

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)



Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for
Program: Bachelors of Science
Course: __T.Y.BSc.(NEP) ____
Subject: _ZOOLOGY__

Choice Based Credit System (CBCS)
with effect from
Academic Year 2025-2026

PROGRAM OUTCOMES

PO	Description
A student completing Bachelor's Degree in Science Program will be able to	
PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate Programme. Execute strong theoretical and practical understanding generated from the specific graduate Programme in the area of work.
PO2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	Social competence: Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Performing dependently and collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

Semester	Course Code	Course Title	Vertical	Credit
V	25ZOOMJ511	Integumentary system & Osteology	Major 1	2
	25ZOOMJ512	Hematology & Immunology	Major 2	2
	25ZOOMJ513	Pathology and Toxicology	Major 3	2
	25ZOOMJP51	Practical based on Integumentary system & Osteology, Haematology & Immunology, Pathology and Toxicology,	Major Practical	2
	25ZOOIKS514	Ethnozoology	IKS	2
	25ZOOEL531	Marine Biodiversity and Physical Oceanography	Elective 1	2
	25ZOOELP51	Practical based on Marine Biodiversity and Physical Oceanography	Elective Practical	2
	25ZOOEL532	Production and Management in fisheries - I	Elective 2	2
	25ZOOELP52	Practical based on Production and Management in fisheries - I	Elective Practical	2
	25ZOOMR52	Parasitology & Medical Zoology	Minor	2
	25ZOOMRP51	Practical based on Parasitology & Medical Zoology	Minor Practical	2
	25ZOOVSC541	Instrumentation & Biostatistics	VSC Practical	2
	25ZOOFP5	Field Project	FP	2
VI	25ZOOMJ611	Enzymology & Homeostasis	Major	2
	25ZOOMJ612	Molecular Biology -I & Molecular Biology -II	Major	2
	25ZOOMJ613	Environment and Wildlife Management	Major	2
	25ZOOMJ614	Genetics & Epidemiology	Major	2
	25ZOOMJP61	Practicals based on - Enzymology , Homeostasis, Molecular, Biology I & II, ,Environment & Wildlife Management, Genetics & Epidemiology	Major Practical	2
	25ZOOEL631	Chemical Oceanography and Oceanographic Instruments	Elective-1	2

	25ZOOELP61	Practicals Based on Chemical Oceanography and Oceanographic Instruments	Elective Practical	2
	25ZOOEL632	Production and Management in fisheries - II	Elective 2	2
	25ZOOELP62	Practical based on Production and Management in fisheries- II	Elective Practical	2
	25ZOOMR621	Applied Zoology - II - Dairy Science & Fishery	Minor	2
	25ZOOMRP61	Practicals based on Applied Zoology - II-Dairy Science & Fishery	Minor Practical	2
	25ZOOOJT6	OJT	OJT	4

Course Code	Major-1 Sem - V	Credits	Lectures Per
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			week
25ZOOMJ511	Integumentary system & Osteology	2	2
Preamble: A course in vertebrate anatomy with special reference to integumentary system and osteology aims to develop a comprehensive understanding regarding to structural peculiarities or anatomical details from the perspective of their function, evolution, adaptations in vertebrates. Students should be able to compare and contrast, understand evolutionary relationships and analyze the functional roles in the aforementioned organ system of vertebrates. Course outcomes CO1: To Memorize key anatomical features of integumentary systems in general and dermal and epidermal derivatives in particular as osteology in endoskeletal stem in general and axial and appendicular skeleton in particular of vertebrates. CO2: To understand the key anatomical differences among different parts of the homologous exo and endo skeletal system of vertebrates. CO3: To Apply the knowledge gained to understand the functional roles of anatomical peculiarities from the perspectives of adaptations to various habitats CO4: To Analyze from the perspectives of adaptations, the structure-function relationship in anatomy of the aforesaid organ systems in the backdrop of evolutionary transition of vertebrates from water to land. CO5 : To evaluate the adaptive and evolutionary significance of anatomy of the aforesaid organ systems of vertebrates & to assess the harmful impact of any causative agent on its functioning.			
Unit	Topic	Credits	Lectures
I	Integumentary system 1.1: Basic structure of integument: Epidermis and dermis 1.2: Epidermal derivatives of Vertebrates 1.2.1: Hair, hoof, horn, claw, teeth, beak and epidermal scales (small scales, large scales, modified scales - spine) 1.2.2: Glands - types (mucous, serous, ceruminous, poison, uropygial and salt gland) and functions 1.3: Dermal derivatives of Vertebrates: Scales in fi scutes in reptiles and birds; dermal scales in mammals - Armadillo, Antler - Caribou 1.4: Special derivatives of integument: Wart in toad, rattle in snake, whale bone in baleen whale, kneepads in camel.		
II	Osteology		

	2.1: Introduction: Bone structure (Histology), physical properties, chemical composition and general functions of bones. Cartilage: General structure, functions 2.2: Axial skeleton 2.2.1: Skull: General characteristics of skull bones - Cranial and facial bones 2.2.2: Vertebral column: General characteristics of a vertebra, structure of different types of vertebrae (cervical, thoracic, lumbar, sacrum and coccyx) 2.2.3: Ribs and sternum: General skeleton of ribs and sternum 2.2.4: Hyoid bone: Structure and function. 2.3: Appendicular skeleton 2.3.1: Pectoral girdle and bones of forelimbs 2.3.2: Pelvic girdle and bones of hind limbs		
References: 1. The Vertebrate Body by Romer Alfred Sherwood 2. Comparative Anatomy of the Vertebrates Paperback – 1 December 2000 by George C. Kent 3. Chordate Zoology E. L. Jorden & P. S. Verma 4. The Vertebrate Integument - Structure, Design and Function · Volume 2 Theagarten Lingham-Soliar · 2015 5. Comparative Osteology: A Laboratory and Field Guide of Common North American Animals Bradley Adams, Pam Crabtree · 2011			

Course Code	Major-2 Sem-V	Credits	Lectures Per week
25ZOOMJ512	Haematology & Immunology	2	2
Course Outcomes- CO1:-Analyze the complex composition of blood plasma and explain the processes of haematopoiesis (erythropoiesis, leucopoiesis, and thrombopoiesis) that lead to the formation of various blood cellular components. CO2:-Evaluate the structure and functions of erythrocytes, haemoglobin, leucocytes, and thrombocytes, and correlate these with common pathological conditions such as anaemia, leukaemia, and clotting disorders. CO3:-Differentiate between innate and adaptive immunity, describing the mechanisms of each, including the first and second lines of defense, and antibody-mediated versus cell-mediated responses. CO4:-Categorize the various cells and organs of the immune system (e.g., B cells, T cells, macrophages, thymus, lymph nodes) and explain their specific roles in generating an effective immune response. CO5:-Define and characterize antigens and antibodies, including their properties, basic structures, and the functional significance of different antibody classes (IgG, IgA, IgM, IgD, IgE). CO6:-Synthesize knowledge of blood physiology and immunology to propose how disruptions in blood composition or immune function can lead to specific health conditions and outline the body's compensatory mechanisms, such as blood volume regulation after hemorrhage.			
Unit	Topic	Lectures	
I	Haematology 1.1: Composition of plasma: Water, respiratory gases, dissolved salts, plasma proteins, nutrients, enzymes, hormones, nitrogenous waste products 1.2: Haematopoiesis: Erythropoiesis, leucopoiesis and thrombopoiesis 1.3: Erythrocytes: Structure and functions, abnormalities in structure, total count, variation in number; ESR; types of anaemia 1.4: Haemoglobin: Structure, formation and degradation; variants of haemoglobin (foetal, adult), abnormalities in haemoglobin (sickle cell and thalassemia) 1.5: Leucocytes: Types and functions, total count and variation in number; leukaemia and its types	15	

	1.6: Thrombocytes: Structure, factors and mechanism of clotting, failure of clotting mechanism 1.7: Blood volume: Total quantity and regulation; haemorrhage	
II	Fundamentals of Immunology 2.1: Concept of immunity Innate immunity - Definition, factors affecting innate immunity, Mechanisms of innate immunity - First line of defence - physical and chemical barriers; Second line of defence - phagocytosis, inflammatory responses and fever 2.1.1: Adaptive or Acquired immunity, Antibody mediated and cell mediated immunity; Active Acquired immunity - Natural and Artificial; Passive Acquired immunity - Natural and Artificial 2.2: Cells and Organs of immune system 2.2.1: Cells of immune system - B cells, T cells and null cells, macrophages, dendritic cells and mast cells 2.2.2: Organs of immune system Primary: Thymus and bone marrow Secondary: Lymph nodes and spleen 2.3: Antigens: Definition and properties; haptens 2.4: Antibodies: Definition, basic structure, classes of antibodies - IgG, IgA, IgM, IgD and IgE	15
References:- - Human Physiology - Volume 1; C.C. Chatterjee. - Essentials of Haematology; Shirish M. Kawthalkar; Jaypee Brothers. Williams Hematology; Kenneth Kaushansky, Marshall A. Lichtman, E. Beutler, Thomas J. Kipps, Josef Prchal, Uri Seligsohn. - Essential Haematology; Victor Hoffbrand, Paul Moss, John Pettit. Rapid Review of Hematology; Ramadas Nayak; Jaypee Brothers. Precise Haematology; Usha Rusia, Meera Sikka, Renu Saxena; Wiley India. Short Textbook of Haematology; Shah B.S.; C.B.S. Publisher and Distributor. Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd., Kolkata; 1999. - Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi; 1978.		

