molecular cloning; Joseph Sambrook, David William Russell; Third Edition; CSHL Press; 2001. Gene Cloning - An Introduction; Brown .T.A; Fourth Edition; Wiley-Blackwell; 2011. Proteomics - Protein Sequence to Function; Pennington, S.R and M.J. Dunn; Viva Books; 2002. Genetic engineering - Principles and Practice; Sandhya Mitra; Macmillan India Ltd., New Delhi. Biotechnology - Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005. 	



13. Biotechnology - Expanding Horizons; B.D.Singh; Kalyani Publishers, Ludhiana.
14. A textbook of Biotechnology; R.C.Dubey; S.Chand and Company Ltd., New Delhi.

PRACTICALS

PAPER 3 : GENETICS AND BIOINFORMATICS (BH. USZO603)

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 Folin-Lowry's method.
5. Problems based on Restriction endonucleases.
6. Karyotype (Idiogram) analysis for the following syndromes with comments on numerical and / 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.



Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. USZO603

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.	
Q.2 Separation of Genomic DNA by Agarose gel electrophoresis.	09
OR	
Q.2 Colorimetric estimation of proteins from given sample by Folin's method.	
Q.3 Problems based on Restriction endonucleases (any two).	08
OR	
Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells.	
OR	
Analyse the given syndrome and comment on numerical and/or structural variations in chromosomes. Interpretation of a genetic formula.	
Q.3 Demonstrate the use of bioinformatics tool:	08
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.	
Q.5 Viva voce	05
Q.6 Journal	05



DETAILED SYLLABUS

Programme: T.Y.B.Sc				Semester: VI	
Course: Environmental Biology and Zoopharmacognosy				Course Code: BH. USZO604	
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
4	4	-	6	(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Environment management				15
2	Wildlife Management				15
3	Bioprospecting and Zoopharmacognosy				15
4	Zoogeography				15
	Total				60

Detailed syllabus

Units	Detailed descriptions	Lecture period /unit
Unit 1	Environment management	15 lectures
Objectives	<ul style="list-style-type: none"> Learner should understand different factors affecting the environment and various methods to improve environmental stewardship. 	
Desired Outcome	<ul style="list-style-type: none"> Learner will understand the different factors affecting environment, its impact and 	



	<i>environment management laws.</i>	
	<p>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 (solar, tidal, wind, biofuel) and non-renewable resources (coal, petroleum oil, natural gas)</p> <p>1.2: Exploitation and Modification of Natural Resources: Impact on climate, flora and fauna</p> <p>1.3: Waste Management 1.3.1: Technologies 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 1.3.2: e-waste and hazardous waste (biological, chemical, medical and nuclear) management.</p> <p>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.</p> <p>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.</p>	
Unit 2	Wildlife Management	15 lectures
Objectives	<ul style="list-style-type: none"> • <i>To sensitize learner regarding the various threats to the wildlife.</i> • <i>To introduce learner various ways that can help in the protection, conservation, management, and enhancement of wildlife populations and habitat.</i> 	
Desired Outcome	<ul style="list-style-type: none"> • <i>Learner will be able to understand various methods for wildlife conservation.</i> • <i>Learner will be able to apply knowledge to overcome the issues related to wildlife conservation and management.</i> 	



	<p>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.</p> <p>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</p> <p>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 Forest policy 1894, 1952, 1988; The Indian Forest Act, 1927; Forest (Conservation) Act, 1980.</p>	
Unit 3	Bioprospecting and Zoopharmacognosy	15 lectures
Objectives	<ul style="list-style-type: none"> • <i>To introduce the learner to the concepts of bioprospecting and zoopharmacognosy.</i> • <i>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.</i> 	
Desired Outcome	<ul style="list-style-type: none"> • <i>Learner will understand the paradigms of discovery and commercialization of biological resources and knowledge gained from self-medication observed in animals.</i> 	
	<p>3.1: Bioprospecting 3.1.1: Traditional and modern bioprospecting, economic value of bioprospecting 3.1.2: Bioprospecting and conservation, advantages and disadvantages</p> <p>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</p>	
Unit 4	Zoogeography	15 lectures



