



SOMAIYA
VIDYAVIHAR

K J Somaiya College of Science & Commerce

Department: Zoology

Somaiya

TRUST

T. Y. B.Sc. Syllabus

K. J. SOMAIYA COLLEGE OF SCIENCE AND COMMERCE, VIDYAVIHAR, MUMBAI 400 077

AUTONOMOUS - AFFILIATED TO UNIVERSITY OF MUMBAI

Scheme of Course Structure

(Faculty of Science)

Syllabus for T.Y.B.Sc.

Program: B.Sc.

Course: Zoology

(Choice based Credit System with effect from

the academic year 2023-24)



T.Y.B.Sc. Draft Syllabus 2023-24: 4 DSC+ 3 DSE + 1 SEC+ 1 GE + 1 AECC				
Semester V	Course Title	Module 1	Module 2	Module 3
DSC I 23US5ZOCCIEAE	Animal type study - Earthworm, Mammalian anatomy and Embryology	Animal type - Earthworm	Mammalian anatomy	Chick embryology
DSC II 23US5ZOCC2HAI	Haematology and Immunology	Composition of Blood and Blood corpuscles	Blood volume and coagulation	Components of Human Immune System
DSC III 23US5ZOCC3MBR	Molecular Biology and Recombinant DNA Technology	Genetic material and central Dogma of life	Gene regulation and mutation	Recombinant DNA Technology
DSC IV 23US5ZOCC4SEE	Study of Environment and Etiology of Diseases	Environmental Science	Environmental biology	Epidemiology
DSE I 23US5ZODSIMFM	Marine Ecology and Non- conventional Fishing methods	Physical and Chemical oceanography	Classification of marine ecosystem	Non- conventional fishing methods
DSE II 23US5ZODS2ENT	Entomology I	Insect Classification	Insect Morphology	Insect Anatomy
DSE III 23US5ZODS3BCH	Biochemistry	Carbohydrates	Proteins	Carbohydrate & Protein Metabolism
SEC I 23US5ZOSEILTZ	Laboratory Techniques in Zoology	Antigen- Antibody interaction	Animal Tissue Culture	Molecular Techniques
General Elective I 23US5ZOG EILOA	Levels of Organization and Animal Morphology	Levels of Organisation and Protista to Nemathelmin thes [Lower Invertebrates]	Annelida to Hemichordat a [Higher Invertebrates]	Chordates
AECC 23US5AEIEVS	Environmental Science			



Semester VI				
DSC I 23US6ZOCCISEH	Animal type study- Shark, Endocrinology and Histology	Animal type - Shark	Endocrinology	Histology
DSC II 23US6ZOCC2ANP	Animal Physiology	Enzymology	Chemical coordination	Regulation of circulation and reproduction
DSC III 23US6ZOCC3TEP	Toxicology, Evolution and Population genetics	Concepts in Toxicology	Metabolism of Toxicants	Evolution and Population genetics
DSC IV 23US6ZOCC4MSB	Environmental studies and Biostatistics	Environmental Pollution	Basic concepts in Biostatistics	Probability and various tests in Biostatistics
DSE I 23US6ZODSIFPF	Fish pathology and fishery products	Diseases in Fish	Quality control and preservation	Byproducts and value-added products
DSE II 23US6ZODS2ENT2	Entomology II	Insect Type Study- Cockroach	Insect Ecology	Applied Entomology
DSE III	Research Methodology	Introduction to Research	Research design	Research Ethics
SEC 23US6ZOSEIASC	Aquarium Science	Fundamentals of Aquarium Set up	Aquaria visits & Conservation strategies	Aquarium setup and management
General Elective 23US5ZOG2APZ	Applied Zoology	Entrepreneurial Zoology	Culturing Techniques I	Culturing Techniques II
AECC 23US6AEIEVS	Environmental Science			



Se me ste r V	Cours e Num ber	Co urs e Titl e	C o u r s e c o d e	C r e d i t s	H o u r s	P e r i o d s (5 0 m i n)	U n i t/ M o d u l e	Lect ures (50 MIN UTE S)	Examination		
									Inte r n a l M a r k s	Ex t e r n a l M a r k s	T o t a l M a r k s
THEORY											
Core courses											
	1	Animal type study - Earth worm, Mammalian anatomy and	X X X X	2	30	36	1	12	20	30	50

		embryology									
							2	12			
							3	12			
	II	Hae mat ology and Im mu nol ogy	Y y y y	2	3 0	3 6					
	III	Molec ular Biolog y and Reco mbina nt DNA Techn ology		2	3 0	3 6					
	IV	Enviro nment al Scienc e, Enviro		2	3 0	3 6					



		Environmental biology and Epidemiology									
Discipline Specific Electives											
DS E	I	Marine ecology and Non-conventional fishing methods		2	30	36	1	12	20	30	50
							2	12			
							3	12			
	II	Ento		2	30	36					



		m o l o g y									
	III (OPTI ONAL)	Bioc hem istry									
Skill Enhancement Electives											
SE C **	I	Lab tec hni que s in Zo olo gy		1	1 5	18	1	9	25/ 0	0 / 25	2 5
							2	9			
PRACTICALS											
CORE COURSES											
				1	2	2. 4			20	3 0	5 0



				1	2	2.4			20	30	50
				1	2	2.4			20	30	50
				1	2	2.4			20	30	50

Discipline Specific Electives											
DSE	1			1	2	2.4			20	30	50
	2			1	2	2.4			20	30	50
	3			1	2	2.4			20	30	50
Skill Enhancement Electives											
SEC				1	2	2.4			25		25
GE					2						
TOTAL				20							

** Skill enhancement courses may have theory or may have only practical components.



T.Y. B. Sc. (ZOOLOGY)

SEMESTER V

Preamble:

The Third year bachelor's degree program is a consolidated culmination of all the topics that have been taught in progression from First year and Second year of the program. The syllabus focuses on core topics with regards to deeper understanding of Zoology and its applied branches. The First course elaborates the complete study of an animal type- earthworm, followed by chordate studies. Course Two teaches two important modules, Hematology and Immunology, giving the learner a thorough understanding of internal systems. Course three encompasses the study of Molecular Biology which forms the foundation for most of the research in Zoology. The application of this knowledge is also elaborated in Recombinant DNA technology. Course Four emphasizes the role of environment and conservation strategies, which are the need of the hour. Human Epidemics, their etiology and preventive measures complete this course.

With the CGCS pattern, we have incorporated Fishery Biology, Entomology and Biochemistry as Discipline Specific electives, keeping in mind the vocational trends of the market. Laboratory Techniques in Zoology will be conducted as a skill enhancement Course to develop the hands-on skills of the learner. This year we have introduced two new generic courses for other students, viz. Levels of Organization, Animal Morphology and Applied Zoology as General elective courses open to all undergraduate students who are keen in understanding the basics of Zoology.



T.Y. B. Sc. (ZOOLOGY)

SEMESTER V

Course – DSCI

COURSE TITLE: Animal Type Study-Earthworm, Mammalian Anatomy and Embryology

COURSE CODE: 23US5ZOCCIEAE

[CREDITS - 02]

Course Learning Outcomes

After the successful completion of the Course, the learner will be able to

- 1) Classify earthworm with reasons.
- 2) Describe the morphology and anatomy of earthworm.
- 3) Sketch neat and labeled diagrams of various systems of Earthworm.
- 4) Explain reproduction in earthworm
- 5) state the ecological and economic importance of earthworm
- 6) compare anatomical structure of integuments, digestive, respiratory, urinogenital, reproductive and nervous system in chordates
- 7) recognize various stages of development in chick embryo
- 8) compare between various processes that take place during development of chick embryo
- 9) illustrate various stages of chick embryo development

Module	Animal type – Earthworm	12
1	<p>Learning Objectives</p> <p>To help the learner understand various life processes of an invertebrate organism with Earthworm as an example and use of earthworms in vermicomposting.</p> <p>Learning Outcomes</p>	

	<p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> Describe various systems of Earthworm. Set up and maintain a vermicompost unit 	
	<p>Animal Type– Earthworm <i>Pheretima posthuma</i></p>	<p>1L</p>
1.1	Systematic position and morphology,	1L
1.2	Digestive system,	2L
1.3	Circulatory system,	4L
1.4	Excretory system,	1L
1.5	Reproductive system,	1L
1.6	Nervous system.	1L
1.7	Economic importance.	1L
1.8		
1.9	Commercially important species of earthworms	1L
2	Mammalian Anatomy	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <p>Make the learner understand the structure of different organ systems in classes of chordates.</p> <p>Learning Outcomes</p>	

	<p>After the successful completion of the module, the learner will be able to</p> <p>1. compare anatomical structure of integuments, digestive, respiratory, urinogenital, reproductive and nervous system in chordates</p>	
2.1	Structure of Integument and its derivatives: Introduction, structure and functions of integument, Derivatives of integument: Epidermal derivatives – Epidermal glands & scales, Digital cornification, Hair.	2L
2.2	Digestive system: Introduction and functions of digestive system, Embryonic digestive tube and its evolution, Primary divisions of tube, Parts, accessory organs, modifications of alimentary canal, digestive glands and mammalian dentition.	2L
2.3	Respiratory system – Introduction and functions of respiratory systems, Respiratory passage or tract – nares, pharynx, larynx, glottis and trachea. Respiratory organs – Lungs.	2L
2.4	Circulatory system – Introduction, (discovery) and functions of circulatory system. Parts of the circulatory system, aortic arches, venous portal, and lymphatic systems in mammals.	2L
2.5	Nervous system – Introduction and functions of the nervous system. Development and differentiation of primary brain vesicles and their cavities, flexures of brain, evolution of cerebral hemispheres & cerebellum in mammals.	2L
2.6	Urinogenital system – Introduction and functions of urinogenital system. Parts of urinogenital system – kidney: archinephros, pronephros, mesonephros, metanephros, Structure of nephron, urinogenital ducts and urinary bladder in mammals.	2L

