



गोंय विद्यापीठ

ताळगांव पठार

गोंय - ४०३ २०६

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(Accredited by NAAC)

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GU/Acad –PG/BoS -NEP/2023/102/37

Date: 16.06.2023

CIRCULAR

The University has decided to implement the UGC Curriculum and Credit Framework for the Undergraduate Programme (CCFUP) of **Bachelor of Science in Zoology/Bachelor of Science in Zoology (Honours)** under the National Education Policy (NEP) 2020 from the Academic Year 2023-2024 onwards.

The approved Syllabus of Semesters I and II of the **Bachelor of Science in Zoology/Bachelor of Science in Zoology (Honours)** Programme is attached.

Principals of Affiliated Colleges offering the **Bachelor of Science in Zoology/Bachelor of Science in Zoology (Honours)** Programme are requested to take note of the above and bring the contents of this Circular to the notice of all concerned.

(Ashwin Lawande)

Assistant Registrar – Academic-PG

To,

1. The Principals of Affiliated Colleges offering the Bachelor of Science in Zoology /Bachelor of Science in Zoology (Honours) Programme.

Copy to:

1. The Director, Directorate of Higher Education, Govt. of Goa.
2. The Dean, School of Biological Sciences and Biotechnology, Goa University.
3. The Vice-Deans, School of Biological Sciences and Biotechnology, Goa University.
4. The Chairperson, BOS in Zoology.
5. The Controller of Examinations, Goa University.
6. The Assistant Registrar, UG Examinations, Goa University.
7. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

Goa University

Programme Structure for Semester I to VIII Under Graduate Programme - Zoology

Semester	Major -Core	Minor	MC	AEC	SEC	I	D	VAC	Total Credits	Exit
I	ZOO-100 Amazing World of Animals (4)	ZOO-111 Understanding Applications of Zoology (4)	ZOO-131- Food, Nutrition and Health (3) OR ZOO-132- Environmental Health (3)		ZOO-141- Skill for Zoologists (3) (1T+2P) OR ZOO-142- Vermitechnology (3) (1T+2P)				20	
II		ZOO-112 Understanding Applications of Zoology (4)	ZOO-133 - Public Health and Hygiene (3) OR ZOO-134 - Environmental Ethics (3)		ZOO-143 - Aquarium Fish Keeping (3) (1T+2P) OR ZOO-144 - Value Addes Fish Products (3)(1T+2P)				20	ZOO-161 - Dairy Technology (4)
III	ZOO-200 - Biology of Non-Chordates (4) ZOO-201 - Cell Biology and Genetics (4)	ZOO-211 - Vector Borne Diseases (4)	ZOO-231 - Emergency and standard First Aid (3) OR Pet Care (3)		ZOO-241 - Useful and Destructive Insects (3) (1T+2P) OR ZOO-242 - Wildlife and Ecotourism (3) (1T+2P)				20	
IV	ZOO-202 - Biology of Chordates (4) ZOO-203 - Chordate Anatomy (4) ZOO-204 - Human Physiology (4) ZOO-205 - Bio-entrepreneurship (2)	ZOO-221 - Bioinstrumentation (4) (VET)							20	ZOO-261 - Poultry Technology (4)

V	ZOO-300 - Molecular Biology (4) ZOO-301 - Biochemistry (4) ZOO-302 - Histology and Endocrinology (4) ZOO-303 - Cave Biology (2)	ZOO-321 - Biostatistics and Data Analytics (4) (VET)				Internship (2)			20	
VI	ZOO-304 - Animal Biotechnology (4) ZOO-305 - Evolution (4) ZOO-306 - Toxicology (4) ZOO-307 - Minor Project (4)	ZOO-322 - Environmental Impact Assessment (4) (VET)							20	
VII	ZOO-400 - Developmental Biology (4) ZOO-401 - Haematology and Immunology (4) ZOO-402 - Parasitology (4) ZOO-403 - Environmental Biology (4)	ZOO-411 - Traditional Ecological Knowledge Systems (4)							20	
VIII	ZOO-404 - Marine Zoology (4) ZOO-405 - Fish and Fisheries (4) ZOO-406 - Animal Behaviour (4) ZOO-407 - Biochemistry and Metabolic Processes (4)	ZOO-412 - Wetland Ecology (4)							20	

Name of the Programme: Zoology

Course Code: ZOO-100

Title of the Course: Amazing World of Animals

Number of Credits: 04 (3 +1)