5. A Text book of Practical Physiology; First Edition; V.G. Ranade; A.V.G. Prakashan, Pune;1968.
6. Principles of Anatomy & Physiology; Thirteenth Edition; Gerard J. Tortora & Bryan Derrickson; Biological Science Textbooks, Inc.; 2012.
7. Biochemistry; Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013.
8. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006. Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier); 2014.
9. Harrison's Hematology and Oncology; 3rd Edition (Harrison's Specialty); Dan Longo; McGraw-Hill.
10. Essentials of Haematology; Second Edition; Kawthalkar Shirish M.; Jaypee; 2013. Medical Biochemistry by C. Jaypee; 2012.
11. Essentials in Hematology and Clinical Pathology; Nayak, Ramadas. Clinical Pathology and Hematology; Maheshwari, Nanda; Jaypee. Practical Hematology; Dacie J V; Churchill Livingstone; 2006.
12. Lecture Notes: Haematology; Hatton, Chris S. R. Hughes-Jones, Nevin C. Hay, Deborah; Wiley-Blackwell.
13. ABC series: ABC of Clinical Haematology; Provan; Drew Publisher: BMJ Books. Principles of Anatomy & Physiology; Thirteenth Edition; Gerard J. Tortora & Bryan Derrickson; Biological Science Textbooks, Inc.; 2012.
14. Biochemistry; Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013.
15. Immunology - Introductory Textbook; Shetty N.; New Age International; 2005.
16. Immunology - Essential and Fundamental; Pathak S., & Palan U.; Science Publishers; 2005.
17. Immunology: A textbook; Rao C. V.; Alpha Science Int'l Ltd.; 2005.
18. Ananthanarayan and Paniker's textbook of Microbiology; C. J. Paniker (Ed.); Ananthanarayan R.; Orient Blackswan; 2005.
19. Textbook of Immunology; Haleem Khan, Rajendra Sagar, Sadguna.
20. Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood & Christopher J. Woolverton; McGraw-Hill Education; 2014.
21. Immunology; Third Edition; Janis Kuby; W.H. Freeman; 1997.
22. Kuby Immunology; Sixth Edition; Thomas J. Kindt, Richard A. Goldsby, Barbara Osborne & Janis Kuby; W.H. Freeman; 2007.
23. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006.

Course Code	Major-3 Sem - V	Credits	Lectures Per week
25ZOOMJ512	Pathology and Toxicology	2	2
Course Outcomes- After completion of this course students can CO1: Memorize the basic concepts of toxicology concepts and various pathological conditions CO2: Understands various tissues degeneration in pathological conditions and in effects of toxins on various systems. CO3 : Applies the knowledge of various medical terminology pertaining to pathological conditions and various areas of toxicology CO4 : Analyse difference between the various Normal and Pathological conditions and prepare for employment in clinical industry and related areas.			
Unit	Topic	Credits	Lectures

I	General Pathology: 1. Introduction and scope 2. Cell injury: Mechanisms of cell injury: ischemic, hypoxic, free radical mediated and chemical 3. Disorders of pigmentation: Endogenous: Brief ideas about normal process of pigmentation, melanosis, jaundice (causes and effects) 5. Necrosis: Definition and causes; nuclear and cytoplasmic changes; types: coagulative, liquefactive, caseous, fat and fibroid 6. Gangrene: Definition and types - dry, moist and gas gangrene		
II	Toxicology 1. Basic toxicology 2. Introduction to toxicology - brief history, different areas of toxicology, principles and scope of toxicology 3. Toxins and Toxicants - Phytotoxins (caffeine, nicotine), Mycotoxins (aflatoxins), 4. Zootoxins (cnidarian toxin, bee venom, scorpion venom, snake venom) 5. Characteristics of Exposure - Duration of exposure, Frequency of exposure, Site of exposure and Routes of exposure 6. Types of Toxicity - Acute toxicity, and Chronic toxicity, Concept of LD50, LC50 7. Target organ toxicity: Hepatotoxicity , examples of hepatotoxicants; Neurotoxicity, examples of neurotoxicants; Nephrotoxicity examples of nephrotoxicants 8. Animal models used in regulatory toxicology studies		
References 1. A Textbook of Veterinary and General Pathology; Second edition; J. L. Vagad; IBDC Publishers. 2. Clinical Pathology; Guru G.; NCERT; 1988. 3. Clinical Pathology; Batra Neelam; Vikas Publishing House Pvt. Ltd.; Nov. 1982. 3. Essentials of General Pathology; Dr. Sudha Shivraj, Dr. Satish Kumar Amarnath, Dr. Sheela Devi; Exclusively distributed by CBS Publishers & Distributors. 4. Textbook of Pathology; Harsh Mohan; Jaypee Publishers. 5. Casarett and Doull's Toxicology - The basic science of poisons; Edited by Curtis Klaassen; McGraw-Hill; 2001. 6. 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. Fundamentals of Toxicology; Kamleshwar Pandey and JP Shukla; New Central book agency Ltd., Kolkata; 2011. 10. Elements of Toxicology; Kamleshwar Pandey and JP Shukla; Wisdom Press, New Delhi; 2010. 11. Principles and Applications of Toxicology; Lahir Y.K.; Seekay Publications; 2013.			

12. Essentials of Clinical Toxicology; Lall S.; Narosa Publishing House; 1998.

Course Code	Major Sem -V	Credits	Lectures Per week
25ZOOMJP51	Practicals based on Integumentary system & Osteology, Hematology & Immunology , Pathology and toxicology	2	4

Course Outcomes

CO1: To Memorize key anatomical features of integumentary system & osteology & key concepts and terminology in haematology, immunology pathology and toxicology

CO2: To understand the key anatomical differences among different parts of the homologous exo and endo skeletal system of vertebrates and structure and functions of blood and immune cells. To understand the difference between chronic and acute toxicity and acute toxicity tests such as LC50. To understand various pathological conditions with their characteristic features and underlying cause.

CO3: To Apply the knowledge gained to understand the functional roles of anatomical peculiarities from the perspectives of adaptations to various habitats as well as applications of blood and immunological tests in diagnosis of disease and health. To apply the knowledge gained for diagnosis and treatment of pathological conditions & toxicity.

CO4: To Analyze from the perspectives of adaptations, the structure-function relationship in anatomy of the aforesaid organ systems in the backdrop of evolutionary transition of vertebrates from water to land. To analyze the pathological reports and compute various ratios from various parameters to evaluate the health status.

CO5 : To evaluate the adaptive and evolutionary significance of anatomy of the aforesaid organ systems of vertebrates & to assess the harmful impact of any causative agent on its functioning. To comparatively evaluate the efficacy of haematological and immunological tests and to comment on normal and extreme values.

Unit	Topic	Credits	Lectures
	- Enumeration of Leucocytes - Total Count. - Differential count of Leucocytes. - Estimation of haemoglobin by Sahli's acid haematin method. - Estimation of total serum/ plasma proteins by Folin's method. - Latex agglutination test - Rheumatoid Arthritis. - To determine LC 50 value of given toxicant using Daphnia as test organism - To study the effect of given toxicant on heart beat of daphnia.		

	8. Identification of diseases or conditions (from slides or pictures): Vitiligo, Psoriasis, Bed sores, Necrosis, Oedema 9. Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation, sectioning, staining. 10. Study and interpretation of abnormal pathological reports: Blood (CBC), Urine (Routine) and Stool (Routine). 11. Mounting of cycloid and ctenoid scales from bony fish and placoid scales from cartilaginous fish 12. Study of feathers of birds as epidermal derivatives 13. Study of mammalian tissues: V.S. of Tooth, T.S. of Stomach, T.S. of small intestine, T.S. of Liver , V.S of Skin of Human 14. Study of Human Axial Skeleton - Skull (whole) and Vertebral column (axis, atlas, typical cervical, typical thoracic, typical lumbar, sacrum, coccyx) 15. Study of Human Appendicular Skeleton - Pectoral and pelvic girdle with limb bones.		
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References

- A Textbook of Veterinary and General Pathology; Second edition; J. L. Vagad; IBDC Publishers.
- Clinical Pathology; Guru G.; NCERT; 1988.
- Clinical Pathology; Batra Neelam; Vikas Publishing House Pvt. Ltd.; Nov. 1982.
- 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.
- Essentials of Haematology; Shirish M. Kawthalkar; Jaypee Brothers.
- Williams Hematology; Kenneth Kaushansky, Marshall A. Lichtman, E. Beutler, Thomas J. Kipps, Josef Prchal, Uri Seligsohn.
- Essential Haematology; Victor Hoffbrand, Paul Moss, John Pettit.
- Rapid Review of Hematology; Ramadas Nayak; Jaypee Brothers.
- Precise Haematology; Usha Rusia, Meera Sikka, Renu Saxena; Wiley India.
- Short Textbook of Haematology; Shah B.S.; C.B.S. Publisher and Distributor.
- Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd., Kolkata; 1999.
- Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi; 1978.
- A Text book of Practical Physiology; First Edition; V.G. Ranade; A.V.G. Prakashan, Pune; 1968.
- The Vertebrate Body by Romer Alfred Sherwood
- Comparative Anatomy of the Vertebrates Paperback – 1 December 2000 by George C. Kent
- Chordate Zoology E. L. Jorden & P. S. Verma
- The Vertebrate Integument - Structure, Design and Function · Volume 2 Theagarten Lingham-Soliar · 2015
- Comparative Osteology: A Laboratory and Field Guide of Common North American Animals Bradley Adams, Pam Crabtree · 2011

Course Code	Major Specific IKS Sem- V	Credits	Lectures Per week
25ZOOIKS514	Ethnozoology	2	2
Preamble : After successful completion of this course, students are expected to: 1. Acquire knowledge to classify and identify different zoo-therapeutic techniques and how they are used in conventional medicine. 2. Analyse the role of animals in historical and contemporary contexts, including their depictions on flags, pillars, and religious texts. 3. Evaluate the ethical, environmental, and conservation issues surrounding ethnozoological methods. Course Outcomes: 1. Understand the origins, historical context, and importance of ethnozoology in human communities. 2. Explain the significance of animals in Indian customs, encompassing myths, symbols, and cherished convictions. 3. Analyse the therapeutic use of items derived from animals in both conventional and contemporary medicine. 4. Evaluate how ethnozoological methods affect the preservation of biodiversity and the wise use of resources.			
Unit	Topic	Credits	Lectures
I	Ethnozoology I 1. Definition and scope of Ethnozoology 2. Historical background and development of the discipline 3. Importance in understanding human-animal relationships 4. Methods of study in Ethnozoology (ethnographic fieldwork, interviews) 5. Traditional Animal Knowledge and Practices 6. Indigenous knowledge of animals and their uses 7. Domestication and management of animals in traditional societies 8. Medicinal and ritualistic uses of animals ▪ Folklore, myths, and legends related to animals 9. Ethnozoological practices in hunting and fishing		
II	Ethnozoology II 1. Human-Animal Relationships and Conservation .The role of animals in cultural identity and symbolism		

	2. Impact of human activities on animal populations (hunting, habitat destruction) Conservation ethics and sustainable practices in ethnozoology 3. Role in animal studies and biodiversity conservation ▪ Indigenous knowledge in wildlife conservation. 4. Applied Ethnozoology and Future Directions 5. Modern applications in agriculture, medicine, food, Decoration, Traction and Transport 6. Animals as indicator of Weather and Climate 7. Contemporary issues and challenges in Ethnozoology 8. Future trends and interdisciplinary approaches 9. Role of Ethnozoology in global conservation and policy-making.		
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References

- Goswamy, B. N. (2017). Indian Art: Animals in Indian Art. Roli Books.
- Gandhi, M. (2015). Animals in Indian Mythology. HarperCollins India.
 - Pattanaik, D. (2006). Myth = Mithya: Decoding Hindu Mythology. Penguin India.
 - Cort, J. E. (2000). Animals in Indian Literature and Tradition. Oxford University Press. Page 40 of 52
 - Harle, J. (1990). The Art and Architecture of Indian Temples. Cambridge University Press.
 - Joy, K. P. (2005). Sacred Invertebrates: A Cultural Perspective. Sarup& Sons.
 - Reade, E. G. (2011). Mythical Creatures and Real-Life Invertebrates in Indian Lore. Routledge India.
 - Doniger, W. (2009). The Hindus: An Alternative History. Penguin Books.
 - Shastri, A. M. (1996). The Ocean in Indian Mythology: Fish and Amphibians. MotilalBanarsidass.
 - Rosen, S. J. (2004). Holy Cow: The Hare Krishna Contribution to Vegetarianism and Animal Rights. Lantern Books.
 - Krishna, N. (2010). Sacred Animals of India. Penguin Books.
 - Kramrisch, S. (1981). The Presence of Shiva. Princeton University Press.
 - SainudeenPattazhy, An Introduction to Ethnozoology, Lambert Academic Publishing
 - Romulo RomeuNobrega Alves, Ulysses Paulino Albuquerque, Ethnozoology: Animals in Our Lives, Academic Press, 2017, ISBN 0128099143,9780128099148.