3	Chick embryology	12
	<p>Learning Objective</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. make the learner understand the basics of biological process where single celled zygote gets converted to the multicellular organism. 2. explain how chick embryo gets its form inspite of being in the shape of the disc. <p>Learning Outcomes</p> <p>After successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> 1. Describe morphogenetic processes of formation of three layered embryo. 2. Draw neat, labelled illustrations of the same. 3. Identify the age of the embryo 	
3.1	<p>Chick Embryology: Development up to 72 hours of age, – hen’s egg, primitive streak, digestive system, nervous system, circulatory system, excretory system, extra-embryonic membranes.</p>	
3.2	<p>Study of placentae: Extra embryonic membranes in mammals, classification of placentae on the basis of external morphology and histology.</p>	

References:

1. Invertebrate Zoology by Kotpal
2. Comparative Anatomy of Vertebrates by George c Kent
3. Vertebrates by Kotpal
4. Chordate Zoology by Jordan and Verma
5. Chordate Zoology by Dhama and Dhama



T.Y. B. Sc. (ZOOLOGY)

SEMESTER V

Course – DSCII

COURSE TITLE: Haematology and Immunology

COURSE CODE: 23US5ZOCC2HAI

[CREDITS - 02]

Course Learning Outcomes

After successful completion of the Course, the learner will be able to:

1. Describe all the components of blood, their synthesis, normal concentration and physiological significance.
2. Explain the factors affecting blood volume.
3. Sketch the cascade of reactions that take place during blood coagulation.
4. Analyze the cause of various blood related disorders by referring to the symptoms.
5. Identify the components of the human immune system.
6. Recall the processes of immune response.
7. Distinguish between various types of immune responses.
8. Make schematic representation of antigen attack and corresponding immune response.
9. Categorize types of antigen and immune responses

Module	Composition of Blood and Blood Corpuscles	12
1	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none">1. help the learner understand the composition of human blood along with the characteristics and functions of each of the components <p>Learning Outcomes</p>	

	<p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> 1. enlist all the components of blood, characteristics and functions of components 2. explain the process of formation of RBC, WBC, platelets and haemoglobin 	
1.1	Composition of blood Plasma: Plasma proteins, Inorganic constituents, respiratory gasses, Organic constituents other than proteins (Internal Secretions, antibodies and enzymes), Serum and Lymph,	3L
1.2	Erythrocytes: Total count, factors causing variation in number, form and structure of Erythrocytes, Haemoglobin structure, function, formation and degradation; Haemolysis (Fragility test), Erythropoiesis, ESR	3L
1.3	Leukocytes: Total count, differential count and variation in number, types of leukocytes and function, Leucopoiesis.	3L
1.4	Platelets: Total count, factors causing variations, structure and Thrombopoiesis	3L
2	Blood volume and coagulation	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <p>Make the learner understand the various factors that affect total blood volume and significance of blood volume.</p> <p>Help develop an understanding of the blood group system, blood transfusion and disorders related to blood.</p> <p>Learning Outcomes</p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> 1. enlist the factors affecting blood volume 	

	<p>2. identify compatible blood groups based on given information</p> <p>3. explain process of blood coagulation</p> <p>4. discuss causes, symptoms and treatment of various disorders related to blood</p>	
2.1	Volume of blood: Total quantity, factors causing variation in blood volume, Haemorrhage, blood transfusion – Common and rare Blood Group systems, and blood transfusion fluids.	3L
2.2	Blood coagulation: clotting mechanism, Bleeding and clotting time, anticoagulants	3L
2.3	<p>Disorders:</p> <p>a. Anaemia- types, causes, symptoms, treatment,</p> <p>b. Leukemia- types, symptoms,</p> <p>c. Haemophilia - disorders involving in failure of clotting mechanism</p>	6L
3	Components of Human Immune System	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. teach the concepts of human immunology. 2. Help learners understand the different types of immunity. 3. elaborate different lines of defenses. 4. To understand the cells in <p>Learning Outcomes</p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> 1. Emphasize the importance of immunology in living systems. 2. relate the knowledge of immunology to the infections occurring in the population around them. 	

	3. The learner shall develop an interest to take up a career in this field.	
3.1	Innate immunity – definition, characteristics, influencing factors. Lines of defenses – first, second and third	3L
3.2	Acquired immunity – definition and characteristics, active and passive acquired immunity and their types. Cells of immune response	3L
3.3	Antigen – complete and incomplete antigens, epitopes, haptens. Determinants of antigenicity – foreignness, molecular size, chemical composition, heterogeneity, susceptibility to tissue enzymes, species specificity, tissue specificity, iso specificity, organ specificity, heterogenic specificity	3L
3.4	Antibodies (Immunoglobulins) – basic structures and types (IgE, IgA, IgM, IgD, IgG)	3L

References

1. C. C. Chatterjee, 2018, Human Physiology, Volume 1, Twelfth edition, New Delhi, CBS Publishers and Distribution Pvt. Ltd.
2. A. C. Guyton, J. E. Hall, 2011, Textbook of Medical Physiology, Twelfth edition, U.S., Saunders Elsevier.
3. Immunology by Kuby
4. Textbook of microbiology by Anantnarayan and Paniker
5. Roitt's essential Immunology



T.Y. B. Sc. (ZOOLOGY)

SEMESTER V

Course – DSCIII

COURSE TITLE: Molecular Biology and Recombinant DNA Technology

COURSE CODE: 23US5ZOCC3MBR

[CREDITS - 02]

Course Learning Outcomes

After the successful completion of the Course, the learner will be able to:

1. Summarize the structure, chemical nature and function of the molecules working as genetic material.
2. Recall experimental evidence that DNA and RNA are genetic materials
3. Elaborate the processes on the central dogma
4. Explain the process of gene regulation in prokaryotes with models.
5. Discuss various DNA damage and repair mechanisms
6. Define and classify mutations and mutagenic agents.
7. Recall the methods and applications of Recombinant DNA technology.
8. Elaborate on the different tools used in recombinant DNA technology

Module	Genetic material and Central dogma of life	12
1	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none">1. Define all basic terminologies related to the central dogma of molecular Biology.2. Explain the process of the dogma viz. Transcription and translation.3. Draw relevant diagrams of all these processes.4. Describe the properties of the genetic code.	

	<p>Learning Outcomes</p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> 1. elaborate the processes of the dogma. 2. Apply this threshold knowledge for further higher order concepts of this subject. 	
1.1	The nature & properties of genetic material.	1L
1.2	DNA as genetic material: Hershey-Chase experiments.	1L
1.3	RNA as genetic material: Singer & Conrad experiment on Tobacco mosaic virus (TMV).	1L
1.4	Genetic Code, Wobble hypothesis	3L
1.5	Transcription: initiation, elongation, and termination of m-RNA in eukaryotes, RNA polymerase of eukaryotes, Difference in transcription in prokaryotes and eukaryotes.	3L
1.6	Translation: Translation in eukaryotes- initiation of protein synthesis, chain elongation and chain termination	3L
2	Gene Regulation and Mutation	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. Teach gene regulation and explain its significance in prokaryotes with examples of lac and trp operon. 2. Explain mutations and mutagens with examples. 3. Help the learner understand DNA damage and repair mechanisms with illustrations. <p>Learning Outcome</p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> 1. Define basic terminologies related to the topic. 2. Elaborate gene regulation in prokaryotes. 	

	3. Explain various types of mutations and mutagenic agents	
2.1	Gene regulation as exemplified by Lac Operon, Trp Operon.	5L
2.2	DNA damage-repair mechanisms: Photoreactivation, excision repair, recombination repair and SOS repair.	3L
2.3	Mutations & mutagenic agents: <ul style="list-style-type: none"> a. Point mutations due to deletion, insertion & substitution (Missense, non-sense, frameshift & silent mutations). b. Tautomerism of bases, transition & transversion c. Agents of Mutagenesis <ul style="list-style-type: none"> Physical Mutagens: effect of ionizing radiations, UV radiation (formation of pyrimidine dimers), Chemical mutagens: base analogue, alkylating agents, deaminating agents, intercalating agents. 	4L
3	Recombinant DNA Technology	12
	<p>Learning Objectives</p> <p>The module is intended to introduce the learners to the concepts of Recombinant DNA technology and its applications.</p> <p>Learning Outcome:</p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> 1. explain the various methodologies involved in Recombinant DNA technology. 2. Enlist various applications of r DNA technology. 3. Apply this knowledge to design small projects. 	

3.1	Restriction enzymes – types, nomenclature and mechanism.	2L
3.2	Cloning vehicles (vectors) – definition, working, pBR322, pUC series, bacteriophage λ , M13, cosmids	2L
3.3	Gene libraries – DNA labelling, probe production, cDNA technique; linker, homopolymer, Insertion of recombinant molecule into host cell (cloning strategy): Cloning in bacterial cell (Somatostatin gene insertion), cloning in animal cell (interferon gene insertion).	3L
3.4	DNA fingerprinting and their applications– PCR, Southern Blotting, RFLP	2L
3.5	Commercial applications of biotechnology: Examples – golden rice, Nif gene, hepatitis, surface antigen, Bt toxin, BioPol, Recombinant vaccines.	3L

References:

1. Cell and Molecular Biology – deRobertis and deRobertis
2. Cell and Molecular Biology – Gerald Karp
3. Genetics, P.K.Gupta
4. U.Satanarayana, Biotechnology, First edition, Books and Allied pvt.ltd, 2005
5. R.C.Dubey, Textbook of Biotechnology, S.Chand publication, 2010
6. B.D.Singh, Expanding Horizons in biotechnology, Kalyani pub, Jan. 2015.