Objectives	<ul style="list-style-type: none"> To introduce learner to the geographic distribution (present and past) of animal species. To introduce learner to various ways of animal distribution.
Desired Outcome	<ul style="list-style-type: none"> The learners will become acquainted with how and why different animal species are distributed around the globe.
	<p>4.1: Introduction: Plate tectonics and continental drift theory</p> <p>4.2: Animal Distribution and Barriers 4.2.1: Isolating Mechanisms 4.2.2: Patterns of animal distribution - continuous, discontinuous and bipolar 4.2.3: Barriers of distribution -Topographic, climatic, vegetative, large water masses, land mass, lack of salinity and special characteristic habit (homing instinct). 4.2.4: Means of dispersal - land bridges, natural rafts and drift wood, favouring gales, migration by host, accidental transportation and by human agencies</p> <p>4.3: Zoogeographical Realms: Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic and Antarctic.</p>

Reference Books:

- Essentials of Environmental Science; N. Vasudevan; Narosa Publishing House Pvt. Ltd. New Delhi 110002.
- Environmental Biology; P.S Verma, V.K Agarwal; S. Chand & company Ltd. New Delhi 110055.
- A textbook of Environmental Science; Arvind Kumar; A P H Publishing Corporation, New Delhi 110002.
- Environmental Biotechnology - Basic Concepts and Application; Indu Shekhar Thakur; I. K. International Pvt. Ltd. New Delhi 110016.
- Text book of environmental science; S. C. Santra.
- Wild life management; Rajesh Gopal.
- Wildlife Management and Conservation - Contemporary Principles and Practices; Paul R. Krausman and James W. Cain III.
- Wildlife Ecology, Conservation, and Management; John M. Fryxell, Anthony R. E. Sinclair, Graeme Caughley.
- Pharmacognosy and Pharmaco biotechnology- Ashutosh Kar. Trease and Evans



10. Pharmacognosy - Evans, W.C. Pharmacognosy - Kokate, C. K. A. and Purohit, A.P.
11. Practical Pharmacognosy- Gokhale, S. B. and Kokate, C. K.
12. Text book of Pharmacognosy; T. E. Wallis.
13. Zoogeography - The Geographical Distribution of Animals; Philip J. Darlington JR; Academic Publishers, Kolkata
14. Animal Geography - Newbegin. Vertebrate Paleontology - Romer. Ecological animal geography- Allee, Park and Schmidt.
15. Zoogeography of India and South East Asia - Dr. S. K. Tiwari; CBS Publishers and Distributors, Delhi; 1985.

PRACTICALS

PAPER 4 : ENVIRONMENTAL BIOLOGY AND ZOOPHARMACOGNOSY (BH. USZO604)

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 - Aloe vera, Aloe ferox.
8. Study of Zoopharmacognosy in ants, cats, elephants and dogs.
9. Indicate the distribution of fauna in the world map with respect 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. Excursion (Study tour / Visit) to Zoo / Sanctuary / National Park / Research institute, etc. and submit a report. College may conduct more than one field visit for wide exposure, if feasible. However, at least one field visit should be such that it is affordable to every student.

Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. USZO604

Time: 9.30 am to 2.30 pm

Total Marks: 50

Q.1 Estimation of BOD / COD / nitrates from the given water sample	10
Q.2 Estimation of phosphates / acidity / alkalinity of sample water.	08
Q.3 Identification	06
a) Based on bioprospecting (Sponge / Aloe ferox / Aloe vera - any one)	
b) Zoopharmacognosy (ants, cats, elephants and dogs - any one)	
Q.4 Identify the given animals with respect to their realms and comment (any two).	06
Q.5 Study tour Visit Report - Submission and Discussion based on any one field visit which is attended by the student.	10
Q.6 Viva voce	05
Q.7 Journal	05



T. Y. B.Sc.
 (Credit-Based Semester and Grading System)
Fishery Biology (Applied Component)
 (to be implemented from the Academic Year 2023-2024)

Semester V
Oceanography, Aquaculture Practices.