Course Code	Elective Sem V -Elective I	Credits	Lectures Per week
25ZOOEL531	Marine Biodiversity and Physical Oceanography	2	2

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1:-Analyze the diverse physical parameters and water movements of the marine environment, and **evaluate** their direct influence on the vertical and horizontal zonation of the sea and the adaptations of marine organisms.

CO2:-Differentiate between the major groups of marine life (plankton, nekton, and benthos) by **explaining** their

unique classifications and specialized adaptations for survival in various marine habitats, including intertidal and deep-sea environments.

CO3:-Assess the profound impact of significant oceanic and atmospheric climatic phenomena, such as monsoons, cyclones, and El Niño, on the physical characteristics of the ocean and the overall health and distribution of marine biodiversity.

CO4:-Evaluate the interconnectedness between physical oceanographic processes (e.g., density, currents, waves, tides) and the ecological distribution and survival strategies of marine organisms across different zones of the sea.

CO5:-Critique the adaptations of marine organisms, from microscopic plankton to deep-sea dwellers, in response to environmental stressors such as varying illumination, temperature, pressure, and water movements.

CO6:-Synthesize knowledge of marine biodiversity and physical oceanography to understand how global climatic changes influence marine ecosystems and the distribution patterns of marine life.

Unit	Topic	Lectures
I	Marine Biodiversity Unit 1: Zonation of the Sea and Marine Biodiversity 1.1 Zonation of the Sea –Vertical and Horizontal 1.2 a) Plankton classification and adaptations b) Nekton adaptations 1.3 Benthic adaptations (two examples of each group) a) Inter-tidal organisms (rocky, muddy & sandy shores) b) Deep sea organisms	15
II	Physical oceanography and ocean related climatic changes 2.1 Physical parameters of the sea a) Density b) Illumination c) Temperature d) Pressure 2.2 Influence of the following water movements in sea a) Currents – wind driven and thermohaline circulation	15

	b) Types of waves (including Tsunami) c) Tides 2.3 Influence of the following climatic phenomena a) Monsoon b) Cyclone (including Phyan) c) El Nino	
References:- 1. A Textbook of Marine Ecology – Nair, N.B. & Thumpty, D.H., the Macmillan Book Company of India Ltd. 2. Biology of intertidal animals - Newell, R.C., Lagos Press. 3. Crafts and Gear of India– Y. Shrikrishna & Latha Shenoy – ICAR Publication 4. Data site: data.gov.in. 5. Ecological Methods for Field and Laboratory Investigations – P.Michael. •Course Material in Fishing Technology – LathaShenoy, CIFE, Versova, Mumbai. 6. Elementary Statistics - Yule & Kendell, Charless Griffin & Co. London. 7. Fisheries Biology, Assessment and Management – Michael King – Fishing New Publishers, 1995. 8. Fisheries Bioeconomics – Theory, Modeling and Management – FAO Fisheries Technical Paper 368 – FAO, 2001. 9. Fish and Fisheries – Chandy, National Book Trust. 10. Financial Management – Prasanna Chandra, 7th Edition. 11. Financial Management – Khan & Jain. 12. Financial Management –I .M. Pandey. 13. Fish and fisheries of India, Jhingran J.S. Hindustan Publication. 14. Marine Fisheries of India – D.V. Bal and K.V. Rao, Tata McGraw – Hill Publishing Co.Ltd., New Delhi.		

Course Code	Elective Practical Sem - V -Elective Practical I	Credits	Lectures Per week
25ZOOELP51	Practicals based on Marine Biodiversity and Physical Oceanography	2	2

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: Identify and describe intertidal, coral, and deep-sea marine animals and their ecological adaptations.

CO2: Demonstrate the identification skills for major marine zooplanktons through microscopic observation.

CO3: Analyze the causes behind the decline of selected endangered marine species.

CO4: Operate and interpret the use of traditional fishing crafts and gear in marine environments.

CO5: Evaluate the ecological significance of coral reef fish species through habitat-based observations.

CO6: Create a photographic portfolio addressing marine science issues and document findings visually.

Unit	Topic		Credits	Lectures
	1.Ecological adaptations: Intertidal animals ● Porifera: Sponge (Sycon) ● Coelenterata: Sea anemone, Coral, Jelly fish ● Annelida: Nereis, Arenicola ● Arthropoda: Balanus, Hermit Crab ● Mollusca: Oyster, Mytilus, Sepia, Loligo, Teredo ● Echinodermata: Starfish, Sea urchin ● Coral fish: Clown Triggerfish, Queen Angelfish ● Deep Sea Animals: Solefish (Psettodes and Cynoglossus), Angler Fish 2.Study of zooplanktons: (Any ten) 3.Endangered marine species: Identification and reason for decline of Salmon, Sturgeon, Sea-lion, Seal and Whale 4. Photographic documentation of Marine Science related issues.Submission of soft & hard copy of 5 original photographs taken by the learner.			

References:-

1. A Textbook of Marine Ecology – Nair, N.B. & Thumpty, D.H., the Macmillan Book

Company of India Ltd.

2. Biology of intertidal animals - Newell, R.C., Lagos Press.

3. Ecological Methods for Field and Laboratory Investigations – P.Michael. •Course

Material in Fishing Technology – LathaShenoy, CIFE, Versova, Mumbai.

4. Fisheries Biology, Assessment and Management – Michael King – Fishing News Publishers, 1995.

5. Fisheries Bioeconomics – Theory, Modeling and Management – FAO Fisheries Technical Paper 368 – FAO, 2001.

6. Fish and Fisheries – Chandy, National Book Trust.

7. Fish and fisheries of India, Jhingran J.S. Hindustan Publication.

8. Marine Fisheries of India – D.V. Bal and K.V. Rao, Tata McGraw – Hill Publishing Co.Ltd., New Delhi.

Course Code	Elective Sem V -Elective II	Credits	Lectures per week
25ZOOEL532	Production and Management in Fisheries -I	2	2

Course Outcomes:-

Upon successful completion of this course, students will be able to:

CO1:-Analyze the commercial aquaculture techniques for significant species such as *Litopenaeus vannamei*, *Lates calcarifer*, and *Rachycentron canadum*, including specific culture systems like brackish water ponds, raceways, and cages.

CO2:-Evaluate the production methods and applications of various marine value-added products, including fish protein concentrate, oils, chitin, chitosan, and surimi, considering their economic and nutritional significance.

CO3:-Differentiate between the key requirements and challenges associated with the commercial culture of different marine species, such as shrimp, sea bass, and cobia.

CO4:-Describe the processes involved in creating a range of fish and prawn-based value-added products, including traditional items like pickles and chutneys, and modern innovations like imitation products and wafers.

CO5:-Apply knowledge of commercial aquaculture principles to identify suitable environments and technologies for the sustainable farming of selected marine species.

CO6:-Synthesize understanding of marine resource utilization to propose strategies for maximizing economic returns from aquaculture and by-products through value addition.

Unit	Topic	Lectures
I	Introduction to commercial culture 1.1 Brackish water aquaculture of <i>Litopenaeus vannamei</i> (Pacific White Shrimp)(Site - selection,Pond design and set-up,Seed selection and stocking,water quality and management,feed management,disease management,harvesting) 1.2 <i>Lates calcarifer</i> (Asian Sea Bass) culture in race ways.(Site - selection,Pond design and set-up,Seed selection and stocking,water quality and management,feed management,disease management,harvesting) 1.3 Cage farming of <i>Rachycentron canadum</i> (Cobia) (Site - selection,Pond design and set-up,Seed selection and stocking,water quality and management,feed management,disease management,harvesting)	15
II	Marine value added product 2.1 Sourcing and Quality control of Raw materials,Pre-processing and handling,Processing techniques for value addition,formulation and protocols,Packaging and labelling,Quality assurance and food safety,Marketing and Distribution of the following 1. Fish protein concentrate, 2. fish maws, 3. isinglass, 4. oils (body and liver), 5. chitin, 6. chitosan, 7. Fish/ Prawn pickle and chutney, 8. fish wafers, 9. Surimi , 10. imitation products.	15
References:- 1) Fish handling & Processing – Aitikin A: 2nd edition, min. Agr. Fish and Food U.K. 2) Fundamentals of Applied Statistics - Gupta S. C. & Kapoor V. K., Fourth edition, SultanChand & Sons. 3) Glimpses of the Indian Ocean – S.Z. Qasim, University Press (India Ltd. 1998). 4) Handbook Fish Biology and Fisheries, Ed. J.B. Hart & John Reynold. 5) History Of Marine Sciences in India – Dr. B.F. Chhapgar Centenary issue BNHS. 6) Introductory Oceanography – 8thEdn. Harold Thurman, Prentice Hall. 7) Introduction to Physics and Biological Oceanography, King C.A.H, ELBS Ltd. London 8) Marine Ecology – Tait. 9) Marine Fisheries of India – D.V. Bal and K.V. Rao, Tata McGraw – Hill Publishing Co.Ltd., New Delhi. 10) Modern Fishing Gear Technology – N. Shahul Hameed, Boopendranath – Daya Publishing House, 2000). 11) Marketing Management – Philip Kotler.		