T.Y. B. Sc. (ZOOLOGY)

SEMESTER V

Course – DSCIV

COURSE TITLE: Study of Environment and Etiology of Epidemics

COURSE CODE: 23US5ZOCC4SEE

[CREDITS - 02]

Course Learning Outcomes

After successful completion of the Course, the learner will be able to:

1. Categorize the sources of energy into different types like conventional - non-conventional, exhaustible - inexhaustible, renewable -nonrenewable.
2. Compare between different types of energy sources.
3. Create awareness and suggest conservation methods for the energy crisis.
4. Describe the features of various zoogeographical regions in the world.
5. Compare the animals of various zoogeographical regions.
6. Discuss various aspects of animal behaviour and their social implications.
7. Enlist different branches of epidemiology.
8. Create awareness plans about identifying symptoms of diseases, their causes, transmission and preventive measures of diseases of bacterial, viral, protozoan and helminth origin.
9. Differentiate between types of epidemiological studies.
10. Design epidemiological triad of disease
11. Identify stages of disease and its screening method
12. Discuss eradicated diseases: Smallpox, polio, plague, cholera.
13. Summarize disinfection methods such as Concurrent, Terminal, Precurrent and Prophylactic methods of disinfection.

Module	Environmental Science	12
1	<p>Learning Objective</p> <p>The module is intended to</p> <p>Make learner understand the current scenario of energy resources availability, accessibility, consumption and consequences of utilization.</p> <p>Learning Outcomes</p> <p>After successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> 1. classify energy resources into different types 2. enlist the pros and cons of energy resource. 3. select a better alternative during energy utilization. 	
1.1	Types of resources: Conventional and non-conventional; exhaustible and inexhaustible; renewable and non-renewable.	2L
1.2	Impact of technology on energy utilization	2L
1.3	Conventional Energy sources: Firewood, fossil fuel, - sources, types, energy potential, advantages and disadvantages.	2L
1.4	New and renewable energy sources solar, Hydel, wind, tidal, geo-thermal, bio-fuels.	2L
1.5		
1.6	Energy conservation and utilization for sustainable development.	2L
	Role of environmental organization - Govt and NGOs	2L

2	Environmental biology	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none"> impart knowledge of geographical distribution of various endemic animals and their characteristics <p>Learning Outcome</p> <p>After successful completion of the module, the learner will be able to</p> <p>Describe the characteristics and zoogeographical distribution of distinct animals</p>	
2.1	<p>Zoogeography: Continuous and discontinuous distribution, dispersal-means and barriers.</p>	
2.2	<p>Zoogeographic realms-geographical limits, climates, topography, vegetation and fauna of -</p>	
2.3	<p>Palaearctic, Nearctic, Neotropical, Ethiopian, Oriental, Australian and Antarctic realms.</p>	
2.4	<p>Animal behavior: Habitat selection, food selection, dispersal, homing, territoriality, aggression.</p>	
	<p>Social behaviour: Schooling in fishes, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.</p>	
3	Epidemiology	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <p>explain various aspects of diseases, their prophylaxis and treatment.</p>	

	<p>Learning Outcomes</p> <p>After successful completion of the module the Learner shall be able to</p> <ol style="list-style-type: none"> 1. explain the scope of epidemiology, 2. make learners aware about identifying symptoms of disease and preventive measures of the same.
<p>3.1 3.2 3.3 3.4 3.5 3.6</p>	<p>Scope of epidemiology: Perspective of epidemiology, descriptive and analytical epidemiology, epidemiological triad; stages of diseases; screening for diseases.</p> <p>Epidemiology of communicable diseases: definition of common terms.</p> <p>Dynamics of disease transmission: Reservoir, route of transmission, incubation period.</p> <p>Eradicated diseases: Smallpox, polio, plague.</p> <p>Prevention and control of Communicable Diseases: Notification, Isolation, Quarantine, Types of Disinfection, Concurrent, Terminal, Precurrent, Prophylactic</p> <p>Methods of disinfection: natural, physical and chemical.</p> <p>Immunization: general measures, health education in India.</p> <p>Epidemiology of Communicable diseases : Diagnosis, Transmission, Prevention, Control measures and treatment of –</p> <ol style="list-style-type: none"> a) Diseases of Viral Origin: Rabies, Dengue, Swine flu. b) Diseases of bacterial origin: TB, National TB control programme, Leprosy, Leptospirosis. c) Diseases of Protozoan origin: Malaria, National Malaria Control Programme. d) Diseases of Helminth origin: Ascariasis, Dracunculosis, Filariasis.



References

1. Robert Ehrlich, Harold Geller, 2017, Renewable Energy, Second edition, U.S. CRC Press.
2. G. N. Tiwari, Rajeev Kumar Mishra, 2012, Advanced Renewable Energy Sources, Great Britain, Royal Society of Chemistry.
3. S. A. Abbasi, N. Abbasi, 2006, Renewable Energy Sources and their environmental impact, Prentice Hall of India.
4. Avery William H, Wy Chin, 1994, Renewable Energy from the ocean, Oxford university press
5. Bhaskararao K, 2012, Renewable Energy, Alfa Publications
6. Basic epidemiology by R. Beaglehole
7. Public health and sanitation for sanitary inspectors and paramedical worker manual by All India Institute of local self-government



T.Y. B. Sc. (ZOOLOGY)

SEMESTER V

Course V – DSE I

COURSE TITLE: Marine Ecology and Non-conventional Fishing methods

COURSE CODE: 23US5ZODSIMFM

[CREDITS - 02]

Course Learning outcomes:

After successful completion of the Course, the learner will be able to:

1. Discuss the role of light, salinity, temperature, and high pressure in ocean.
2. Describe and sketch the various cycles of dissolved gases and nutrients in ocean.
3. Compare and distinguish various bio-zones and light zones in ocean.
4. Enlist the various biotic and abiotic components in the ocean.
5. Recognize different pelagic, intertidal, and benthic communities.
6. Identify and describe the different types of mangroves and the role of wetlands.
7. Investigate various anthropogenic activities around marine ecosystems.
8. Interpret the various strategies to conserve estuaries and coral reefs.
9. Explore unconventional methods of fishing which is used for recreational and scientific purpose.

Module	Physical and Chemical oceanography	12
1	<p>Learning Objectives</p> <p>The module is intended to make the Learner understand the various physical and Chemical factors that define the ocean.</p> <p>Learning Outcomes</p>	

	<p>After successful completion of the module the learner will be able to</p> <ol style="list-style-type: none"> describe various physical and chemical factors that affect life in the ocean. 	
1.1	Light	2L
1.2	Temperature	1L
1.3	Salinity	1L
1.4	High pressure	2L
1.5	Dissolved gasses- Oxygen, Carbon dioxide	2L
1.6	Nutrients- Nitrates, Silicates, Phosphates.	2L
1.7	Heavy metals- Lead, Copper, Zinc	2L
2	Classification of marine ecosystem	12
	<p>Learning Objectives</p> <p>The module is intended to make learners understand the habit, habitat and distribution of various animals in marine ecosystems.</p> <p>Learning Outcomes</p> <p>After successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> describe the zonation of the sea and its related environment 	
2.1	Pelagic communities: a) Plankton b) Nekton	1L
2.2	Benthos	1L
2.3	Intertidal communities.	1L

2.4	Mangrove/ wet land	2L 2L
2.5	Coral reefs	2L
2.6	Estuaries	3L
2.7	Anthropogenic: a) Reclamation b) Destruction- oil, sewage, mining and radiation, impact of pollution on marine ecosystems	
3	Non-conventional fishing methods	12
	<p>Learning Objectives</p> <p>The module is intended to make the learner understand unconventional methods of fishing which can be used for sport fishing and for research.</p> <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to</p> <ol style="list-style-type: none"> 1. explore the unconventional method of fishing. 2. differentiate between commercial fishing and non-commercial fishing methods 	
3.1	Electrofishing	2 L
3.2	Light fishing	2 L
3.3	Sport fisheries	2 L
3.4	Blast fishing	2 L
3.5	Bottom trawling	2 L
3.6	Impact on fisheries and environment: Maximum Sustainable Yield and Optimum Sustainable Yield	2 L 2 L

References:

<https://www.michiganbuilderslicense.com/blog/5-Unconventional-Fishing-Techniques/>



<https://www.sciencedirect.com/topics/earth-and-planetary-sciences/electrofishing>

T.Y. B. Sc. (ZOOLOGY)

SEMESTER V

Course – VI

COURSE TITLE: Entomology (DSE II)

COURSE CODE: 23US5ZODS2ENT

[CREDITS - 02]

Course Learning Outcomes

After successful completion of the Course, the learner will be able to:

1. Identify and classify the insects upto order level with respect to metamorphosis.
2. Differentiate between the types of metamorphosis found in insects.
3. Illustrate and describe external features of insects.
4. Compare anatomy of mouthparts and adaptations for different food habits.
5. Differentiate structure of antennae, legs, and wings in insects.
6. Identify and describe the functions of various appendages in insects.
7. Explain the structure and function of different organs in an insect body.
8. Discuss various systems and state their role in an insect body.