Theory				
Course	Unit	TOPIC	Credits	L/Week
BH.USACFBIO501	1	Oceanography	2	4
	2	Crafts and Gear		
	3	Farming of Major Carps		
	4	Aquaculture Practices in Freshwater		
Practical				
BH.USACFBIO5P1		Practical based on Course BH.USACFBIO501	2	4

Semester VI
Marine resources, post-harvest techniques.

Theory				
Course	Unit	TOPIC	Credits	L/Week
BH.USACFBIO601	1	Marine Fin-fish of India	2	4
	2	Marine Shellfish of India		
	3	Diseases		
	4	Preservation and Processing		
	5	Byproducts and Value-added Products		
Practical				
BH.USACFBIO6P1		Practical based on Course BH.USACFBIO601	2	4



Programme: T.Y.B.Sc				Semester: V	
Course: Oceanography, Aquaculture Practices.				Course Code: BH.USACFBIO501	
Teaching Scheme				Evaluation Scheme (Theory)	
Lecture (Periods per week) x	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
04	04	--		(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Oceanography				15
2	Crafts and Gear				15
3	Farming of major carps				15
4	Aquaculture practices in freshwater.				15
	Total				60



Detailed syllabus		
Units	Detailed descriptions	Lecture /unit
UNIT 1	Oceanography	15 lectures
Objectives	<ul style="list-style-type: none"> To study different instruments and equipments in navigation and oceanography To introduce physical, chemical and biological oceanography 	
Desired Outcome	<ul style="list-style-type: none"> Learner shall understand and learn about the use of sea safety, navigational equipments and oceanographic instruments Learner shall understand basic physical, chemical and biological oceanography 	
	<p>1.1 Navigational and sea safety equipments</p> <ul style="list-style-type: none"> i) Life saving devices ii) Global Positioning System (GPS) iii) Rudder iv) Signaling devices <p>1.2 Oceanographic Instruments</p> <ul style="list-style-type: none"> i) Niskin water sampler ii) Peterson's grab iii) Dredges iv) Fish finding instruments / Methods v) Remote sensing <p>1.3 Introduction to basic physical, chemical and biological oceanography</p>	
UNUT 2	Crafts and Gears	15 lectures
Objectives	<ul style="list-style-type: none"> To study the process of boat building, materials used and various types of diesel engines To study various types of nets used in fishery 	
Desired Outcome	<ul style="list-style-type: none"> Learner shall comprehend boat building techniques and design of engines used in mechanized boats Learner shall understand the operations of various types of nets and fishing method 	
	<p>2.1 Basic boat building (parts, design, material used), methods of protection from foulers and borers</p>	



	<p>2.2 Basic studies of marine engines:</p> <p>2.2.1 Outboard and Inboard Engines 2.2.2 Sectional View of 2-stroke and 4-stroke Diesel engines 2.2.3 Winch and Deck Side Equipment</p> <p>2.3 Operations:</p> <p>2.3.1 Gill, Trawl, Purse seine Nets 2.3.2 Hooks and Lines 2.3.3 Non-conventional Fishing Methods such as</p> <ul style="list-style-type: none"> • Light Fishing • Hose Pipe Fishing • Electric Fishing
UNIT 3	Farming of major carps 15 lectures
Objectives	<ul style="list-style-type: none"> • <i>To study and develop skills in breeding techniques, hatchery, nursery and management of various carps</i> • <i>To study and explore various techniques used in fishery and poly culture practices</i>
Desired Outcome	<ul style="list-style-type: none"> • <i>Learner will understand breeding techniques and skills for culture of major carps</i> • <i>Learner will comprehend hatchery and nursery management of major carps</i>
	<p>3.1 Breeding techniques of major carps and common carp</p> <p>3.2 Hatchery and nursery management of Major carps:</p> <p>i) IMCs: <i>Labeo rohita</i> (Rohu), <i>Catla catla</i> (Catla), <i>Cirrhinus mrigala</i> (Mrigal)</p> <p>ii) Exotic carps: <i>Hypophthalmichthys molitrix</i> (Silver carp), <i>Ctenopharyngodon idella</i> (Grass carp)</p> <p>iii) <i>Cyprinus carpio</i> (Common carp)</p> <p>3.3 Mono-culture and polyculture practices:</p> <p>i) Extensive ii) Semi-intensive iii) Intensive</p>
UNIT 4	Aquaculture practices in freshwater 15 lectures
Objectives	<ul style="list-style-type: none"> • <i>To develop skills and understanding of breeding and rearing of sewage-fed fishery, Basa cat fish and Tilapia by novel ways</i>
Desired Outcome	<ul style="list-style-type: none"> • <i>Learner will be equipped to carry out entrepreneurial</i>