Course Code	Elective Practical Sem V-Elective Practical -II	Credits	Lectures per week
25ZOOELP52	Practicals based on Production and management in Fisheries -I	2	2
Course Outcomes:- Upon successful completion of this course, students will be able to: CO1 (Remembering): Recall and identify various species of common edible marine fauna (fish, molluscs, and crustaceans) and molluscan shells based on morphological characteristics. CO2 (Understanding): Explain the concepts and importance of primary productivity and Biological Oxygen Demand (BOD) in assessing marine ecosystem health. CO3 (Applying): Demonstrate the procedure to estimate primary productivity and BOD in marine samples using standard methods. CO4 (Analyzing): Differentiate and analyze between various marine edible fauna and molluscan shells using taxonomic keys and physical features. CO5 (Evaluating): Assess the quality and usability of marine by-products such as fish oil, chitin, chitosan, and fish protein concentrate based on preparation techniques. CO6 (Creating): Design and prepare selected marine by-products from raw marine materials, demonstrating innovative use in food or industrial applications.			
Unit	Topic	Lectures	
	1. Estimation of primary productivity		
	2. Estimation of Biological Oxygen Demand (BOD)		
	3. Identification of Common edible marine fauna: a) Fish: Polynemus spp, Lates calcarifer, Pampus argenteus, Formio niger, Rastrelliger kanagurta, Cybium guttatum, Harpodon nehereus, Sardinella longiceps b) Molluscs: Oyster, Sepia, Loligo c) Crustaceans: Shrimp, Lobster, Crab		
	4. Identification of molluscan shells: Trochus, Umbo, Oliva, Conus, Conch shell, Telescopium, Mytilus, Donax, Katelaysia.		
	5. Preparation of Fish-Shellfish byproducts • Fish protein concentrate • Fish maws • Isinglass • Oils (body and liver) • Chitin • Chitosan		

References:-

- Fish handling & Processing – Aitkin A: 2nd edition, min. Agr. Fish and Food U.K.
- Glimpses of the Indian Ocean – S.Z. Qasim, University Press (India Ltd. 1998).
- Handbook Fish Biology and Fisheries, Ed. J.B. Hart & John Reynold.
- History Of Marine Sciences in India – Dr. B.F. Chhapgar Centenary issue BNHS.
- Introductory Oceanography – 8thEdn. Harold Thurman, Prentice Hall.
- Introduction to Physics and Biological Oceanography, King C.A.H, ELBS Ltd. London
- Marine Ecology – Tait.
- Marine Fisheries of India – D.V. Bal and K.V. Rao, Tata McGraw – Hill Publishing Co.Ltd., New Delhi.
- Modern Fishing Gear Technology – N. Shahul Hameed, Boopendranath – Daya Publishing House, 2000).
- Marketing Management – Philip Kotler.
- Official Website FAO and CIFT.

Course Code	Minor Sem - V	Credits	Lectures Per week
25ZOOMR 521	Applied Zoology - I (Parasitology & Medical Zoology)	2	2

Course Outcomes

After completion of this course students will be

CO1: Recall and list the classification, morphology, and life cycles of medically and veterinary important parasites.

CO2: Explain the host-parasite interactions, modes of transmission, and pathogenesis of common parasitic infections.

CO3: Demonstrate the ability to identify parasitic forms under the microscope and apply diagnostic techniques in laboratory settings.

CO4: Analyze parasitic epidemiological data to determine risk factors, transmission patterns, and control strategies.

Unit	Topic	Credits	Lectures
I	Introduction, Scope and Branches of Parasitology 1.1 Definition: Host, Parasite, Vector, Commensalisms, Mutualism and Parasitism. 1.2 Branches of Parasitology. 2. Types of Parasites and Hosts 2.1 Ectoparasites. 2.2 Endoparasites and its Subtypes. 2.3 Types of Hosts - Intermediate, Definitive, Paratenic and Reservoir.		15

	3. Host-Parasite Relationship 3.1 Host Specificity. 3.2 Types of Host Specificity: Structural Specificity, Physiological Specificity and Ecological Specificity. 3.3 Effects of Parasite on Host. 4. Study of Parasitic Protists 4.1 <u>Entamoeba histolytica</u> Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment. 4.2 <u>Plasmodium vivax</u> Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment. 5. Study of Parasitic Worms 5.1 <i>Ascaris lumbricoides</i> - Study of Morphology, Life Cycle, Prevalence. 5.2 Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment. 5.3 <i>Taenia solium</i> (Tapeworm) Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment. 6. Study of Parasitic Arthropoda Morphology, Pathogenicity and Control Measures of - 6.1 Soft tick. 6.2 Head Louse. 6.3 Rat Flea. 6.4 Bed Bug.		
II	Medical Zoology 1 Introduction of Medical zoology and its importance 2.1 Death and its Causes External Examination of Deceased Body - Internal Examination - Determination of Time since Death and Cause of Death. 2.2 Injuries-Classification - Medico-Legal Aspects of Injuries. 2.3 Post-Mortem Changes - Collection of Post-Mortem Samples and Preservation. 3. Urine Analysis 3.1 Physical Characteristics, Abnormal Constituents, Renal Failure, Renal Calculi, Dialysis. 4. Non-infectious Diseases		15

	4.1 Causes, Types, Symptoms, Complications, Diagnosis and Prevention of Diabetes (Type I and II), Hypertension, Hypotension, Obesity, Atherosclerosis, Myocardial Infarction. 5. Infectious Diseases 5.1 Causes, Types, Symptoms, Complications, Diagnosis and Prevention of Tuberculosis and Hepatitis.		
References - Parasitology by K.D. Chatterjee - Paniker's Textbook of Medical Parasitology C. K. Jayaram Paniker, 2013 - Medical Parasitology CP Baveja v Baveja - Textbook of protozoa parasitology Sajad Sarvar & Rashiba AP - Textbook Of medical parasitology Subhashchandra Parija - Robbins and Cotran Pathologic Basis of Disease" by Kumar, Abbas & Aster - Textbook of Pathology" by Harsh Mohan			

Course Code	Elective Practical Sem-V	Credits	Lectures Per week
25ZOOMRP 51	Practicals based on Applied Zoology - I	2	4
Course Outcomes : After completion of this course students will be CO1: Recall and list the classification, morphology, and life cycles of medically and veterinary important parasites. CO2: Explain the host-parasite interactions, modes of transmission, and pathogenesis of common parasitic infections. CO3: Demonstrate the ability to identify parasitic forms under the microscope and apply diagnostic techniques in laboratory settings. CO4: Analyze parasitic epidemiological data to determine risk factors, transmission patterns, and control strategies.			
	Topic	Credits	Lectures
1	To study Life cycle and pathogenicity, and preventive measures of <i>Plasmodium vivax</i> , <i>Leishmania major</i> , <i>Toxoplasma gondii</i> , <i>Entamoeba histolytica</i>		
2	To study Life cycle and pathogenicity, and preventive measures of <i>Ancylostoma duodenum</i> , <i>Taenia solium</i> , <i>Dracunculus medinensis</i> , <i>Ascaris lumbricoides</i>		
3	Study of ectoparasites : Head louse , Tick , Mites , Bedbug, Leech		

4	Mounting of Mouth parts of <i>Anopheles</i> and <i>Culex</i> mosquito		
5	To study vectors - Mosquitos , Tick , House fly ,TseTse Fly , Sand fly , Cats , Flea		
6	Study of Zoonotic diseases - Bird flue - Avian Influenza , Swine flu , Rabies , Ebola		
7	Study of Microbial diseases in human - TB, Hepatitis, AIDS , Candidiasis, African Sleeping Sickness, Amoebic dysentery		
8	To Detect Rheumatoid arthritis Antibody in the serum sample		
9	To study various Laboratory safety Symbols and Lab safety techniques		
10	To study Urine analysis - Normal and Abnormal constituents		
11	To study various methods of sterilization aseptic techniques		
12	To study various metabolic health ratios from the pathological reports HOMA- IR , Triglyceride- Glucose Index , Total Cholesterol : HDL, Total Cholesterol : LDL, HDL: LDL , Triglyceride: HDL and conversion of HbA1C to average blood glucose .		
13	Gram Staining of Bacteria		
14	To determine Haemoglobin content of the given blood sample by Sahli's Method		
15	Study of Biomedical Instrument : Introduction , Principle , Brief working of ECG, Ultrasound/ Sonography , PCR		
16	To study various investigations methods and treatments of human physiological disorders - Angiography , Angioplasty , Dialysis , Dexa scan , Biopsy		
References			

- Parasitology by K.D. Chatterjee
- Paniker's Textbook of Medical Parasitology C. K. Jayaram Paniker, 2013
- Medical Parasitology CP Baveja v Baveja
- Textbook of protozoa parasitology Sajad Sarvar & Rashiba AP
- Textbook Of medical parasitology Subhashchandra Parija
- Robbins and Cotran Pathologic Basis of Disease" by Kumar, Abbas & Aster
- Textbook of Pathology" by Harsh Mohan

Course Code	Vocational Skills Course (VSC) Sem-V	Credits			Lectures Per week
25ZOOVSC541	Instrumentation and Biostatistics	2			4

Preamble:

A practical course in instrumental techniques & biostatistics aims to equip students with the ability to apply statistical methods to analyze biological data, understand and interpret graphs, and utilize statistical tests as well as aims to equip students with principle behind working and construction, functions and application of various instrumentation techniques used to biological sciences

The course will equip students to communicate statistical ideas effectively and to learn & apply statistical software for biological data and conduct instruments- based experiments and practicals.

Course outcomes:

CO1: To Memorize key terms and concepts in biostatistics and instruments used in biological sciences.

CO2: To understand the key difference between various key concepts, terms, tests & methods of biostatistics. as well as the principle and working of various instruments used in biological sciences.

CO3: To Apply the knowledge gained to select specific statistical tests to given primary or secondary data to solve biological problems and to select and use experiment specific instrumental technique for biochemical analysis.

CO4: To calculate and analyze the results and data of instrumental analysis and draw conclusions and draft comments.

CO5: To evaluate the advantages and disadvantages or drawbacks of particular methods of statistical and instrumental analysis.