Module	Insect classification	12
1	<p>Learning Objectives</p> <p>The module is intended to introduce the basic and modern scheme of insect classification and terminologies.</p> <p>Learning Outcomes</p>	

	<p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> classify the insect upto order level 	
1.1	Introduction to classification	2L
1.2	<p>Classification upto orders</p> <ol style="list-style-type: none"> Ametabolous orders Hemimetabolous orders Holometabolous orders 	10L
2	Insect Morphology	12
	<p>Learning Objective</p> <p>The module is intended to make the learner understand the terminologies used for identifying different external body parts of the insects.</p> <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> differentiate between insects and other invertebrates. describe the insect morphology 	
2.1	Basic insect body plan - terminologies	1L
2.2	<p>Head morphology-</p> <p>2.2.1 Head Sclerites, Head sutures,</p> <p>2.2.2 Basic structure of antenna and Study of types of antennae,</p>	4L
2.3	<p>Thorax morphology-</p> <p>2.3.1 Thoracic sclerites</p>	2L

2.4	2.3.2 Thoracic appendages- Legs and wings 2.3.1.1 Study of wing and wing modification 2.3.1.2 Structure of insect leg and modification of legs in insects Abdomen morphology	2L 2L
3	Insect Anatomy	12
	<p>Learning Objectives</p> <p>The module is intended to make the learner understand the terminologies used for identifying internal body parts of the insects</p> <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> 1. identify different internal body parts, their functions and physiology 	
3.1	Integument	2L
3.2	Digestive system	2L
3.3	Circulatory system	2L
3.4	Excretory system	2L
3.5	Reproductive system	2L
3.6	Nervous system	2L

References:

- 1.Modern Entomology book by Tembhare
- 2.Principles of insect morphology by R.E Snodgrass



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SEMESTER V

Course – VII

COURSE TITLE: Biochemistry (DSE III) OPTIONAL

COURSE CODE: 23US5ZODS3BCH

[CREDITS - 02]

Course Learning outcomes:

After successful completion of the Course, the learner will be able to:

I. explain the structure, classification, biological functions and metabolism of Carbohydrates and Proteins.

Module	Carbohydrates	12
1	<p>Learning Objective</p> <p>Learner will get to know about the structure, classification and biological functions of Carbohydrates</p> <p>Learning Outcome</p> <p>Learner will be able to explain about the structure, Classification and functions of Carbohydrates</p>	
	<p>1.1 Classification and bond formation in Carbohydrates – structure, Glycosidic bond - types</p> <p>1.1.1 Monosaccharides – examples, types</p> <p>1.1.2 Oligosaccharides -</p> <p>1.1.3 Polysaccharides</p> <p>1.2 Biological functions of Carbohydrates</p>	

2	Proteins	12
	<p>Learning Objectives</p> <p>Learner will get to know about the structure, classification and biological functions of Proteins</p> <p>Learning Outcomes</p> <p>Learner will be able to explain about the structure, Classification and functions of Proteins</p>	
	<p>2.1 Classification of Proteins</p> <p>2.2 Organization of Protein structure</p> <p>2.3 Amino acids – Classification</p> <p>2.4 Peptide bond formation</p> <p>2.5 Biological functions of Proteins</p>	
3	Carbohydrate and Protein metabolism	12
	<p>Learning Objectives</p> <p>Learner will get to know about the processes involved in metabolism of Carbohydrates and Proteins</p> <p>Learning Outcomes</p> <p>Learner will be able to explain the metabolic processes involved in Carbohydrate and Protein metabolism</p>	
	<p>3.1 Carbohydrate metabolism</p> <p>3.1.1 Basic concepts of Glucose metabolism</p> <p>3.1.2 Glycolysis</p>	



3.1.3 Gluconeogenesis

3.1.4 Glycogen metabolism: Glycogenesis and Glycogenolysis

3.2 Protein Metabolism

3.2.1 Metabolism of Amino acids: transamination , Oxidative and Non oxidative deamination

3.2.2 Metabolism of Ammonia: Urea Cycle

References:

1. Lehninger principles of Biochemistry, David L Nelson; Michael M Cox; Albert L Lehninger
2. Biochemistry by U. Satyanarayana

T.Y. B. Sc. (ZOOLOGY)

SEMESTER V

Course – VIII

COURSE TITLE: Laboratory techniques in Zoology (SEC I)

COURSE CODE: 23US5ZOSEILTZ

[CREDITS - 02]

Course Learning Outcomes

After successful completion of the Course, the learner will be able to:

1. Analyse various techniques involved in Antigen-Antibody interactions.
2. Categorise various Animal tissue culture requirements, media, and techniques.
3. Demonstrate Molecular techniques.
4. Design an experiment using these methods.

Module	Antigen – Antibody Interactions	15
1	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. make the learner understand the structure of antigen and antibody. 2. explain the basic reactions of antigens and antibodies. <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> 1. elaborate the importance of the antibodies. 2. interpret the ‘medical report’ where antibodies are tested for sensitivity of the patient. 3. describe various ag-Ab interactions 	
1.1	Antigen antibody interactions –	

	<ul style="list-style-type: none"> a. Precipitin reactions (tube test, slide test,) b. Immunodiffusion reactions (Radial or Mancini, Double or Ouchterlony), immunoelectrophoresis. c. Agglutination reaction – hemagglutination, tube agglutination, passive agglutination, Coomb’s test, d. Complement fixation. 	<p>3L</p> <p>3L</p> <p>3L</p> <p>3L</p>
2	Animal tissue culture	15
	<p>Learning Objectives</p> <p>The module is intended to acquaint the learner with various strategies of Animal Tissue Culture and its applications.</p> <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ul style="list-style-type: none"> 1. describe the techniques involved in Animal Tissue Culture 2. enlist its applications. 3. define all terminologies related to animal cell lines. 4. explain stem cells and their applications in medicine 	
2.1	Basic requirement of the tissue culture Lab	3L
2.2	Primary and established cell lines.	3L
2.3	Culture media – definition, types – biological media (blood plasma, serum, tissue extracts, complex media), HAT medium selection	3L
2.4	Culture techniques – test tube, slide, coverslip (single, double), flask culture	3L
2.5	Hybridoma technology: Somatic cell fusion, somatic cell genetics, production & applications of monoclonal antibodies, Stem Cell technology/ engineering: division of stem cells, biological role and properties of stem cells, types	3L

	of stem cells and applications (cell replacement therapy, cardio-vascular therapy etc.)	
3	Molecular techniques	15
	<p>Learning Objectives</p> <p>The Module is intended to</p> <ol style="list-style-type: none"> 1. teach the learner various molecular techniques used in Molecular research and their applications. <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> 1. perform various molecular techniques. 2. discuss their applications 3. design small projects based on these techniques 	
3.1	Genomic DNA extraction from E. coli	3L
3.2	Purity checking of DNA by Agarose gel electrophoresis.	3L
3.3	PCR	3L
3.4	Separation of Proteins by PAGE	3L
3.5	Western blot set up for the separated proteins	3L

References:

1.R.Ian Freshney,Animal Tissue Culture Second edition,IRLpress,1992

2.B.D.Singh,Expanding Horizons in biotechnology, Kalyani pub, Jan. 2015



Evaluation Pattern: Theory

For each course

External Evaluation – Semester End Examination (60 M)- Duration : 2.5 hours

Paper Pattern

Question No	Module	Marks with Option	Marks without Option
1	1	30	20
2	2	30	20
3	3	30	20

Internal Evaluation - (40 M)

Three CIE tests are conducted per course-

CIE	Pattern	Marks
I	Objective based written test	15
II	Home assignment- essay/ poster/RBPT/mindmap	15
III	Subjective based written test- short notes/ answer in brief/diagrams	10



T. Y. B. Sc. (ZOOLOGY)

SEMESTER V - Practical

Practical I- DSCI+DSCII

COURSE CODE: 23US5ZOCPI

DSCI

Experiments-		Number of Credits	Number of hours
1.	Demonstrations of various systems in Earthworm-digestive/reproductive/nervous system.	01	30
2.	Mountings – setae, spermatheca, nerve ring, septal nephridia		
3.	Mounting of chick embryo		
4.	Identification of Chick embryos- 16hrs, 24 hrs, 36 hrs, 48 hrs, 72 hrs etc.		
5.	Study of Placenta		
6.	Identification of hair of different mammals		
7.	Types of dentitions and formula derivation		

DSC II

Experiments		Number of Credits	Number of hours
1.	Colorimetric estimation of total plasma proteins by Folin Lowry method	01	30
2.	Estimation of blood glucose by O-toluidine method.		
3.	Estimation of serum/plasma total cholesterol by FeCl ₃ method.		
4.	Estimation of serum/plasma total triglycerides by Phosphovanillin method.		
5.	Enumeration of erythrocyte-total count.		
6.	Enumeration of leucocytes -total and differential count.		
7.	Estimation of hemoglobin by Sahli's acid haematin method.		
8.	Study of Lymphoid organs: Lymph node, Thymus and Spleen.		
9.	Study of Leukemic cells using permanent slides.		
10.	Observation of bone marrow cells.		
11.	Latex agglutination test (any available/ Rheumatoid Arthritis)		
12.	Determination of blood group and Rh factor-RA test serum		
13.	Visit to pathology lab and prepare a report		



Practical II- DSCIII+ DSCIV

COURSE CODE: 23US5ZOCCP2

DSCIII

Experiments		Number of Credits	Number of hours
1.	Estimation of RNA by Orcinol method.	01	30
2.	Estimation of DNA by Diphenylamine method.		
3.	Use of autoclave for sterilization of equipment for tissue culture.		
4.	Media preparation and sterilization		
5.	To prepare cells for culture from kidney or spleen or chick embryo using trypsin.		
6.	Problems in Molecular Biology, recombinant DNA technology & Bioinformatics.		

Course-IV (DSC IV)

Experiments		Number of Credits	Number of hours
1.	Rapid field test for sulfate and nitrate content as well as base deficiency of soil samples.	01	30
2.	Determination of carbonates in soil by rapid titration.		