	<p><i>operations or gain confidence to work in freshwater prawn unit</i></p> <ul style="list-style-type: none"> • <i>Learner will gain knowledge about how to breed and rear ornamental fishes and commercially viable fish species</i>
	<p>4.1 <i>Macrobrachium rosenbergii</i> (Freshwater prawn)</p> <p>i) Breeding, life cycle, hatchery management ii) Monoculture of <i>Macrobrachium rosenbergii</i> iii) Composite culture of major carps and <i>Macrobrachium rosenbergii</i></p> <p>4.2 Ornamental fishes – breeding and rearing:</p> <p>i) Egg layers:</p> <ul style="list-style-type: none"> • <i>Danio spp.</i> (Danio) • <i>Pterophyllum spp.</i> (Angel) • <i>Symphysodon spp.</i> (Discus) • <i>Paracheiroidon innesi</i> (Neon tetra) • Flower horn (Hybrid variety) • <i>Betta splendens</i> (Siamese fighter) <p>ii) Live bearers:</p> <ul style="list-style-type: none"> • <i>Poecilia reticulata</i> (Guppy) • <i>Xiphophorus hellerii</i> (Swordtail) • <i>Poecilia velifera</i> (Tangerine) • <i>Poecilia sphenops</i> (Molly) • <i>Xiphophorus maculatus</i> (Platy) <p>4.3 Breeding and rearing of:</p> <ul style="list-style-type: none"> • Sewage-fed fishery of air breathing fish: <i>Pangasianodon hypophthalmus</i> (Striped catfish), <i>Clarius spp.</i>, <i>Heteropneustes spp.</i> and <i>Anabas spp.</i> • <i>Pangasius bocourti</i> (Basa Catfish) • All meal (Less bones) <i>Tilapia</i> – GIFT (Genetically Improved Farmed <i>Tilapia</i>)

SEMESTER 5 PRACTICALS	
FISHERY BIOLOGY	USACFBIO5P1
1.	<p>Identification and functioning of oceanographic instruments:</p> <ul style="list-style-type: none"> • Niskin water sampler • Peterson's Grab • Dredge
2.	<p>Layout of fishing vessels and sectional view of 2 stroke and 4 stroke diesel engines, lifesaving equipment, winch and deck side equipment.</p>



3. Identification of various stages of development of carps and study of sexual dimorphism in adults.

Indian major carps:

- *Labeo rohita* (Rohu)
- *Catla catla* (Catla)
- *Cirrhinus mrigala* (Mrigal)

Exotic carps:

- *Cyprinus carpio* (Common Carp)
- *Hypophthalmichthys molitrix* (Silver Carp)
- *Ctenopharyngodon idella* (Grass Carp)

4. a) Identification of *Litopenaeus vannamei* (Pacific white shrimp) and *Macrobrachium rosenbergii* (Freshwater prawn)
b) Study of sexual dimorphism in adults.