Unit	Topic				Lectures
I	Introduction to the instruments ● Microscope- Simple , compound , ● pH meter, ● Colorimeter, ● Centrifuge , ● Gel electrophoresis apparatus- Agarose Gel electrophoresis, Polyacrylamide Gel electrophoresis, ● Incubator, ● Autoclave 2. To determine the best filter for a given test solution using its absorption maximum. 3. To assess linear relation between optical density (absorbance) and concentration of chromogen. 4. Determine the pH of given samples using pH				

	paper, BDH indicator and pH meter 5. To study Titration curve of weak acid Vs Strong base 6. Demonstrate use of centrifuge for separation of DNA using soap salt solution 7. To study Thin layer chromatography of lipids 8. To study Central tendencies (mean, mode median) of given biological data				
	9. To represent the given biological data in the graphical form (Bar diagram- Simple , Multiple , Subdivided, Histogram , Pie chart) 10 Calculation of Mean and Standard Deviation 11. To test the goodness of fit of given ratio and association between two attributes using Chi Square test 12. Calculate correlation coefficient for given data 13. To test the difference between means of two small samples using paired t test and unpaired t test 14. To apply Z test to find the significant of difference between the means of two large samples				
References: 1. Methods in Biostatistics for Medical Students and Research Workers By B. K Mahajan 2. Introduction To Biostatistics And Research Methods 5Th Edition by P.S.S.Sundar Rao & j. Richard 3. Principles and practices of biostatistics Dr J. V. Dixit 4. An Introduction to Practical Biochemistry Plummer David T. 5. Biochemical Methods (Paperback, Sadasivam, S, Manickam, A 6. Bioinstrumentation By L. Veerakumari · 2021 7. Laboratory manual in Biochemistry J. Jayraman 8. Practical Biochemistry DR J S Kulkarni, DR R A Fursule, DR R A Maheshwari &, P J Agarkar					

Course Code	Field Project (FP)Sem - V	Credits	Lectures Per week
25ZOOF5	Field Project (FP)	2	4
General Guidelines 1. Each department should ensure collaborations/Tie-ups (in terms of MoU/LoI) with relevant academic institutions/industries/organizations etc. as per project requirements. 2. All the communication with the academic institutions/industries/organizations etc. should be done through the department. 3. Internal faculty should be allotted to the students or group of students for the evaluation of the project. 4. Departments should maintain the relevant documents (such as attendance records, proposals, diary, MoUs/LoI etc) and correspondence regarding Field project course.			

Field Project (FP):

Objectives: a) To provide practical experience in implementing research projects.

b) To assess students' ability to apply theoretical knowledge in real-world situations.

c) To develop skills in project management, teamwork, and communication. Course outcomes should be designed at departmental level in alignment with above course objectives

2 credits of Field Project comprises of the ways of implementing actual field engagement which needs to be determined by respective departments.

Evaluation Consists of Two Parts: Evaluate each student for 50 marks per semester at department level – - 20 marks for Continuous evaluation (CE) • Review of project work to be undertaken. • Progress report on project implementation. (Field diary) - 30 marks for End Semester Examination (ESE) • Project Report • Final presentation (PPT) of field project findings

Sem-VI			
Course Code	Major Sem -VI Paper I	Credits	Lectures Per week
25ZOOMJ611	Enzymology and Homeostasis	2	2
Course Outcomes : After completion of this course, Students will be able to CO1 : Memorise various enzymology and physiology terminologies and concepts CO2 : Understand Enzyme kinetics and enzyme inhibition, Thermoregulation and homeostasis concepts CO3 : Apply the knowledge of enzymes in food and detergent industry and other physiological processes. CO4 : Analyse how allosteric enzymes are regulated and how various animals give adaptive responses to changes in temperature			
Unit	Topic	Credits	Lectures

I	Enzymology 1.1: Introduction and Nomenclature: Definition; concept of activation energy; nomenclature and classification (based on IUB - Enzyme Commission) of enzymes; chemical nature of enzyme, co-factors and co-enzymes 1.2: Enzyme Action and Kinetics: Mechanism; Factors affecting enzyme activity - substrate, pH and temperature. Derivation of Michaelis-Menten equation and Lineweaver-Burk plot; Concept and significance of K_m, V_{max} and K_{cat} 1.3: Enzyme Inhibition: Competitive and non-competitive inhibitors and their kinetics; therapeutic applications of enzyme inhibitors 1.4: Regulation of Enzyme Activity: Allosteric regulation and regulation by covalent modification of enzymes; Isozymes (LDH) 1.5: Industrial applications of enzymes: Food and detergents		15
II	Homeostasis 2.1: Homeostasis 2.1.1: External and internal environment; Acclimation and acclimatization 2.1.2: Body clock - Circadian & Diurnal rhythm 2.2: Thermoregulation 2.2.1: Endothermy and ectothermy 2.2.2: Temperature balance: Heat production - shivering and non-shivering thermogenesis;		15

	brown fat, mechanisms of heat loss 2.2.3: Adaptive response to temperature - daily torpor, hibernation, aestivation 2.3: Osmotic and Ionic Regulation 2.3.1: Living in hypo-osmotic, hyper-osmotic and terrestrial environment - Water absorption, salt water ingestion and salt excretion, salt glands, metabolic water 2.3.2: Role of kidney in ionic regulation		
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References

- Lehninger Principles of Biochemistry 8th Edition by [David L. Nelson](#)
- Biochemistry- 2nd Ed. 2002 by U. Satyanarayan, Books and Allied Publ.
- Biochemistry- 2nd Ed. S.C. Rastogi, Tata McGraw Hill.
- Fundamentals of Biochemistry- 3rd Ed. 1988; J.I.Jain, S. Chand and Co. Publ.
- Biochemistry- a Functional Approach; MacGuliver
- [www.enzymesIndia.com](#)
- Biochemistry – by [Donald Voet](#) (Author) Judith voet and more
- Cell and molecular biology 8th ed- De Robertis E.D.P
- Comparative Animal Physiology; Knut Schmidt Nielson; Cambridge Press.
- Comparative Animal Physiology; Prosser and Brown.
- Comparative Animal Physiology; William S Hoar.
- Text book of Comparative Physiology; R Nagabhushanam, Ms Kodarkar, Sarojini R.
- India Book House Pvt. Ltd.
- Animal Physiology; N. Arumugam, A. Mariakuttikan; Saras Publication.

Course Code	Major Sem -VI	Credits	Lectures Per week
25ZOOMJ612	Molecular Biology I and II	2	2
Course Outcomes After completion of this course students will be CO1 . To memorise the basic terms of Central Dogma of Molecular biology CO2 : To understand the concepts of Transcription, Replication , Translation CO3 : To Apply knowledge of Gene regulations , point mutations in use of Recombinant DNA technology CO4 : To Analyse various DNA Sequence using Sanger's method and solve the many genetic code related problems.			
Unit	Topic	Credits	Lectures

I	Molecular Biology I 1. DNA as genetic material - Evidences (Griffith's , Avery et al, Harshey and Chase expert) , RNA as genetic material- Singer Conrad Expt - TMV 4 2. DNA Replication - Semi conservative Model (Messelson and Stahl Experiment), Basic mechanism of replication of prokaryotes 3. Transcription :Basic Mechanism of Transcription of Prokaryotes , RNA Polymerase enzyme in Prokaryotes 4. Translation - Genetic Code , Properties of Genetic Code , Basic mechanism of Translation in E Coli 5. Point mutations types - substitution, deletion and insertion mutations , trinucleotide repeat expansion		15
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II	Molecular biology - II 1. Prokaryotic Gene Regulation - Lac Operon 2. DNA Repair Mechanisms Photo Repair , Base excision Repair, Nucleotide excision Repair 3. Enzymes involved Recombinant DNA Technology : Introduction, nomenclature, Restriction Enzymes - Characteristics and Applications, DNA Ligase - T4 DNA Ligase 4. Cloning Vectors - Essential features of cloning vectors , Plasmid (PBR 322) , λ Phage 5. Cloning techniques -Cloning after restriction digestion - blunt and cohesive end, Creation of restriction sites, linkers , Cloning after Homopolymer tailing , cDNA synthesis (Reverse transcription), genomic and cDNA libraries 6. PCR techniques: Principle and Application 7. Sequencing techniques:, Sanger's method		15
References 1. Introduction to Molecular Biology; Peter Paoletta; Tata McGraw Hill; 2010. 2. Molecular Biology; David Freifelder; Narosa Publishing House; 2008. 3. Genetics; Robert Weaver and Philip Hedrick; McGraw Hill; 2001. 4. iGenetics - A Molecular Approach; Third Edition; Peter J. Russell; Pearson Education, Inc. (Benjamin Cummings), San Francisco; 2010. 5. Molecular Biology - Academic Cell Update; Update Edition; David Clark; Elsevier, Inc.; 2010. 6. Genetics; M.W. Farnsworth; Harper and Row Publishers, Inc., USA; 1978. 7. Principles of Genetics; Eighth Edition; Gardner, Simmons and Snustad; John Wiley and Sons (Asia) Pte. Ltd., Singapore; 2002. 8. The Science of Genetics - An Introduction to Heredity; Fourth Edition; George W. Burns; Macmillan Publishing Co., Inc., New York; 1980. 9. Molecular Biology - Bios Instant Notes; Fourth Edition; Alexander McLennan, Andy Bates, Phil Turner & Mike White; Garland Science; 2013. 10. https://www.ncbi.nlm.nih.gov/books/ 11. Current Protocols in Molecular Biology; Frederick M. Ausubel, Roger Brent, Robert E. 12. Kingston, David D. Moore, Seidman J. G., John A. Smith and Kevin Struhl; John Wiley & Son, Inc.; 2003.			