3.	<p>Analysis of community by working out ecological indices (frequency/importance probability, rarity, fidelity, constancy, species diversity and Shannon-Weiner Indices)</p> <p>a. Using transect method b. Using quadrat method</p>		
4.	<p>Study of interaction between organism: Social organization in : Honey bee,Termite, Hanuman langur, Asian elephant</p>		
5.	<p>Study of fauna of different zoogeographic regions :</p> <p>a. Palaearctic –Giant panda, Japanese snow Monkey b. Nearctic- Virginia opossum, sea otter, raccoon c. Neotropical- South American lungfish, lowland tapir/ Brazilian tapir, llama d. Oriental- flying frog, gharial, flying lizard, Asian elephant, Indian porcupine,Great Indian bustard, one- horned rhino. e. Ethiopian- African lungfish, ostrich, African elephant. f. Australian- duck- billed platypus, spiny ant eater, Australian lungfish, red kangaroo.</p>		
6.	<p>g. Antarctic- penguins, Minke Whale, Antarctica midge, leopard seal,</p>		
7.	<p>Identification of permanent slides/ specimens of <i>Plasmodium</i>, <i>Ascaris</i>, <i>Wuchereria</i></p> <p>Temporary preparation of head and mouth parts of mosquito</p>		



Practical III- DSEI+ DSEII

COURSE CODE: 23US5ZODSP3

DSEI

Experiments	Number of Credits	Number of hours
1. Identification of plankton/ mounting of planktons.	01	30
2. Identification with adaptations of intertidal communities (Muddy, sandy and rocky).		
3. Identification of seaweed.		
4. Identification of any two or three flora and fauna of Mangroves.		
5. Identification of corals.		
6. Qualitative test for heavy metals - Lead, Copper, Zinc.		
7. Estimation of PO ₄ -Phosphorus and Silicates,		
8. Estimation of Nitrate-nitrites		
9. Excursion / field visit		

DSEII

Experiments		Number of Credits	Number of hours
1.	Study of insect head sclerites	01	30
2.	Study of insect mouth parts		
3.	Study of insect thoracic sclerites		
4.	Study insect wing venation		
5.	Study of basic insect leg		
6.	Study of insect genitalia		
7.	Mounting of spiracles		
8.	Estimation of uric acid from cockroach excreta		
9.	Estimation of chitin		
10.	Protein estimation from insect leg/thoracic muscles by Folin Lowry method		
11.	Study of different types of insect larvae		
12.	Study of different types of insect pupae		
	On field identification of insects		



Course-VII (DSE-III) - Optional

Experiments	Number of Credits	Number of hours
<ol style="list-style-type: none">1. Qualitative tests for Carbohydrates.2. Estimation of Starch by Anthrone method.3. Estimation of Liver/Muscle Glycogen4. Testing for G6PD5. Identification of proteins by Biuret, Ninhydrin, Xanthoproteic , Millon's test6. Estimation of total free amino acids.7. Study of Carbohydrate and Protein related metabolic disorders.	01	30

Evaluation pattern: Practical

Total 50 marks per course-

Question	Pattern	Marks**
1	Major Experiment	12
2	Minor Experiment	10
3	Identification/ Problems	18
4	<i>Viva voce</i>	5
5	Journal	5

**Marks are subject to change based on course content



Semester VI

Syllabus -T. Y.B.Sc. Zoology

Semester VI	Course Number	Course Title	Course code	Credits	Hours	Periods (50 min)	Unit/Module	Lectures (50 MINUTES)	Examination		
									Internal Marks	External Marks	Total Marks
THEORY											
Core courses											
	1	Animal type study-Sha	XXXXX	2	30	36	1	12	20	30	50



		rk, End ocri nol ogy and Hist olo gy										
							2	12				
							3	12				
	II	Anima l Physiol ogy	Y Y Y Y	2	3 0	3 6						
	III	Toxico logy, Evoluti on and Popula tion geneti cs		2	3 0	3 6						
	IV	Enviro nment al Polluti on and		2	3 0	3 6						



		Biostatistics									
Discipline Specific Electives											
DS E	I	Fish pathology and fishery products		2	30	36	1	12	20	30	50
							2	12			
							3	12			



	II	Entomology II		2	30	36					
	III (OPTIONAL)	Research Methodology									
Skill Enhancement Electives											
SE C **	I	Aquarium Science		1	15	18	1	9	25/0	0/25	25
							2	9			
PRACTICALS											



CORE COURSES											
				1	2	2.4			20	30	50
				1	2	2.4			20	30	50
				1	2	2.4			20	30	50
				1	2	2.4			20	30	50

Discipline Specific Electives											
DSE	1			1	2	2.4			20	30	50
	2			1	2	2.4			20	30	50
	3			1	2	2.4			20	30	50
Skill Enhancement Electives											
SEC				1	2	2.4			25		25
TOTAL				20							



AECC											
GE											

** Skill enhancement courses may have theory or may have only practical components.



T.Y. B. Sc. (ZOOLOGY)

SEMESTER VI

Preamble

The sixth semester of the TYBSc undergraduate program is well planned and systematic considering the remaining core topics of Zoology. Course one describes the Type study of a vertebrate system taking Shark as the example, followed by in depth study of the mammalian endocrine glands and organs. Course two elaborates on Physiological studies of the mammalian system covering enzymes, chemical messengers, reproduction and circulation. Course three is more applied with the study of Toxicology based on which the research problems can be designed . The other part deals with Evolutionary studies and population genetics, both of which find great significance in Zoology. Course four deals with study of Environmental pollution which is of great significance considering the environmental problems worldwide and Biostatistics which will be significant considering its application in research.

The Discipline specific Electives include Fish pathology, fishery products and Entomology II. The Skill Enhancement Course involves Aquarium Set up and Management to give the students hands-on training in setting up and maintenance of Aquarium.

We are introducing a generic elective on Applied Zoology in semester 6, which will include modules on Entrepreneurial Zoology, Culturing techniques I and II. These are included keeping in mind the vocational interests of the stakeholders.



Course – I

SEMESTER VI

(DSC I)

COURSE TITLE: Animal type study- Shark, Endocrinology and Histology

COURSE CODE: 23US6ZOCCISEH

[CREDITS - 02]

Course Learning Outcomes

After successful completion of the Course, the learner will be able to:

1. Classify Shark - *Scoliodon* giving reason.
2. Describe the morphology, habit, habitat, organ systems of Shark- *Scoliodon*
3. Explain functions of different organs in Shark- *Scoliodon*
4. Sketch neat and labeled diagrams of various systems.
5. State ecological and economical importance of Shark
6. Describe the structure and functions of mammalian endocrine glands.
7. Enlist the properties and functions of hormones.
8. Discuss the concept of positive and negative feedback mechanisms of hormone action.
9. Diagnose the different clinical conditions related to endocrine glands.
10. Describe and sketch the various mammalian histological sections.
11. Locate different cell organelles in the histological sections.
12. State various histological functions of the mammalian organs

Module	Animal type – Shark	12
1	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. make the learner understand various life processes of a vertebrate organism by studying Shark as an example. <p>Learning Outcomes</p> <p>Learner will be able to describe various systems of shark</p>	
	<p>Animal Type study -Shark</p>	1L
1.1	Systematic position, habit & habitat, distribution, external characters morphology, skin,	2L
1.2	Exoskeleton, endoskeleton- Axial and appendicular skeleton	1L
1.3	Digestive system- alimentary canal and digestive glands,	1L
1.4	Respiratory system,	
1.5	Blood vascular system-External and internal structure of heart, Arterial system, venous system,	2L
1.6	Nervous system- central nervous system and cranial nerves receptor organs- Neuromast organs, Ampullae of lorenzini, Olfactory organs, Eye, internal ear.	3L
1.7	Male and female urinogenital system, copulation, fertilization and development,	
1.8	Economic and ecological importance.	1L
2	Mammalian Endocrinology	12
	<p>Learning Objectives</p>	

	<p>The module is intended to make the learner understand the histology and functions of endocrine glands, their secretions, and function.</p> <p>Learning Outcomes</p> <p>After successful completion of the module the Learner will be able to</p> <ol style="list-style-type: none"> 1. describe histology and functions of endocrine glands and hormones. 2. Explain disorders related to hormones. 3. Draw neat diagrams detailing organ histology 	
2.1	Hormones: Properties and functions of hormones	1L
2.2	Concept of positive and negative feedback mechanism of hormone action	2L
2.3	Histology and hormones of endocrine glands- <ol style="list-style-type: none"> a. Pituitary b. adrenal c. thyroid d. pancreas. 	5L 4L
2.4	Study of clinical conditions associated with malfunction of endocrine glands- such as Gigantism, Dwarfism, Acromegaly, Cretinism, Myxedema, Grave's Disease, Cushing's disease	
3	Mammalian Histology	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. make the learner understand the detailed histology of organs <p>Learning Outcomes</p> <p>After successful completion of the module the learners will be able to:</p>	

	<ol style="list-style-type: none"> 1. describe the gross histology of mammalian organs. 2. Draw detailed labelled diagrams of all organs. 3. Enlist the functions of all organs 	
3.1	Definition and Introduction of histology	II L
3.2	<p>Histological structure of the following mammalian organs:</p> <ol style="list-style-type: none"> a. Skin, b. Tongue, c. tooth, d. stomach, e. intestine, f. liver, g. Artery, h. vein, i. kidney, j. testes and ovary. 	II L

References:

- Inderbir Singh's Textbook of Human Histology
- A textbook of Animal Physiology: K.A.Goel , K.V. Sastri
- Mammalian Endocrinology: Ashok Kumar Boral
- Chordate Zoology by Jordan and Verma
- Chordate Zoology by Dhami & Dhami
- Vertebrates by R.L. Kotpal



T.Y. B. Sc. (ZOOLOGY)

SEMESTER VI

Course – II (DSCII)

COURSE TITLE: Animal Physiology

COURSE CODE:23US6ZOCC2ANP

[CREDITS - 02]

Course Learning Outcomes

After successful completion of the Course, the learner will be able to:

1. Define and classify enzymes.
2. Describe the mechanisms of working and kinetics of Enzymes.
3. Define and classify chemical messengers.
4. Elaborate on neurotransmitters, their types and working.
5. Enlist various pheromones of the animal kingdom, with respect to roles and examples.
6. Describe the processes involved in Chemical coordination in lower organisms.
7. Summarize the regulation of circulation in mammals.
8. Recall the roles of various hormones involved in the regulation of mammalian reproduction, pregnancy and lactation
9. Identify the various stages of the estrous cycle.
10. Diagnose fertility problems and discuss solutions.