5. Identification of fishes:

- *Anabas testudineus* (Climbing perch)
- *Clarius batrachus* (Walking catfish)
- *Boleophthalmus spp.* (Mudskipper)
- *Pangasianodon hypophthalmus* (Iridescent shark)
- *Pangasius bocourti* (Basa catfish)
- *Tilapia* (GIFT)

6. Identification of:

A) Ornamental fishes:

- *Pterophyllum spp.* (Angel)
- *Xiphophorus hellerii* (Swordtail)
- *Paracheirodon innesi* (Neon tetra)
- *Betta splendens* (Siamese fighter)
- *Danio spp.* (Danio)
- *Symphysodon spp.* (Discus)
- Flower Horn (Hybrid variety)

B) Aquatic plants:

- Ludwigia
- Cabomba
- Corkscrew *Vallisneria*
- Aquarose
- Amazon Sword plant

C) Aquarium accessories:

- Aerator
- Under Gravel Filter
- Internal Filter



<ul style="list-style-type: none"> • External / Canister Filter • Food dispensers
7. Study of models and functioning of D 81 hatchery, Shirgur's hatcheries and Chinese hatchery.
8. Microbial studies: <ul style="list-style-type: none"> i. Dilution of sample ii. Gram staining technique iii. Identification of Bacilli, Cocci, Vibrio bacteria
9. Organoleptic tests for fish and prawn / shrimp
10. Total Plate Count (TPC) of bacteria from fish.
11. Identification of packaging materials: <ul style="list-style-type: none"> • Waxed duplex carton • Master carton • Simple cans • Coated [Lacquered] cans • Polyolefin • Retort
12. Estimation of toxins and moulting retardant <ul style="list-style-type: none"> • H₂S (qualitative) • Ammonia (qualitative) • Ca (quantitative) • Mg (quantitative)
13. Photographic documentation of fishery biology related topics. Submission of 5 hard and soft copies of 5 original photographs taken by the learner.
14. Assignment (may be submitted in a group not exceeding three students)



Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. USZO501

Time: 10 am to 2 pm

Total Marks: 100

Q. 1 Identification 20

Identify spots 'a' to 'e' as per instructions

- a) Identify and describe the oceanographic instrument / 2-stroke / 4-stroke engine.
- b) Identify and describe lifesaving equipment / deck side equipment
- c) Identify and describe accessory respiratory organ / ornamental fish / aquarium plant.
- d) Identify and describe the aquarium accessory.
- e) Identify and describe the packaging material.

Major Experiment

Q. 2 Perform organoleptic tests to differentiate fresh and stale fish and prawn. 25

Minor Experiment

Q. 3 Prepare various dilutions of the given sample of bacteria. 15

OR

Q. 3 Quantitative estimation of Calcium / Magnesium from the given water sample. 15

OR

Q. 3 Qualitative estimation of NH₃ and H₂S from the given water sample. 15

OR

Q. 3 Identify the given bacteria with the help of Gram's Staining technique. 15

Q. 4 a. Submission of five photographs on relevant topics of fishery biology. 10

b. Submission of assignment and viva based on it. 20

Q. 5 Certified journal. 10



Programme: T.Y.B.Sc				Semester: VI	
Course: Marine resources, Post-harvest and Farm Engineering				Course Code: BH.USACFBIO601	
Teaching Scheme				Evaluation Scheme (Theory)	
Lecture (Periods per week) x	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
04	04	--		(Marks - 40)	(Marks: 60)
INDEX					
Unit	Description				Periods
1	Marine Fin-fish and shell fish of India				15
2	Diseases				15
3	Preservation and Processing				15
4	By-products and Value-added Products				15
	Total				60