Effective from AY: 2023-24

Pre-requisites for the Course:	Nil	
Course Objectives:	<ol style="list-style-type: none">1. To outline the origin, diversity and distribution of Animals2. To explain the silience of animal life	
Content:	<p>MODULE I: Origin, diversity and distribution of Animals Evolution of earth; the first living cell; Brief idea of geological time line and evolution of animals; outline classification of animal kingdom; major habitats associated animal diversity (desert, Savanna grassland, forest, cave, oceanic); Paleozoology as a tool to demonstrate evolution.</p> <p>MODULE II: Role and Values of animals in the dynamics of the earth and drivers of species extinction Role of animals in ecosystem (as niche species, pollinators and seed dispersal by insect and birds, bioindicators); in human life; ethnozoology. Values of animals: Ethical, Ecological, Economic, Aesthetic, Scientific and Cultural. Threats to animals: Natural threats such as flood, Volcanic eruption, landslides, forest fires, tsunamis; habitat loss and fragmentation; Urbanization; Man and Wildlife conflict, threats of linear infrastructure, Zooanthroponosis, Global climate change.</p> <p>MODULE III: Wonders of animal world Bioluminescence in animals, Echolocation in Bats and cetaceans, Pearl formation in Mollusca, Regeneration in animals, Mimicry in butterflies, Bird migration and Jatinga bird phenomenon, Breeding and parental care in animals (fishes, amphibia and mammals), Extreme survival adaptations in animals, Regeneration in animals, Animal cognition.</p>	<p>15 hours</p> <p>15 hours</p> <p>15 hours</p>
Practicals:	<p>Practicals:</p> <ol style="list-style-type: none">1. Study of Desert, Savanna grassland, Forest, Cave and oceanic animas (02 specimen each).	30 Hrs
	<ol style="list-style-type: none">1. Mounting of Protozoans from Pond Water sample and identification of any two specimen.2. Study of bioluminescent animals (any 2 examples).3. Study of pearl formation through examination of Molluscan shellfish like Window pane Oyster/Rock Oyster.4. Demonstration of regeneration of fin in fish (suitable specimen may be taken).5. Study of 'Batesian and Mullerian' Mimicry in butterflies.6. Camouflage as a protective mechanism in animals with reference to larvae of Common Mormon and Common Baron Butterfly.7. Study of parental behaviour in animals (Arthropod (Potter Wasp, Scorpion), Fishes (Sea horse, cat fish), Amphibia (Midwife toad and Ichthyophis), Birds (Baya Weaver Bird, Common Crow)8. Study of campus fauna: Butterflies (at least 4), Birds (at least 4), Amphibia (At least 2), Reptiles (At least 2).	

	<p>9. Listing of Official State fauna of Goa and assessing their conservation threats.</p> <p>10. Visit to a Zoo or an Aquarium to appreciate ex situ conservation approach.</p>	
Pedagogy:	<p>Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools. Fundamental theoretical concepts will be explained by practical demonstration.</p>	
References/ Readings:	<ol style="list-style-type: none"> 1. K. K. Chaki, G. Kundu, and S. Sarkar, Introduction to General Zoology: Volume I, 4th ed. India: New Central Book Agency, 2011. 2. P. R. Yadav, Understanding Zoology. India: Discovery Publishing Pvt. Ltd., 2010. 3. M. P. Arora, Organic Evolution, 2nd ed. India: Himalaya Publishing House, 2000. 4. J. Z. Young, The Life of Vertebrates. Oxford University Press, 2004. 5. P. D. Sharma, Ecology and Environment, 13th Ed. Rastogi Publications, 2014. 6. <u>J. Z. Young</u>, The Life of Vertebrates, Oxford University Press (1 January 2004) 	
Course Outcomes:	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the origin, diversity and distribution of Animals 1. Summarize the role of animals in the dynamics of earth. 2. Discover the fascinating world of animals. 4. Relate to the factors important for sustenance of animals 	