Module	Enzymology	12
1	<p>Learning Objectives</p> <p>The module is intended to</p> <p>Teach the learner the various concepts of animal physiology related to enzymes and their working in a cell and apply this to design practicals in the laboratory.</p> <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> 1. Define and classify enzymes as per international nomenclature. 2. Explain the working of enzymes and the various models diagrammatically. 3. Derive the Michaelis Menten equation of enzyme kinetics. 4. Describe factors affecting enzyme activity. 5. Reteriarate various terminology with respect to enzymes 	
1.1	Enzyme as biocatalysts: concept of activation energy, chemical structure of enzymes, nomenclature and classification with numerical code.	2L
1.2	Brief study of oxidoreductases, transferases, hydrolases, lyases, isomerases and ligases.	1L
1.3	Co-enzymes, Enzyme specificity, mechanism of enzyme action	1L
1.4	Basic principle of chemical kinetics: (Derivation of Michaelis-Menten equation), Derivation of Lineweaver-Burk equation, plot and its significance, significance of V_{max}	3L
1.5	Factors affecting/regulating enzyme activity: temperature, pH, substrate concentration, Enzyme activation, Enzyme inhibition.	3L
1.6	Regulation of enzymes: allosteric and covalently modulated enzymes.	1L
1.7	Isoenzymes and their significance.	1L

2	Chemical coordination	12
	<p>Learning Objectives</p> <p>The module is intended to familiarize the learner with the types and functioning of neurotransmitter substances and correlate animal behavior based on these compounds.</p> <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> 1. Define and classify chemical messengers. 2. Explain the working of a neurotransmitter with examples. 3. Recognise messengers in the environment by relevant animal examples 	
2.1	Chemical Messengers: Introduction, concept and classification.	2L
2.2	Neurotransmitters: Acetylcholine, catecholamine, Gamma-amino butyric acid (GABA), Aspartic acid, Purine ATP.	2L
2.3	Mode of working of transmitters.	2L
2.4	Neurosecretory substances and a brief account of Neurosecretory systems.	2L
2.5	X and Y organs in Crustaceans.	2L
2.6	Study of pheromones and their applications.	2L
3	Regulation of circulation and reproduction	12
	<p>Learning Objective</p> <p>The module is intended to help the learner recognise the role of hormones in two key physiological processes of the human body viz. Circulation and Reproduction.</p>	

	<p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> 1. Define terminologies related to circulation 2. Discuss different patterns in heart pumps across animal kingdom 3. Demonstrate the use of ECG and BP in the study of heart functioning 4. Describe all parts of the male and female reproductive system. 5. Explain the hormones involved in various stages of human reproduction
<p>3.1</p> <p>3.2</p> <p>3.3</p> <p>3.4</p> <p>3.5</p> <p>3.6</p> <p>3.7</p>	<p>Regulation of blood circulation: Vascular pumps: Suction pump in open circulation and pressure pump in closed circulation.</p> <p>Heart size (Heart mass-Hm) in vertebrates, heart rate frequency in vertebrates and invertebrates; Cardiac output and Blood pressure.</p> <p>Pace maker, Neurogenic and Myogenic hearts; Electrical activity in heart muscles: Electrocardiogram; chemical and nervous regulation of heart.</p> <p>Regulation of breeding cycle: Endocrine regulation of male reproductive system, Endocrine regulation of female reproductive system.</p> <p>Types of female reproductive cycles (estrous and menstrual).</p> <p>Endocrine regulation of pregnancy, parturition and lactation in mammals.</p> <p>Sterility and in vitro fertilization.</p>



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SEMESTER VI

Course – III (DSC III)

COURSE TITLE: Toxicology, Evolution and Population genetics

COURSE CODE: 23US6ZOCC3TEP

[CREDITS - 02]

Course Learning Outcomes

After successful completion of the Course, the learner will be able to:

1. Enumerate the various types of toxicants found in nature and their effects.
2. Define LC₅₀, LD₅₀, ED₅₀, NOAEL, margin of safety, therapeutic index.
3. Reproduce dose-response relationship curves for essential and non-essential chemicals
4. Discuss the metabolism of different toxicants.
5. Recall significant concepts in evolution such as natural selection, genetic variation, reproductive and non-reproductive isolation mechanism, random genetic drift.
6. Apply the laws of population genetics to solve problems based on allelic frequencies.

Module	Concepts in Toxicology	12
1	<p>Learning Objectives</p> <p>The module is intended to</p> <p>Explain the concepts and terminology used in toxicity studies.</p> <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p>	

	<ol style="list-style-type: none"> elaborate all terms related to toxicology. enlist various types of toxins and identify the sources of toxicants in their surroundings. design a toxicological experiment 	
1.1	Toxicology: definition, scope	1L
1.2	Sources of some common toxic compounds and their effects: food additives, chemicals at the workplace (lead and mercury). Drugs of abuse	3L
1.3	therapeutic drugs, pesticides and cosmetics. Naturally occurring toxins: mycotoxins, microbial toxins, plant toxins, animal toxins (honeybee sting, venoms of coelenterates, scorpion, snake & fish).	4L
1.4	Dose response relationship: Measurement of dose response relationship, dose response curves, LC50 and LD50, acute and chronic toxicity; margin of safety & therapeutic index; threshold dose and no observed effect level (NOAEL); MDL, LDL	4L
2	Metabolism of Toxicants	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none"> make the learner understand the absorption of toxicants through various organs of the body and its metabolism. <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p>	

	<ol style="list-style-type: none"> describe the various routes of absorption and their metabolism elaborate various types of organ toxicities 	
2.1	Mechanism of absorption through membranes, rates of penetration, routes of absorption in mammals, dermal, gastrointestinal and respiratory; distribution & accumulation.	3L
2.2	Metabolism of toxicants: Phase I reactions, Phase II reactions,	3L
2.3	Metabolism of carbon tetrachloride (CCl ₄) and paracetamol. Diclofenac- Case study.	3L
2.4	Target organ toxicity – <ol style="list-style-type: none"> hepatotoxicity; susceptibility of liver, types of liver injury, examples of hepatotoxicants, nephrotoxicity, susceptibility of kidney, examples of nephroto neurotoxicity, vulnerability of nervous system, examples of neurotoxicants. 	3L
3	Evolution and Population genetics	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none"> help the learners understand concepts in evolution and population genetics. explain the fundamental forces of evolution <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p>	

	<ol style="list-style-type: none"> 1. solve the problems based on Hardy - Weinberg equilibrium 2. discuss various factors that are responsible for evolution 	
3.1	Genetic Basis of Evolution: Reproduction, Significance of Meiosis, Population Genetics: Gene Pool, Gene Frequencies, allelic frequency, Hardy-Weinberg equilibrium Law	3L
3.2	Variations as raw Material for Evolution. Types of Variations , Mutation and Recombination	2L
3.3	Elemental forces of Evolution: Migration (Gene Flow), Mutation, Natural Selection and Genetic Drift. Types of natural selection.	2L
3.4	Speciation: Allopatric and Sympatric speciation, Isolating Mechanisms of Isolation	3L
3.5	Concept of Micro, Macro and Mega evolution.	2L

References :

1. Hedgson Ernest, 2010, A textbook of Modern Toxicology, Fourth edition, Wiley and sons
2. Ngozi Patrick H, 2013, Environmental Toxicology, Random exports.
3. Curtis Klaassen, Cassarretand Dou's toxicology, second edition, MCGraw-Hill edu. 2018
4. Helferich William, Winter Carl, 2013, Food Toxicology, CRC press.
5. Timbrell John, 2017, Principles of Biochemical Toxicology, Fourth edition, Informa Healthcare
6. Strickberger M. W., 2000, Evolution, Third edition, Jones and Bartlett Publications
7. Strickberger M. W. 2015, Genetics, Third edition



T.Y. B. Sc. (ZOOLOGY)

SEMESTER VI

Course – IV (DSC IV)

COURSE TITLE: Environmental Studies and Biostatistics

COURSE CODE: 23US6ZOCC4MSB

(CREDITS – 02)

Course Learning Outcomes

After successful completion of the Course, the learner will be able to:

1. Discuss the causes and effects of air, water, and soil pollution.
2. Analyze the different resources and their potential to cause pollution.
3. Support and promote environmentally friendly practices.
4. Define basic terminology of biostatistics.
5. Compare various sampling methods and distribution tables.
6. Apply the rules of probability and correlation to biological systems.
7. Analyze data using t-test, z test and chi square test.
8. Use computers to solve statistical problems.

Module	Environmental Pollution	12
1	<p>Learning Objectives</p> <p>The module is intended to make the learner aware about sources of various pollutants, their effects and management.</p> <p>Learning Outcome</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none">1. describe the causes and effects of various types of pollutants.	