Detailed syllabus		
Units	Detailed descriptions	Lecture /unit
UNIT 1	Marine Fin-fish and shell fish of India	15 lectures
Objectives	<ul style="list-style-type: none"> To study coastal and deep sea fishes To study commercial potential and major landing centres 	
Desired Outcome	<ul style="list-style-type: none"> Learner shall understand deep sea and coastal fishes. Learner shall understand commercial potential and know about the major landing centres of the fishes 	
	<p>1.1 Coastal fisheries:</p> <ol style="list-style-type: none"> <i>Stromateus cinereus</i> (Silver pomfret) <i>Stromateus niger</i> (Black pomfret) <i>Polynemus tetradactylus</i> (Threadfin) <i>Pseudosciaena diacanthus</i> (Two-spined Jewfish or Ghol) <i>Synagris japonicus</i> (Blackmouth splitfin) <i>Scomber microlepidotus</i> (Mackerel) <i>Cybium guttatum</i> (Seerfish or Surmai) <i>Sardinella longiceps</i> Indian Oil Sardine <p>1.2 Deep sea fisheries (more than 45 fathoms) of Indian exclusive economic zone</p> <ul style="list-style-type: none"> <i>Thunnus alalunga</i> (Longfin tuna) <i>Sarda orientalis</i> (Striped bonito) <p>1.3 Crustacean fisheries</p> <ol style="list-style-type: none"> <i>Penaeus monodon</i> (Giant tiger prawn) <i>Penaeus ndicus</i> (Indian prawn) <i>Metapenaeus affinis</i> (Jinga shrimp) <i>Parapenaeopsis stylifera</i> (Kiddi shrimp) <i>Acetes indicus</i> (Jawala paste shrimp) <i>Panulirus polyphagus</i> (Mud spiny lobster) <i>Scylla serrata</i> (Giant mud crab) <p>1.4 Molluscan fisheries</p> <ol style="list-style-type: none"> <i>Crassostrea spp.</i> (Oyster) <i>Sepia pharaonis</i> (Pharaoh cuttlefish) <i>Loligo duvaucelii</i> (Indian squid) <p>1.5 Commercial potential and major landing centres of the above fishes</p>	
UNUT 2	Diseases	15 lectures
Objectives	<ul style="list-style-type: none"> To acquire knowledge of the various aspects of diseases affecting fishes 	
Desired	<ul style="list-style-type: none"> Learner will be oriented towards understanding causes, pathogenicity, prophylaxis and preventive measures of various fish diseases and 	



Outcome	<i>physiological disorders</i>	
	2.1 Viral diseases, prophylaxis and preventive measures 2.2 Bacterial, fungal, and protozoan infections and treatment 2.3 Crustacean infections and treatment 2.4 Physiological disorders (Dropsy) / diseases and treatment	
UNIT 3	Preservation and Processing	15 lectures
Objectives	<ul style="list-style-type: none"> <i>To derive knowledge about various fish preservation and processing methods</i> 	
Desired Outcome	<ul style="list-style-type: none"> <i>Learners will acquire the knowledge and would put in to practice the preservation and processing techniques for commercial ventures</i> 	
	3.1 Traditional methods and their modifications: i) Icing ii) Drying iii) Salting 3.2 Introduction to refrigeration: Types and properties of refrigerants i) Types of freezers: a. Brine b. Air blast c. Tunnel d. Contact plate e. Cryo-quick f. IQF: Individual Quick Freezing ii) Freezing Procedures: a. PUD (Peeled and Un-deveined) b. DV (Deveined) 3.3 Principle and steps involved in can reform and canning of fish and shrimp in various media. 3.4 Equipment and utensils used in seafood processing	
UNIT 4	By-products and Value-added Products	15 lectures
Objectives	<ul style="list-style-type: none"> <i>To acquire knowledge of fish by-products, value-added products and good manufacturing practices</i> 	
Desired Outcome	<ul style="list-style-type: none"> <i>Learner will gain sound knowledge about the fish by-products and value-added products</i> 	



	<ul style="list-style-type: none"> Learner will explore good manufacturing practices while manufacturing these products
	<p>4.1 Proximate composition of fish meat and products</p> <p>4.2 Introduction to by-products</p> <ul style="list-style-type: none"> i) Fish protein concentrate ii) Fish maws / Isinglass iii) Fish hydrolysates iv) Chitin, Chitosan v) Glucosamine hydrochloride vi) Gelatin vii) Fish silage viii) Surimi and imitation products ix) Pearl essence <p>4.3 Different types of value added products from fish and shell fish</p> <ul style="list-style-type: none"> i) Fish / Prawn / Shrimp pickle ii) Fish wafers iii) <i>Acetes indicus</i> (Prawn) chutney iv) Fish soup powder v) Fish / Crab steaks vi) RTE (Ready To Eat) vii) Battered and breaded products viii) Marinated tandoori prawns ix) Prawn curry <p>4.4 Good manufacturing practices: Health and training of personnel, hygiene</p>