Course Code	Major Sem -VI	Credits	Lectures Per week
25ZOOMJ613	Environment and Wildlife Management	2	2
Course Outcomes CO1: Recall key concepts of ecology, biodiversity, and conservation strategies used in environmental and wildlife management. CO2: Explain the roles of ecosystems, habitats, and species interactions in maintaining ecological balance and wildlife health. CO3: Apply environmental laws, conservation techniques, and habitat management practices in case-based or field scenarios. CO4: Analyze the impact of human activities, climate change, and habitat fragmentation on wildlife populations and ecosystem sustainability.			
Unit	Topic	Credits	Lectures
I	Environment Management 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) 1.2: Exploitation and Modification of Natural Resources: Impact on climate, flora and fauna 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 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	2	15

	1.4.2: Watershed management: Definition, need and objectives, classification (mini, micro, mili, sub-watershed, macro-watershed), Watershed management practices: Contour, gully control, stone bunds. Growing greenery and integrated watershed approach (IWA). 1.4.3: Case study: Ice-stupa artificial glaciers by Sonam Wangchuk 1.4.4: Effluent treatment, recycling plants, control and treatment of sewage water. 1.5: Acts and Rules of Environment Management 1.5.1: Environment Protection Act - 1986, Air (Prevention and Control of Pollution) Act - 1981, Water (Prevention and Control of Pollution) Act - 1974 1.5.2: Hazardous Wastes (Management and Handling) Rules - 1989 1.5.3: EIA (Environmental Impact Assessment) 1.5.4: Role of Central and State Government (Pollution Control Board) and NGOs		
II	Wildlife Management 2.1: Habit, Habitat, Territory and Niche of Wild Animals: Herbivores, carnivores, solitary, social (flock, pod, community), pack and herd, types of habitats and territories, niche concept 2.2: Threats to Wildlife 2.2.1: Poaching and hunting, deforestation, encroachment, competition (intra-specific and inter-specific), overgrazing and climate change, diseases (zoonosis and reverse zoonosis) 2.2.2: Tourism and human animal conflict 2.3: Wildlife Conservation 2.3.1: Techniques and methods used for wildlife census: Aerial counts, camera trap, line transect census and track surveys, capture mark recapture method, wildlife radio telemetry 2.3.2: Forest management, policies and Acts: Harvesting Trees, Thinning harvest, Clearcut Harvest, Shelterwood harvest, Seed tree harvest, Group selection harvest, Single-tree	2	15

	selection harvest, Prescribed burning, Reforestation National Forest Policy (2018) The Indian Forest Act, 1927; Forest (Conservation) Act, 2023		
References ● Padhy, A. (2017). Wildlife Protection Act of India: A Critical Appraisal. Regal Publications, New Delhi. ● Environmental Law and Policy in India – by Shyam Divan & Armin Rosencranz ● Divan, S., & Rosencranz, A. (2001). Environmental Law and Policy in India (2nd ed.). ● Biodiversity in India – by T.C. Majupuria ● Majupuria, T.C. (2002). Biodiversity in India. White Lotus Press, New Delhi. ● Textbook of Environmental Science – by P.D. Sharma ● Fundamentals of Ecology – by E.P. Odum & Gary W. Barrett ● Environmental Studies: From Crisis to Cure – by R. Rajagopalan ● Forest Ecology and Environment – by G.P. Mishra ● Wildlife Ecology and Management – by B.B. Hosetti ● Groombridge, B. (Ed.). (1992). Global Biodiversity: Status of the Earth's Living Resources. Chapman & Hall, London. ● Principles of Conservation Biology – by Martha J. Groom, Gary K. Meffe, & C. Ronald Carroll			

Course Code	Major Sem - VI	Credits	Lectures Per week
25ZOOMJ614	Genetics & Epidemiology	2	2
Course Outcomes After completion of this course students will be CO1 . To memorise the basic terms of genetics and epidemiology , CO2 : To understand the concepts of Mendelian and Non Mendelian inheritance and learn about various viral, bacterial and parasitic diseases CO3 : To Apply knowledge of Chromosomal aberrations , transmission of microbial diseases and its effect on human health CO4 : To Analyse various Genetical Crosses and Disorders and Effect of many epidemic diseases and its how to prevent it.			
Unit	Topic	Credits	Lectures
I	Genetics 1. Mendelian Genetics- 1) Selection of Pea Plant 2) Mendelian Inheritance - Laws of Heredity and their practical applications (Monohybrid cross and Dihybrid cross) 3) Test Cross and back cross 2. Non Mendelian Genetics 1) Concept of Gene Interaction	2	15

	2) Dominance and Co dominance , Incomplete dominance 3) Lethal genes in <i>Mus musculus</i> 3. Multiple Alleles 1) Concept and Characteristics 2) ABO Blood group System 3) Inheritance of Rh Antigen , Erythroblastosis foetalis 4. Chromosomes 1) Introduction : Morphology and types of chromosomes (based on position of Centromere and involvement in Sex Determination) 2) Chromatin , its structure and its types (Euchromatic and Heterochromatin) 3) Chromosomal Aberrations : Structural (Deletion , Duplication , Inversion , translocation) and Numerical (Euploidy, Polyploidy , Anueploidy - Monosomy, Nullisomy , Trisomy) 5. Sex Determination 1) XX - XY method, 2) XX- XO Method , 3) ZZ- ZW Method, Genetic Balance in Drosophila 6. Sex Inheritance 1) X linked 2) Y linked 3) XY linked 4) Examples of Sex Linked Inheritance : Haemophilia, Colour blindness and Hypertrichosis. 7. Extrachromosomal inheritance : Mitochondrial inheritance and its example		
II	Epidemiology 1.Introduction to Epidemiology Definitions : Parasitology , Host , Parasite , Vectors , 2.Dynamics of disease transmission : Reservoir, route of transmission, incubation. 3.Prevention and control of communicable diseases- Notification, isolation, quarantine, disinfection; concurrent, terminal, precurrent/ prophylactic methods of disinfection: natural, physical, chemical, immunization; general measures, health education in India. 4. Epidemiology of communicable diseases: Diagnosis, transmission, prevention, control measures and treatment of 1) Diseases of viral origin- Rabies, Dengue, Covid, Chickanguniya 2) Diseases of bacterial origin- TB, leprosy, Leptospirosis. 3) Diseases of parasitic origin- Malaria, Ascariasis, Taenia solium.	2	15
References 1. Genetics - The continuity of life; Daniel Fairbanks and Ralph Andersen; Brooks/ Cole Publishing Company; 1999. 2. Introduction to Molecular Biology; Peter Paoella; Tata McGraw Hill; 2010. 3. Molecular Biology; David Freifelder; Narosa Publishing House; 2008.			

4. Genetics; Robert Weaver and Philip Hedrick; McGraw Hill; 2001.
5. iGenetics - A Molecular Approach; Third Edition; Peter J. Russell; Pearson Education, Inc. (Benjamin Cummings), San Francisco; 2010.
6. Molecular Biology - Academic Cell Update; Update Edition; David Clark; Elsevier, Inc.; 2010.
7. Genetics; M.W. Farnsworth; Harper and Row Publishers, Inc., USA; 1978.
8. Principles of Genetics; Eighth Edition; Gardner, Simmons and Snustad; John Wiley and Sons (Asia) Pte. Ltd., Singapore; 2002.
9. The Science of Genetics - An Introduction to Heredity; Fourth Edition; George W. Burns; Macmillan Publishing Co., Inc., New York; 1980.
10. Parasitology- Chatterjee K.D., Chatterjee Medical Publishers.
11. Medical Parasitology- Arora
12. Textbook of Medical Parasitology-.C.K Jayaram Paniker, Jaypee Brothers.
13. Text book of Parasitology- Kochhar S.K. Dominant Pub.& Dis, New Delhi.
14. Essentials of Parasitology- Gerald D. Schmidt: Universal Bookstall, New Delhi.
15. Introduction to Parasitology- Sharma P.N.and Ratnu L.S., Chand S & Co.Pvt.Ltd.
16. Introduction to Parasitology- Chandler and Read John Wiley & Sons

Course Code	Major Practical Sem-VI	Credits	Lectures Per week
25ZOOMJP61	Practicals based Enzymology & Homeostasis ,Molecular Biology I and II, Environment and Wildlife management,Epidemiology	2	4

Course Outcomes

After completion of this course students will be

CO1 . To memorise the concepts and background informations of various experiments like enzymatic reactions, DNA RNA separation

CO2 : To understand how bioinformatics tools can be used for nucleotide and protein sequence comparison

CO3 : To Apply knowledge of various epidemic diseases wrt to precautionary measures and prevention of its spread in community

CO4 : To Analyse various karyotypes with reference to structural and numerical aberration and its phenotypic effects.

Unit	Topic	Credits	Lectures
1	1. Effect of varying pH on activity of enzyme Acid Phosphatase. 2. Effect of substrate variation on the activity of enzyme Acid Phosphatase 3. Quantitative Estimation of RNA by Orcinol method. 4. Quantitative Estimation of DNA by Diphenylamine method. 5. Separation of Genomic DNA by Agarose gel electrophoresis.Problems based on molecular biology 6. Problems based on Restriction endonucleases. 7. Problems based on genetics , pedigree 8. Karyotype (Idiogram) analysis for the following syndromes with comments on numerical and / or		

	structural variations in chromosomes (no cutting of chromosomes): - Turner's syndrome - Klinefelter's syndrome - Down's syndrome - Cri-du-chat syndrome - D-G translocation - Edward's syndrome - Patau's syndrome - Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells. - Explore BLAST for nucleotide sequence comparison - Explore the databases (Nucleotide, Protein) at NCBI for querying a nucleotide or protein sequence. - Exploring bibliographic database PubMed for downloading a research paper on subject of interest with the use of operators. - Estimation of BOD / COD / Nitrates / acidity and alkalinity from sample water.. - To study epidemic diseases in human - Viral Diseases Influenza, Swineflue , Herpes Zoster - Bacterial Disease : Typhoid , cholera - Parasitic Disease : Leishmaniasis , Toxoplasmosis, Dracunculosis, Filariasis - 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		
	References: - Padhy, A. (2017). Wildlife Protection Act of India: A Critical Appraisal. Regal Publications, New Delhi. - Environmental Law and Policy in India – by Shyam Divan & Armin Rosencranz - Divan, S., & Rosencranz, A. (2001). Environmental Law and Policy in India (2nd ed.).		

	• Biodiversity in India – by T.C. Majupuria • Majupuria, T.C. (2002). Biodiversity in India. White Lotus Press, New Delhi. • Textbook of Environmental Science – by P.D. Sharma • Fundamentals of Ecology – by E.P. Odum & Gary W. Barrett • Environmental Studies: From Crisis to Cure – by R. Rajagopalan • Forest Ecology and Environment – by G.P. Mishra • Wildlife Ecology and Management – by B.B. Hosetti • Groombridge, B. (Ed.). (1992). Global Biodiversity: Status of the Earth's Living Resources. Chapman & Hall, London. • Principles of Conservation Biology – by Martha J. Groom, Gary K. Meffe, & C. Ronald Carroll • Introduction to Molecular Biology; Peter Paoletta; 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.		