	2. identify the activities that generate carbon credits and leave carbon footprints	
1.1	Air: Components of air and their significance, Common Air Pollutants, their sources, effects and management, Green House gasses and Global climate change, Carbon Credits and Footprint.	3L
1.2	Water: Common water pollutants, their sources, effect and management.	2L
1.3	Land: Mining and its effect; Agricultural practices and their polluting effects; Types of Solid Wastes and strategies of waste management – 3Rs, Real life examples	3L
1.4	Plastic Pollution	2L
1.5	Environmental Management : EIA studies, Role of pollution control boards — Central and Maharashtra state, Role of NGOs	3L
2	Basic concepts in Biostatistics	12
	<p>Learning Objective</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. make the learner understand the basic concepts of Biostatistics. <p>Learning Outcome</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> 1. analyze basic data using principles of Biostatistics. 2. Define terminologies related to Biostatistics. 3. Classify the given data through various representation methods. 	
2.1	Scope of biostatistics: Definition and Limitations.	1L

2.2	Sampling techniques : Simple random sampling –lottery method, with and without replacement , use of table of random numbers, stratified random sampling.	3L
2.3	Classification of data : Tabulation-simple tables (one-way and two way), complex tables, frequency distribution tables, diagrammatic presentation—frequency polygon, frequency curves, bar diagram,(simple, multiple, segmented), pie diagrams.	4L
2.4	Measure of central tendency and dispersion : Mean, Median, Mode, Variance and Standard deviation.	4L
3	Probability and various tests in Biostatistics	12
	<p>Learning Objectives</p> <p>The module is intended to</p> <ol style="list-style-type: none"> acquaint the learner with the concepts of probability and the parametric and non-parametric tests in Biostatistics. <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> demonstrate the applications of probability and various tests in Biostatistics in biological scenarios. 	
3.1	Probability—Addition and multiplication rules and their applications.	2L
3.2	Normal distribution: Properties of normal distribution.	2L
3.3	Parametric test of significance - t test, z- test	2L
3.4	chi –square test and its applications.	2L
3.5	Correlation	2L
3.6	Use of computers in biostatistics.	2L



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References :

1. Singh M. P., 2011, Air Pollution and Environment, Enkay publication house
2. Bharti Pawan Kumar, 2013, Aquatic biodiversity and pollution, Discovery publication house
3. Behra P. K, 2015, Encyclopedia of air pollution control technology, Dominant Publication
4. Eckenfelder Wesley, 2014, Industrial water pollution control, McGraw hill Education India Ltd
5. Ramnchandra T. V., 2011, Soil and Groundwater pollution from agricultural activities, Teri press, Energy and resources institute
6. Mossalamy E. H. ET, 2013, Solid waste pollution and health, Discovery Publication House
7. Veer Bala Rastogi, Biostatistics third edition,medtech pub 2017
8. B. K. Mahajan Methods in Biostatistics 7th edition,jaypee pub. Jan2010



T.Y. B. Sc. (ZOOLOGY)

SEMESTER VI

Course – V (DSE I)

COURSE TITLE: Fish pathology and fishery products

COURSE CODE: 23US6ZODSIFPF

[CREDITS - 02]

Course Learning Outcomes

After successful completion of the Course, the learner will be able to:

1. Describe various Fish diseases, their causative agents and control measures.
2. Distinguish between bacterial, protozoan, helminth and crustacean disease in fish
3. Explain the treatment and control measures for various fish diseases caused by parasites.
4. Diagnose the physiological diseases in fish.
5. Describe the proximate composition, major and minor components of fish meat and its products
6. Compare and contrast between fish by-products, fish value-added products and imitation products and give examples.
7. Discuss the processing and packaging technique of fish products.
8. Design and create new fish by-products and value-added products
9. Select the appropriate fish quality testing protocol based on given conditions
10. Discuss mechanisms of fish spoilage
11. Identify the appropriate preservation technique in the given condition
12. Compare between various packaging materials

Module	Diseases in aquarium fishes	12
1	<p>Learning Objective</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. Familiarize the learner with the different diseases found in fish, their symptoms and management <p>Learning Outcome</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> 1. maintain the aquarium disease free 	
1.1	Bacterial, Fungal, Protozoan infections and treatment.	4L
1.2	Worm & Crustacean infections and treatment.	4L
1.3	Physiological disorders / diseases and treatment.	4L
2	Quality control and preservation	12
	<p>Learning Objective</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. Acquaint the learner with the various methods of Fish Quality assessment and preservation. <p>Learning Outcomes</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> 1. apply the knowledge for testing Fish quality 2. perform preservation of fish. 	
2.1	<p>Brief methods for evaluating freshness & quality of fish:</p> <p>a. Organoleptic b. Microbial c. Chemical</p>	3L

2.2	Mechanism of spoilage: Hyperaemia, Rigor mortis, Autolysis, Rancidity.	3L
2.3	Preservation techniques:	3L
2.4	Various packaging materials used in the freezing & canning industry – Polyolefin, Wax duplex carton, master carton, can.	3L
3	Byproducts and value-added products	12
<p>Learning Objective</p> <p>The module is intended to</p> <ol style="list-style-type: none"> Teach the Learner about the various by products and value added products that can be obtained from fish <p>Learning Outcome</p> <p>After successful completion of the module the learner will be able to:</p> <ol style="list-style-type: none"> apply the knowledge about obtaining various by products and value added products from fish 		
3.1	Proximate composition of fish meat & Products.	1L
3.2	By-products – Fish protein concentrate, Fish oil, Collagen, Fish maws / Isinglass, chitosan, Gelatin, Fish silage, surimi & Imitation products.	5L
3.3	Value addition – Different types of value-added products from fish & shell, prawn pickle, fish wafers, prawn chutney, fish soup powder, fish steaks,	5L
3.4	Fish skin grafting	1L



References:

1. A Textbook of Fishery Science and Indian Fisheries by C.B.L.Srivastava and Sushma Srivastava.
2. Introduction to Economic Zoology by Sarkar Kundu Chaki.
3. Marine and Freshwater Products Handbook by Roy E. Martin, Emily Paine Carter.
4. www.fao.org
5. <https://www.nap.edu/read/1024/chapter/7>
6. <https://extension.umn.edu/preserving-and-preparing/preserving-fish-safely>
7. <http://www.nzdl.org/gsdImod?e=d-00000-00---off-OcdI--00-O----O-10-O---O---Odirect-10---4-----O-11--11-en-50---20-about---00-O-1-00-O--4---O-O-11-10-OutfZz-8-00&cl=CL2.21&d=HASH25076a497f8fa8e662338a.1>1>



T.Y. B. Sc. (ZOOLOGY)

SEMESTER VI

Course – VI (DSEII)

COURSE TITLE: Entomology II

COURSE CODE: 23US6ZODS2ENT2

[CREDITS - 02]

Course Learning Outcomes

After the successful completion of the Course, the learner will be able to

- 1) Acquire knowledge on theory and practice of insect type study- cockroach.
- 2) Explain basic principles of insect ecology and insect behavior.
- 3) Describe various interactions between insects.
- 4) Elaborate on major pests, seasonal history, and integrated management.

Module	Insect Type Study- Cockroach	12
1	<p>Learning Objectives</p> <p>This module is intended to</p> <ol style="list-style-type: none">1. Make learners understand the cockroach morphology.2. Understand various systems in cockroach. <p>Learning Outcomes</p> <p>After the successful completion of the module, the learner will be able to:</p> <ol style="list-style-type: none">1. Classify cockroach.2. Draw neat and labeled diagrams of various systems and body parts of cockroach	



	3. Explain various systems in cockroach	
1.1	Cockroach – Systematic position and External characteristics	1L
1.2	Study of Digestive system in Cockroach	2L
1.3	Study of Nervous system in Cockroach	2L
1.4	Sense organs in Cockroach	2L
1.5	Study of Circulatory system in Cockroach	2L
1.6	Study of Reproductive system in Cockroach	2L
1.7	Economic importance of Cockroach	1L
2	Insect Ecology	12

Learning Objectives

This module is intended to –

1. make learner Understand insect ecology
2. understand reproductive, foraging and communication behavior.
3. Make learner understand various defense strategy used by insects.
4. Provide knowledge on social behavior and learning behavior found in insects.

Learning Outcomes

After the successful completion of the module, the learner will be able to:

1. Elaborate on reproductive and foraging behavior in insects.
2. Comment on communication and mimicry in insects.
3. Describe and identify social insects and will be able to comment on their behavior.
4. Explain learning behavior in insects.
5. Apply this threshold knowledge for further higher order concepts of insect ecology.

2.1	Introduction and Scope of insect ecology.	1L
2.2	Reproductive and Foraging behavior	1L 2L
2.3	Types of communication	2L
2.4	Mimicry and its types	3L

2.5	Social insects: Levels of Sociality, ecological consequences of sociality.	3L
2.6	Learning, memory and instinct. Types of learning behavior.	
3	Applied Entomology	12
	<p>Learning Objectives</p> <p>After the successful completion of the module, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Understand the different types of pest 2. Understand insects of medical and forensic use <p>Learning Outcomes</p> <p>After the successful completion of the module, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Describe life cycle of pests agricultural and veterinary pest 2. List the control measures for pests agricultural and veterinary pest 3. Explain about the insects in medical and forensic 	
3.1	Agricultural Pest -	
	3.1.1. Pests of Mango, life cycle and control	2L
	3.1.2. Pests of Rice, life cycle and control	2L
3.2	Veterinary Pest -	
	3.2.1. Life cycle and control of Horse fly,	1L
	3.2.2. Life cycle and control of blood sucking fly	
3.3	Medical and Forensic Entomology-	1L



	3.3.1. Common insect vectors –life cycle, disease transmitted, control measures.	3L
	3.3.2. Insects of forensic importance	3L

References

1. Wigglesworth, V.B.: The Principles of Insects Physiology. Vlbs & Methuten & Co.Ltd.,London.
2. Tembhare, D.B.: A Textbook of Insect morphology, Physiology and Endocrinology. IIEnd. S. Chand & Co., New Delhi.



T.Y. B. Sc. (ZOOLOGY)

SEMESTER VI

Course – VII (DSE III) Optional

COURSE TITLE: Research Methodology

COURSE CODE: 23US6ZODS3REM

[CREDITS - 02]

Course Learning outcomes:

Learners will be able to put to application the basics of Research problem framing, Research Design and report generation.