SEMESTER 6 PRACTICALS	
FISHERY BIOLOGY	USACFBIO6P1
<p>1) Identification of marine fishes.</p> <ul style="list-style-type: none"> • <i>Stromateus cinereus</i> (Silver pomfret) • <i>Stromateus niger</i> (Black pomfret) • <i>Polynemus tetradactylus</i> (Threadfin) • <i>Pseudosciaena diacanthus</i> (Two-spinned jewfish or Ghol) • <i>Trichiurus haumela</i> (Ribbon fish) • <i>Synagris japonicus</i> (Blackmouth splitfin) • <i>Scomber microlepidotus</i> (Mackerel) 	



<ul style="list-style-type: none"> • <i>Cybium guttatum</i> (Seerfish or Surmai) • <i>Sardinella longiceps</i> (Indian Oil Sardine) • <i>Thunnus alalunga</i> (Longfin tuna)
<p>2) Identification of Crustaceans and Molluscs.</p> <ul style="list-style-type: none"> a. <i>Penaeus monodon</i> (Giant Tiger Prawn) b. <i>Metapenaeus affinis</i> (Jinga shrimp) c. <i>Parapenaeopsis stylifera</i> (Kiddi shrimp) d. <i>Acetes indicus</i> (Jawala paste shrimp) e. <i>Panulirus polyphagus</i> (Mud spiny lobster) f. <i>Scylla serrata</i> (Giant mud crab) g. <i>Crassostrea spp.</i> (Oyster) h. <i>Sepia pharaonis</i> (Pharaoh cuttlefish) i. <i>Loligo duvaucelii</i> (Indian squid)
<p>3) Preparation of formulated feed for fish and prawn.</p>
<p>4) Identification of parasitic infections in aquatic organisms.</p> <ul style="list-style-type: none"> • Fungal – Dermatomycosis • Bacterial – Fin/Tail rot and Dropsy • Protozoan – Costiasis and White Spot • Crustacean – Argulosis
<p>5) Fish dressing, filleting, prawn peeling – PUD, DV and grading.</p>
<p>6) Fish morphometry – Length weight relationship of a suitable fish.</p>
<p>7) Preparation of Surimi, Fish protein concentrate.</p>
<p>8) Preparations of fish burger, fish fingers, fish/prawn pickle, fish chutney, fish curry.</p>
<p>9) Preparation of Chitin – Chitosan, Pearl essence.</p>
<p>10) Identification of various farm equipment such as:</p> <ul style="list-style-type: none"> • Feeding cups / Trays • Paddle wheel aerator • Fountains • Sluice gate models • Elbow pipe outlets
<p>11) Study of models of raft, pen, cage culture and materials used in rope culture.</p>
<p>12) Project – Feasibility / Scientific.</p>
<p>13) Field Visit Report.</p>



Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION BH. USZO601

Time: 10 am to 2 pm

Total Marks: 100

Q.1 Identification	20
Identify spots 'a' to 'e' as per instructions	
a) Identify and describe the given fish w.r.t. fishery	
b) Identify and describe the given crustacean / mollusc w.r.t. fishery	
c) Identify and describe the pathogen and its prevention and treatment of the given specimen.	
d) Identify and describe farm equipment / model / material.	
e) Identify and describe byproducts chitosan / chitin / pearl essence.	
Major Experiment	
Q. 2 Prepare the marked by-product / value-added product with suitable method: Surimi / Fish Protein Concentrate / Fish Burger / Fish or Shrimp Pickle / Chitin / Chitosan.	25
Minor Experiment	
Q. 3 Determine the fish morphometry – Length weight relationship of a suitable fish.	15
OR	
Q. 3 Demonstrate the technique of fish dressing and filleting.	15
Q. 4 Project and viva based on it.	20
Q. 5 Field report	10
Q. 6 Certified journal	10