Course Code	Elective Sem-VI	Credits	Lectures Per week
25ZOOEL631	Chemical Oceanography and Oceanographic Instruments	2	2
Course Outcomes Upon successful completion of this course, students will be able to: CO1:-Explain the critical role of key chemical parameters such as salinity, pH, dissolved oxygen, and carbon dioxide in characterizing the marine environment and supporting marine life. CO2:-Describe the biogeochemical cycles of essential nutrients (nitrates, phosphates, silicates) and the significance of dissolved organic matter within the ocean, relating them to marine productivity. CO3:-Identify and compare the various instruments employed for collecting marine biological samples, including water samplers, benthic grabs, corers, and different types of plankton nets, detailing their specific applications. CO4:-Analyze the operational principles and practical uses of instruments designed for measuring physical oceanographic parameters such as temperature (reversing thermometers), currents (current meters), light penetration (Secchi disc), depth (echosounder), waves (wave recorder), and the integrated CTD system. CO5:-Evaluate the effectiveness and limitations of modern fish-finding technologies, including GPS, SONAR, remote sensing, and satellite oceanography, for their application in fisheries management and marine research. CO6:-Synthesize knowledge of marine chemical properties with the appropriate selection and application of oceanographic instrumentation to design basic sampling strategies for a specific marine research objective.			
Unit	Topic	Lectures	

I	Chemical Oceanography 1.1 Parameters of the sea water a) Salinity b) pH c) Dissolved gases (oxygen and carbon dioxide) 1.2 Nutrients in sea water a) Minor constituents (nitrates, phosphates and silicates) b) Dissolved organic matter	
II	Oceanographic instruments 2.1 Instruments used for marine biological sampling a) Niskin water samplers b) Dredge and Petersen Grab c) Corer d) Plankton net (Typical plankton net, Hensen net & Indian Ocean standard net) 2.2 Instruments used for measurement of physical factors a) Protected and unprotected reversing thermometer b) Current meter c) Secchi disc d) Echosounder e) Wave recorder f) CTD (Conductivity, temperature and depth) 2.3 Introduction to fish finding equipments and methods a) GPS b) SONAR	

	c) Remote sensing and satellite oceanography	
References:- 1) History Of Marine Sciences in India – Dr. B.F. Chhapgar Centenary issue BNHS. 2) Introductory Oceanography – 8thEdn. Harold Thurman, Prentice Hall. 3) Introduction to Physics and Biological Oceanography, King C.A.H, ELBS Ltd. London 4) Marine Ecology – Tait. 5) Marine Fisheries of India – D.V. Bal and K.V. Rao, Tata McGraw – Hill Publishing Co.Ltd., New Delhi. 6) Modern Fishing Gear Technology – N. Shahul Hameed, Boopendranath – Daya Publishing House, 2000). 7) Operations Research Theory and Application, Third edition, Sharma J. K.: Macmillan India Ltd. 8) Pollution and Toxicology, Venugopalan, V.K.: CAS in Marine Biology. 9) Project Management – Prasanna Chandra. 10) Refrigeration by Arora. 11) Textbook of Marine Pollution - Prakesh P. 12) The Oceans – Svedrup, H.V. et al, Asian Publishing House.		

Course Code	Elective Practical Sem VI-Elective I	Credits	Lectures per week
25ZOOELP61	Practicals based on Chemical Oceanography and Oceanographic Instruments	2	4
Course Outcomes Upon successful completion of this course, students will be able to:- 1. CO1 – Recall and describe the principles and procedures of chemical analysis of seawater including silicate, phosphate, pH, and salinity estimations. 2. CO2 – Explain the working principles and applications of oceanographic instruments such as Niskin Sampler, Van Veen Grab, Reversing Thermometer, etc. 3. CO3 – Determine the pH and salinity of a given water sample using standard laboratory techniques. 4. CO4 – Analyze the data obtained from oceanographic instruments and interpret results relevant to marine environmental conditions. 5. CO5 – Evaluate the efficiency and suitability of different traditional crafts and fishing gear in various oceanographic conditions. 6. CO6 – Design and conduct a basic sampling and data collection plan using appropriate oceanographic instruments for a selected marine study area.			
	1.Chemical Analysis of sea water: Silicates		
	2.Chemical Analysis of sea water: Phosphate		
	3.Estimation of pH from a given water sample.		
	4.Estimation of Salinity from given water sample.		
	5.Study of oceanographic instruments: ● Niskin Water Sampler		

	• Van-Veen Grab • Reversing Thermometer • Current Meter • Secchi Disc • Standard Plankton Net • Echosounder • Corer		
	6. Identification and operation of traditional crafts and gear.		
References:- 1. Duxbury, A.C., & Duxbury, A.B. (2002). An Introduction to the World's Oceans. McGraw-Hill Education. 2. Open University Course Team. (1989). Seawater: Its Composition, Properties and Behaviour. Pergamon Press. 3. CMFRI (2006). Handbook on Fishing Gear and Craft. Central Marine Fisheries Research Institute, Kochi. 4. Bal, D.V., & Rao, K.V. (1990). Marine Fisheries. Tata McGraw-Hill, New Delhi. 5. Jhingran, V.G. (1991). Fish and Fisheries of India (3rd ed.). Hindustan Publishing Corporation, Delhi. 6. History Of Marine Sciences in India – Dr. B.F. Chhapgar Centenary issue BNHS. 7. Introductory Oceanography – 8th Edn. Harold Thurman, Prentice Hall. 8. Introduction to Physics and Biological Oceanography, King C.A.H, ELBS Ltd. London 9. Marine Ecology – Tait. 10. Marine Fisheries of India – D.V. Bal and K.V. Rao, Tata McGraw – Hill Publishing Co.Ltd., New Delhi. 11. Modern Fishing Gear Technology – N. Shahul Hameed, Boopendranath – Daya Publishing House, 2000). 12. Operations Research Theory and Application, Third edition, Sharma J. K.: Macmillan India Ltd. 13. Pollution and Toxicology, Venugopalan, V.K.: CAS in Marine Biology. 14. Project Management – Prasanna Chandra. 15. Textbook of Marine Pollution - Prakesh P. 16. The Oceans – Svedrup, H.V. et al, Asian Publishing House.			

Course Code	Elective Sem VI-Elective -II	Credits	Lectures per week
25ZOO EL632	Production and Management in Fisheries -II	2	2
Course outcomes:- Upon successful completion of this course, students will be able to: CO1:-Evaluate various methods (organoleptic, microbial, chemical) for assessing the freshness and quality of fish and prawn, and explain the underlying mechanisms of spoilage (hyperemia, rigor mortis, autolysis, rancidity) CO2:-Analyze the principles and applications of different fish and prawn preservation techniques, including icing, drying, salting, canning, pickling, and freezing. CO3:-Identify and classify major fish diseases based on their causative agents, including protozoans, bacteria, fungi, worms, and crustaceans, and describe common non-parasitic diseases and fish tumors. CO4:-Correlate the symptoms of specific fish diseases with their causative agents and recommend appropriate treatment strategies for infected aquaculture stocks.			

CO5:-Develop prevention strategies for fish diseases, incorporating techniques such as crop rotation, the use of immunostimulants, and genetic improvement in aquaculture practices.
CO6:-Synthesize knowledge of seafood quality control and preservation with an understanding of fish pathology to ensure the production of healthy, high-quality fish and prawn products for consumption.

Unit	Topic	Credits	Lectures
I	Introduction to quality control, preservation and processing 1.1 Methods of evaluating freshness and quality of fish and prawn. (Organoleptic, Microbial and Chemical) 1.2 Mechanisms of spoilage (Hyperemia, rigor mortis, Autolysis, Rancidity) 1.3 Methods of preservation– Icing, Drying, Salting, Canning, Pickling, Freezing	2	15
II	Fish pathology 2.1 Fish diseases caused by: a) Protozoan b) Bacteria c) Fungi d) Worms e) Crustaceans f) Non parasitic diseases g) Fish tumour 2.2 Symptoms and Treatment of the above Diseases 2.3 Prevention techniques: Crop Rotation, Immune Stimulants, Genetic Improvement	2	15

References:-

1. Prawn and Prawn Fisheries – Kurian & Sebastian.
2. Handbook Fish Biology and Fisheries, Ed. J.B. Hart & John Reynold.
3. Fisheries Bioeconomics – Theory, Modeling and Management – FAO Fisheries Technical Paper 368 – FAO, 2001.
4. Text book of fish biology and Indian Fisheries by Dr. R.P. Parihar, Central Publication House, Allhabad.
5. Project Management – Prasanna Chandra.
6. Refrigeration by Arora

Cours e Code	Elective Practical Sem- VI	Credits	Lectures Per week
25ZO OEL P62	Practicals based on Production and Management-II	2	4

Course Outcomes

Upon successful completion of this course, students will be able to:

1. **CO1** – Explain the correlation between jaw and gill structures and the feeding habits of different fish species.
2. **CO2** – Identify common marine algae such as Ulva, Sargassum, Padina, Fucus, Polysiphonia, and Laminaria using morphological features.
3. **CO3** – Recognize and classify common fish diseases from photographs or specimens based on pathological symptoms.

4. **CO4** – Analyze foraminifera shell morphology for species identification and ecological interpretation.
5. **CO5** – Evaluate and document the functioning and contribution of fishery-related organizations or industries through field visits and interaction.
6. **CO6** – Design and develop a project-based study on a selected fisheries or marine biology topic and compile a well-structured group report.