Module	Introduction to research	12
1	<p>Learning Objective</p> <p>Learner will get to know about the objectives, significance and methods of Research.</p> <p>Learning Outcome</p> <p>Learner will be able to apply the knowledge in planning out the research projects.</p>	
1.1	Definition of research, objectives, motivation, types of research	
1.2	Significance of research	
1.3	Methods of research – how research is done, various processes, criteria.	
1.4	Selection of a research problem, defining a research problem, formulation of hypothesis	

2	Research Design	12
	<p>Learning Objective</p> <p>Learner will get to know about research design, survey and learn to prepare a report.</p> <p>Learning Outcome</p> <p>Learner will be able to apply the knowledge in designing the research projects and preparing reports</p>	
2.1	Experimental design	
2.2	Nonexperimental design	
2.3	Field work	
2.4	Survey research	
2.5	Report generation- APA format	
3	Research Ethics	12
	<p>Learning Objective</p> <p>Learner will know about the ethics involved in research</p> <p>Learning Outcome</p> <p>Learner will be able to plan and execute the research projects keeping ethical issues in mind.</p>	
3.1	Experiment ethics	
3.2	Animal ethics	
3.3	Plagiarism	



SOMAIYA
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K J Somaiya College of Science & Commerce

Somaiya

TRUST

Department: Zoology

T. Y. B.Sc. Syllabus

References:

1. Research Methodology: methods and Techniques by C.R. Kothari
2. Research Methodology: A step by step guide for Beginners by Ranjith Kumar



T.Y. B. Sc. (ZOOLOGY)

SEMESTER VI

Course – VIII (SEC II)

COURSE TITLE: Aquarium Science

COURSE CODE: 23US6ZOSEIASC

[CREDITS - 02]

Course Learning outcomes

After successful completion of the Course, the learner will be able to:

- 1) Discuss the fundamentals and practices involved in setting up and maintenance of Aquariums.
- 2) Quantify various water parameters of an aquarium.
- 3) Select an appropriate aquatic animal for a particular aquarium depending upon its requirement.
- 4) State various enrichment strategies used in aquarium settings.
- 5) Manage the handling and transportation of aquarium animals.
- 6) Recognize and evaluate the health condition of aquarium animals.
- 7) Discuss the nutrition in fish and identify nutritious food for aquarium fishes.
- 8) Write a report on the Aquariums visit.
- 9) Plan start-ups in this field
- 10) Work as a freelancer or consultant for small pet stores or house aquariums
- 11) Design aquarium
- 12) Differentiate between various types of aquarium.
- 13) Create infographic for setting up and maintaining aquarium

Module	Fundamentals of Aquarium setup	15
1	<p>Learning Objective</p> <p>The module is intended to</p> <p>Teach the Learner the fundamentals involved in successful setting up of an Aquarium</p> <p>Learning Outcomes</p> <p>Learner will be able to apply the knowledge in successfully setting up the Aquarium</p>	
1.1	Water Quality	3L
1.2	Selection of aquatic animal	2L
1.3	Enrichment in Aquarium setting	3L
1.4	Aquatic animal handling and transport	2L
1.5	Aquatic animal health and quarantine	3L
1.6	Fish nutrition	2L
2	Aquariums and Conservation Strategies	15
	<p>Learning Objectives</p> <p>The module is intended to</p> <p>ize the learner with all aspects of an Aquarium through visits to public Aquaria arious conservation strategies</p> <p>Learning Outcomes</p> <p>Learners will be able to apply the knowledge thus gained in setting up an Aquarium and conservation of aquatic animals.</p>	

2.1	Visit to public aquariums and report	3L
2.2	Benefits of Aquarium	2L
2.3	Types of Aquaria- home, public	3L
2.4	Design of public aquariums- case study	3L
2.5	Aquarium accessories	2L
2.6	Conservation strategies in aquariums	2L
3	Aquarium management	15
	<p>Learning Objective</p> <p>Learner will get hands on experience in setting up and maintenance of Aquarium.</p> <p>Learning Outcome</p> <p>Learners will have gained experience of Aquarium setup and maintenance and can consider it as a career prospect in future.</p>	
3.1	Setting up of aquarium	
3.2	Maintaining log and submitting report- group activity	
3.3	Aquaponics	



References:

- 1 Aquariums & Aquarium Fish: The Comprehensive Expert Guide to Planning, Building, Stocking and Maintaining Your Aquarium, Whether Marine or Freshwater by Mary Bailey, Gina Sandford
2. A Complete Guide to Setting Up and Maintenance of an Aquarium by Pawar Prabhakar
3. Freshwater Aquariums: Basic Aquarium Setup and Maintenance (Fish Keeping Made Easy) by David Alderton
4. Fish Tank: The Ultimate Aquarium Guide by Ann Blackwell
5. The making of Nature aquarium, a beginner's guidebook by ADA- Aqua Design Amano



Evaluation Pattern: Theory

For each course

External Evaluation – Semester End Examination (60 M)- Duration : 2.5 hours

Paper Pattern

Question No	Module	Marks with Option	Marks without Option
1	1	30	20
2	2	30	20
3	3	30	20

Internal Evaluation - (40 M) - CIE

Three CIE tests are conducted per course-

CIE	Pattern	Marks
I	Objective based written test	15
II	Home assignment- essay/ poster/RBPT/mindmap	15
III	Subjective based written test- short notes/ answer in brief/diagrams	10



T. Y. B. Sc. (ZOOLOGY)

SEMESTER VI - Practical I

DSCI+DSCII

COURSE CODE: 23US6ZOCPI

Experiments	Number of Credits	Number of hours
1. Shark: a. Demonstrations: Digestive, Circulatory, Urinogenital, Cranial nerves b. Mountings: placoid scales, scroll valve, muscles, nerve fiber, cartilage. 2. Histology of stomach, intestine, liver, kidney, testes and ovary 3. Histology of Pituitary, adrenal, thyroid and pancreas 4. Study of any 5 clinical conditions associated with endocrine glands malfunction with the help of photographs (Gigantism, Dwarfism, Acromegaly, Cretinism, Myxedema, Grave's Disease, Cushing's disease)	01	30

Course-II (DSC II)

Experiments	Number of Credits	Number of hours
1. Study of Acid phosphatase activity a. Effect of substrate concentration	01	30



<p>b. Effect of pH variation</p> <p>c. Effect of enzyme concentration</p> <p>d. Effect of inhibitor</p> <p>2. Determine specific activity of Acid phosphatase</p> <p>3. Separation of LDH isozyme by electrophoresis on agarose /PAGE</p> <p>4. Study of vaginal smear to identify stages of estrous cycle</p> <p>5. Study of human ECG: Normal, Sinus tachycardia, Sinus bradycardia, Ventricular fibrillation</p> <p>6. Mounting of nerve cells and neurosecretory cells from cockroach.</p> <p>7. Demonstration of measurement blood pressure.</p>			
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Practical II

DSCIII + DSCIV

COURSE CODE: 23US6ZOCCP2

Experiments	Number of Credits	Number of hours
1. Determination of LC50 for a suitable pollutant (any one salt of a heavy metal dissolved in water) on Daphnia, 2. Effect of salt of a heavy metal on the heartbeat of Daphnia. 3. The study of marker enzymes - estimation of acid phosphatase and alkaline phosphatase, aspartate Aminotransferase and alanine aminotransferase. 4. Identification <ul style="list-style-type: none"> a) Types of natural selection (with the help of graphs / examples) b) Types of Speciation c) Isolating Mechanisms 5. Problems based on Hardy Weinberg equilibrium 6. Visit to various databases and making a phylogenetic tree	01	30

Course-IV (DSC IV)

Experiments	Number of Credits	Number of hours
1. Physical properties of water <ul style="list-style-type: none"> a. Turbidity b. Conductivity c. Chemical properties of water 	01	30



	d. Total acidity			
	e. Total alkalinity			
	f. COD			
	g. BOD			
2.	From the given data, make a frequency distribution table.			
3.	From the given data, plot a frequency polygon/histogram.			
4.	From the given data, derive mean and standard deviation.			
5.	From the given data, plot bar diagram/pie diagram.			
6.	Application of Z-test			
7.	Application of t-test			
8.	Application of chi-square test of significance			
	a. To test the goodness of fit of observed and expected proportions.			
	b. To test the association between two events.			
9.	Use of spreadsheet programs in biostatistics.			

Practical 3

DSE1+ DSE 2

COURSE CODE: 23US6ZODSP3

Experiments	Number of Credits	Number of hours
1. Identification of parasitic infections in fishes - Fungal - Dermatomycosis; Bacterial - Fin/Tail rot & Dropsy; Protozoan - Costiasis & White Spot; Worm - Leech; Crustacean - Argulosis.	01	30
2. Microbial studies: Identification of Bacilli, cocci, vibrio bacteria by using gram staining technique.		
3. Microbial studies: Organoleptic tests for fish.		
4. Estimation of lipid from fish by Folch's method.		
5. Comparative Estimation of proteins from dry and fresh fish by Lowry's method.		
6. Preparation of formulated feed for fish & prawn. Fish dressing, Prawn peeling.		
7. Preparation of surimi, fish protein concentrate / fish soup powder.		
8. Preparations of fish burger, fish fingers, fish/prawn pickle.		
9. Preparation of Isinglass.		
10. Identification of packaging materials: Polyolefin, Wax duplex carton, Master carton, Simple cans, and coated cans cans.		

II.	Project (Individual activity) and assignments (group activity).		
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Course-VI (DSE-II)

Experiments	Number of Credits	Number of hours
<ol style="list-style-type: none"> 1. Study of Morphology- Cockroach 2. Mounting of Gizzard of cockroach 3. Mounting of Malpighian tubule of cockroach 4. Study of Digestive system of cockroach 5. Study of reproductive system of cockroach 6. Pest surveillance through light traps, pheromone traps 7. Physical and mechanical methods of IPM 8. Study of mimicry in insects 9. Observation of foraging behavior in insects [RBPT] 10. Methods of sampling of insects 	01	30

Course-VII (DSE-III)

Experiments	Number of Credits	Number of hours
<ol style="list-style-type: none"> 1. Framing of Research problem 2. Writing a Research Proposal 3. Review of Research Papers 4. Use of Excel in Research 	01	30