REFERENCES

USACFBIO501 & USACFBIO601

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- 2) An Introduction to Fishes by Khanna S.S. – Central Book Depot, Allahabad(1993).
- 3) Aquaculture, Principles and Practices by Pillay T.V.R. – Fishing News Books(1988).
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- 24) Prawn and Prawn Fisheries by Kurian and Sebestian.
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- 27) Technology for forming of Pacific White Shrimp *Litopenaeus vannamei* in inland saline soils using ground saline water by Lakra, Reddy and Harikrishna, CIFE and ICAR.
- 28) Text Book of Fish Biology and Indian Fisheries by Dr. R. P. Parihar, Central Pub. House, Allahabad.
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- 30) Wealth of India – Vol. IV – CSIR Pub.

For Additional and Latest Information on the topics, various Web Sites can be visited.

MODALITY OF ASSESSMENT:

MODALITY OF ASSESSMENT: SEMESTER V and VI

A) Internal Assessment- 40%: 40 marks

SR. NO.	CONTENT	MARKS
1.	Test (CIA 1)	20 M
2.	Assignment (CIA 2)	20 M

Assignment types can include:

- a. Surveys
- b. Case studies
- c. Model making
- d. Seminar Presentation
- e. Self-study assignments
- f. Small Research Projects
- g. Societal Subject related venture (Kitchen waste composting, safe water drinking, hygiene of orphan homes, old-age homes etc).

B) External examination: 60%

a) Semester End Theory Assessment- 60%: 60 Marks

i) Duration – These examinations shall be of two and a half hours duration for each paper.

ii) Theory Question Paper Pattern:

- Each unit will carry a total of 20 marks.

The theory paper is divided as follows

Subjective Based Questions Short notes (12 MARKS)	The first question consists of 8 questions of 3 marks each. Each unit contributes 6 marks. The student has to attempt any four questions only.
Subjective Based Questions - Brief questions (48 MARKS)	Question No. 2 to 5 consists of 4 questions of 6 marks each. The student will attempt any two questions only. Each unit contributes 12 marks.



b) Practical: 50 Marks

Paper Pattern: (Semester end Examination V & VI)

MARKS: 60

DURATION: 2 HOURS.

- Q 1** Answer any **four questions** from the following: **(12)**
- a) UNIT 1
 - b) UNIT 1
 - c) UNIT 2
 - d) UNIT 2
 - e) UNIT 3
 - f) UNIT 3
 - g) UNIT 4
 - h) UNIT 4
- Q 2** Answer any **two questions** from the following: (unit 1) **(12)**
- a)
 - b)
 - c)
 - d)
- Q 3** Answer any **two questions** from the following: (unit 2) **(12)**
- a)
 - b)
 - c)
 - d)
- Q 4** Answer any **two questions** from the following: (unit 3) **(12)**
- a)
 - b)
 - c)
 - d)
- Q 5** Answer any **two questions** from the following: (unit 4) **(12)**
- a)
 - b)
 - c)
 - d)



Overall Examination & Marks Distribution Pattern

Semester V & VI

Course	BH.UZO			BH.UZO			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200

Rubrics of evaluation for ESE

Unit	Knowledge	Understanding	Analysis & critical thinking	Total marks/unit
1	03	06	06	15
2	03	06	06	15
3	03	06	06	15
4	03	06	06	15
Total per objective	12	24	24	60
% weightage	20	40	40	100



Rubrics of evaluation for CIA-2 assignment

Class: _____ Roll No _____ Topic _____

Parameters	Max Marks	80 – 100% Excellent	60 - 80% Good	40 – 60% Satisfactory	20 – 40% Poor	0-20% very poor
CONTENT	10					
Content: Introduction –	02					
Content: Development	03					
Content:– Conclusion -	03					
Content: - Bibliography	02					
Effective Research Skills	10					
Language, Style and Structure;	05					
Aids	05					
Total	20					

Name of evaluator _____