Unit	Topic	Credits	Lectures
	- Determining feeding habits of fish from jaws and gills. - Identification of common marine algae: Ulva, Sargassum, Padina, Fucus, Polysiphonia, Laminaria. - Fish diseases: Identification from photograph / specimen. - Identification of foraminiferan shells - Visit to any of the research institutes, fishery industry, landing centres, boat building industry, research vessel, fish market, fishery co-operative societies, funding agencies office and processing units and submission of report. - Project and submission of report (Project report may be submitted in a group not exceeding three students).	2	

References:-

- Gopakumar, K. (2002). Textbook of Fish Processing Technology. Indian Council of Agricultural Research, New Delhi.
- Srivastava, C.B.L., & Sinha, P.R. (2007). Fish Pathology. Narendra Publishing House, New Delhi.
- Roberts, R.J. (2012). Fish Pathology (4th ed.). Wiley-Blackwell.
- Balachandran, K.K. (2001). Post Harvest Technology of Fish and Fish Products. Daya Publishing House, Delhi.
- Mishra, A., & Saksena, D.N. (2003). Fish and Fisheries of India. Pointer Publishers, Jaipur
- Handbook Fish Biology and Fisheries, Ed. J.B. Hart & John Reynold.
- Fisheries Bioeconomics – Theory, Modeling and Management – FAO Fisheries Technical Paper 368 – FAO, 2001.
- Text book of fish biology and Indian Fisheries by Dr. R.P. Parihar, Central Publication House, Allhabad.
- Project Management – Prasanna Chandra.
- Krishnamurthy, V. (2000). Taxonomy of Algae. Affiliated East-West Press Pvt. Ltd., New Delhi.
- Rao, K.S. (1988). Marine Algae of the Indian Coast. Indian Council of Agricultural Research (ICAR), New Delhi.
- Jhingran, V.G. (1991). Fish and Fisheries of India (3rd ed.). Hindustan Publishing Corporation, Delhi.
- Lagler, K.F., Bardach, J.E., & Miller, R.R. (2007). Ichthyology. CBS Publishers & Distributors, New Delhi.
- Santhanam, R., & John, K.R. (1985). A Manual of Marine Fishes of India. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Course Code	Minor Sem - VI	Credits	Lectures Per week
25ZOO MR621	Applied Zoology - II - Dairy Science & Fishery	2	2
Course Outcomes After completion of this course students will be			

CO1 . To memorise the basic terms of dairy science , fisheries

CO2 : To understand the concepts of various aquaculture and dairy science field practises

CO3 : To Apply knowledge of dairy science and fishery to get self employment in allied field

CO4 : To Analyse differences between quality of Milk of Cow and Buffalo , commercial important fisheries and byproducts

Unit	Topic	Credits	Lectures
I	Dairy Science 1. Indian Cattle breeds - Origin , Distribution , Distinguishing characters and economic uses - Malvi, Haryana, Deoni, Red Sindhi, Khillari 2. Exotic Breeds : Origin , Distribution , Distinguishing Characters , Economic uses - Jersey , Holstein , Nagpuri, Bhadawari, Murrah, Jafrabadi 3. Systems of inbreeding and crossbreeding 4. Maintenance of dairy farm 5. Weaning of calf, castration and dehorning 6. Diseases and control 7. Dairy development in India Role of dairy development in rural economy, employment opportunities 8. Dairy Processing Filtration, cooling, chilling, clarification, pasteurization, freezing 9. Milk and milk products Composition of milk Types of milk: A. Buffalo milk and B. Cow milk (A1 and A2) Whole milk and toned milk Milk products	2	15
II	Fisheries 2.1 Introduction 2.2 Types of Inland (Fresh Water Fisheries) and 2.3 Marine Fisheries: Coastal, Offshore and Deep Sea Fisheries Coastal ,Offshore and Deep-Sea Fisheries, Estuarine Fisheries (Brackish Water Fisheries) 2.4 Habit, Habitat and Cultural Methods of Selected Fresh Water Forms - <i>Labeo Rohita, Catla Catla, Cirrhina Mrigala</i> 2.5 Fish Farm : Culture Methods 2.6 Harvesting of Some Marine Forms <i>Harpodon Nehereus ,Rastrelliger Kanagurta</i> (Indian Mackerel), Pearl	2	15

	Oysters 2.7 Crafts and Gears in Indian Fishery -Catamaran Craft , Machwa Boats ,Dinghi 2.8 Principal Fishing Gears Dol Net , Purse Net , Rampani Net, Cast Net , 2.9Fishery Byproducts , Fish Meal , Fish Flour Liver Oil , Ising Glass, Fish Glue , Fish Manure ,Fish Fin Soup ,Ladies Purse 2.10Fish Preservation - Causes of Spoilage of Fish 2.11Fish Preservation Techniques		
References • Candler, W., & Kumar, N. (1998). India: The dairy revolution: The impact of dairy development in India and the World Bank's contribution. World Bank Publications. • Park, Y. W., &Haenlein, G. F. (Eds.). (2013). Milk and dairy products in human nutrition: production, composition and health. John Wiley & Sons. • Venkatasubramanian, V., Singh, A. K., &Rao, S. V. N. (2003). Dairy development in India: An appraisal of challenges and achievements. Concept Publishing Company. • Shrivastava, J. S. M. (2008). Dairy Development In The New Millennium (The Second White Revolution). Deep and Deep Publications. • Course Manual in Fishing Technology by LathaShenoy, CIFE, Versova, Mumbai. • Prawn and Prawn Fisheries by Kurian and Sebastian • Freshwater Aquaculture R.k. rathy Scientific publication • A text book of fish biology and fisheries Khanna&singh Narendra Publication • Handbook of fisheries and aquaculture Yadav ICAR • Fish processing technology Gopakumar ICAR • Coldwater fisheries of india V.g. jhingran ICAR • Practical course manual fishery and gear • Technology Lathashenoy, y CIFE, Mumbai • Fundamental of fish taxonomy Jayaram, KC Narendra			

Course Code	Minor Practical Sem- II	Credits	Lectures Per week
25ZOOMRP61	Practical based on Applied Zoology - II - Dairy Science & Fishery	2	4
Course Outcomes After completion of this course students will be CO1 . To memorise the basic terms of dairy science and Fisheries CO2 : To understand the identification of different indian and exotic cattle breeds, and fresh water and marine fish fauna CO3 : To Apply knowledge of making various dairy products and fish products and be an entrepreneur in allied field. CO4 : To Analyse quality of milk by MBRT method, density method and fish preservation and its commercial value			
Unit	Topic	Credits	Lectures
	1. Identification of Indian Cattle breeds – Origin, distribution, distinguishing characters and		

	economic uses; Malvi,Hariyana,Deoni.Red sindhi Khillari 1. Identification of Indian buffalo breeds - Origin, distribution, distinguishing characters and economic uses; Nagpuri,Bhadawari, Murrah ,Jafrabadi 2. Identification of Exotic breeds - Origin, distribution, distinguishing characters and economic uses; Jersey Holstein 3. Extraction of casein from milk and its qualitative estimation 4. Comparison of protein content from cow and buffalo milk 5. Comparison of fat content from cow and buffalo milk 6. To determine quality milk by Methylene blue reduction test 7. To do qualitative test for adulteration of milk 8. Preparation of paneer from given milk sample 9. Preparation of caramel custard /Kharvas 10. Measurement of density of milk using different samples by Lactometer 11. Visit to dairy farm /aquaculture and submit report of the same. 12. To measure ova diameter of Fish 13. Mounting of scales of Fish - Cycloid, ctenoid and Placoid scales. 14. Identification of Fresh water fish - Rohu, Catla , Mrigal , Tilapia, Catfish 15. Identification of Marine Fish and its economic importance - Mackerel , Bombay Duck , Pomfret and its types , 16. Study of Crustacean fishery - Prawn/ Shrimp. Crab Lobster , Edible oyster 17. Visit to fish landing center - CIFE, CMFRI		
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References

- Course Manual in Fishing Technology by LathaShenoy, CIFE, Versova, Mumbai.
- Prawn and Prawn Fisheries by Kurian and Sebastian
- Freshwater Aquaculture R.k. rathy Scientific publication
- A text book of fish biology and fisheries Khanna&singh Narendra Publication
- Handbook of fisheries and aquaculture Yadav ICAR
- Fish processing technology Gopakumar ICAR
- Coldwater fisheries of india V.g. jhingran ICAR
- Practical course manual fishery and gear
- Technology Lathashenoy, y CIFE, Mumbai
- Fundamental of fish taxonomy Jayaram, KC Narendra

Course Code	OJT Sem- VI	Credits	Lectures Per week
25ZO0OJT6		4	8
Course Outcomes 1. After successful completion of this course, students are expected to: • 2. Get actual work experience with office and virtual exposure to various management styles, technical, industrial, and procedural systems • 3. Acquaint the knowledge related to working hours, work protocols and guidelines Understand the roles and responsibilities of employee as well as team work.j 4. Justify job experiences that match their potentials, skills, and competencies Internship: Internship An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills. On the job training On the job training is a form of training provided at the workplace. During the training, employees are familiarized with the working environment they will become part of. Employees also get a hands-on experience using machinery, equipment, tools, materials, etc. Internship An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills. On the job training On the job training is a form of training provided at the workplace. During the training, employees are familiarized with the working environment they will become part of. Employees also get a hands-on experience using machinery, equipment, tools, materials, etc. Internal Evaluation Criteria for Students by the Mentor: 1. Quality of Work (10 marks): How well did the student perform their assigned tasks during the Internship / OJT? Evaluate the accuracy, thoroughness, and attention to detail in their work. 2. Initiative and Proactiveness (10 marks): Did the student show initiative in taking on additional responsibilities or tasks beyond their assigned role? Did they demonstrate a proactive attitude towards problem-solving? 3. Communication Skills (10 marks): Assess the student's ability to communicate effectively with colleagues, superiors, and clients (if applicable). Consider both written and verbal communication. 4. Problem-Solving Skills and Time Management (10 marks): Evaluate the student's ability to analyze problems, propose solutions, and implement effective strategies to overcome challenges. How well did the student manage their time during the Internship / OJT? Were they able to meet project deadlines and handle multiple tasks efficiently? External Evaluation Criteria for Students by the Supervisor and Mentor: 1. Student Diary (15 marks): Review the student's diary to understand their reflections, insights gained, and self-assessment of their performance during the Internship / OJT. 2. Final Report (15 marks): Evaluate the quality and comprehensiveness of the student's final report, including the clarity of their achievements and contributions. 3. Presentation of Student in Viva Voce (30 marks): Evaluate the responses given by the student to the questions asked by the faculty in the Viva Voce. Evaluation Criteria for Final Viva Voce: 1. Presentation Skills 2. Knowledge of the Internship / OJT Project 3. Practical Application and Work Experience 4. Problem-Solving and Critical Thinking 5. Communication and Professionalism			
*Note - The practicals may be conducted by using specimens authorized by the wild			

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

N.B:

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

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

1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and

2) A Dissection Monitoring Committee (DMC) to ensure that no dissections are done.

Composition of DMC shall be as follows:

i) Head of the Concerned Department (Convener / Chairperson)

ii) Two Senior Faculty Members of the concerned Department

iii) One Faculty of related department from the same College

iv) One or two members of related department from neighbouring colleges.

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

Evaluation Scheme for Third Year (UG) under NEP (2 credits)

I. Internal Evaluation for Theory Courses – 20 Marks

1) Continuous Internal Assessment(CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

2) Continuous Internal Assessment(CIA) ONLINE Unit Test – 10 marks

II. External Examination for Theory Courses – 30 Marks

Duration: 1 Hours

Theory question paper pattern: All questions are compulsory.

Question	Based on	Marks
Q.1	Unit I	15
Q.2	Unit II	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

III. Practical Examination

- Each core subject carries 50 Marks.
- Duration: 2 Hours for each practical course.
- Minimum 80% practical from each core subjects are required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam

NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.