Name of the Programme: B.Sc. Zoology

Course Code: ZOO-111

Title of the Course: Understanding Applications of Zoology

Number of Credits: 04

Effective from AY: 2023-24

Pre-requisites	Nil	
Course Objectives:	1. To outline the history, scope and applications of Zoology in human health, trade, commerce and industry. 2. To explain the importance of animal conservation.	
Content:	MODULE I: History, Milestones and Scope of Zoology Genesis of Zoology as knowledge system, Rise of the Naturalist. Aristotle's Zoology. Major milestones in Zoology from 17 th Century to present. Branches of Zoology.	15 hours
	MODULE II: Application of Zoology in Public Health Protozoans and Helminthes of public health importance; Protozoan causing intestinal amoebiasis and malaria. Helminths infestations- Tapeworm and Round worm. Mode of transmission, symptoms and prevention of Tuberculosis, Cholera, Tetanus, Rabies. Medical importance and control of disease-causing vectors: <i>Anopheles sp., Culex sp., Aedes sp.</i>	15 hours
	MODULE III: Application of Zoology in Trade, Commerce and Industry Bionomic Zoology: Apiculture, Lac culture, Sericulture, Mariculture (Mussel culture, Oyster culture). Introduction to Genetically Modified Organisms and Bioprospecting Introduction to Animal inspired designs.	15 hours
	MODULE IV: Conservation of Animal wealth Significance of conservation biology and global conservation efforts. <i>In-situ</i> and <i>Ex-situ</i> conservation strategies, conservation genetics, wildlife forensics (DNA fingerprinting). Centrally Sponsored Schemes for Wildlife Conservation (Project Tiger, Project Elephant, crocodile breeding project, Gir Lion project).	15 Hours
Pedagogy:	Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools.	
References/ Readings:	1. K. K. Chaki, G. Kundu, and S. Sarkar, Introduction to General Zoology: Volume I, 4 th ed. India: New Central Book Agency, 2011. 2. P. R. Yadav, Understanding Zoology. India: Discovery Publishing Pvt. Ltd., 2010. 3. R. L. Kotpal, Modern Textbook of Zoology: Invertebrates, 12 th Ed. Rastogi Publications, 2020. 4. R. R. Prabhu Jayasurya, Economic Zoology. India: Saras Publications, 2013. 5. K.D. Chatterjee, Parasitology: Protozoology and Helminthology, 13 th ed. India: CBS Publishers & Distributors, 2019. 6. P. Joshi, and P. Joshi, Textbook of Conservation Biology. India: Evincepub Publishing, 2020.	
Course Outcomes:	At the end of the course, students will be able to: 1. Recall the history and scope of Zoology. 2. Appraise the role of Zoology in public health. 3. Discuss applications of Zoology in trade, commerce and industry. 4. Describe the importance of conservation of animals.	

Name of the Programme: B.Sc. Zoology

Course Code: ZOO-131

Title of the Course: Food, Nutrition and Health

Number of Credits: 03

Effective from AY: 2023-24

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To examine the impact of nutrition on health 2. To recognize the importance of managing Health and Wellness	
Content:	<p>MODULE I – Food and its constituents Basic concept of Food, Nutrition and Nutrients. Classification of Nutrients: Macro and Micro nutrients. Dietary sources of Carbohydrates, Proteins, Lipids. Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source (DEMO 1) and importance Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their biological functions. (DEMO 2) Water - Functions, daily requirements, Water balance. Demo 1 – Presence of Vitamin C in Packaged Orange Juice and Lime water Demo 2 - Reading food labels and its importance</p> <p>MODULE II – Human Nutrition Define Nutrition and Malnutrition. Concept of a Balanced Diet, BMR, Nutrient needs and Dietary pattern for various groups (adults, pregnant and nursing mothers, infants, school children, adolescents and elderly). Major nutritional Deficiency diseases Protein Energy Malnutrition (kwashiorkor and Marasmus). Vitamin deficiency disorders, Iron deficiency disorders - their causes, symptoms, treatment, prevention Demo 1 – Preparation of indigenous recipes (Ragi laddoo/ Khichdi/ Tizann (Millet porridge). Demo 2 – Planning and preparation of normal diets Demo 3- Preparation of Diet Plan / Healthy Eating Plate / Healthy Diet Plan</p> <p>MODULE III – Management of Health and Wellness Importance of health and wellness Education. Factors affecting health and wellness. Sedentary lifestyle and its risk of disease. Stress, anxiety, and depression. Factors affecting mental health. Depression and Suicidal tendencies, Substance abuse (Drugs, Cigarette, Alcohol), de-addiction, counselling and rehabilitation. Spirituality and mental health. Role of sleep in maintenance of physical and mental health. Demo1: Role of Yoga, asanas and meditation in maintaining health and wellness.</p>	<p>15 hours</p> <p>15 hours</p> <p>15 Hours</p>
Pedagogy:	Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools. Fundamental theoretical concepts will be explained by practical demonstration.	
References/ Readings:	1. S. R. Mudambi, and M. V. Rajagopal, Fundamentals of Foods, Nutrition and Diet Therapy, 5 th ed. New Age International Publishers, 2007. 2. B. Srilakshmi, Nutrition Science. New Age International (P)Ltd., 2002. 3. B. Srilakshmi, Food Science, 4 th ed. New Age International (P)Ltd., 2007. 4. C. Bouchard, S. N. Blair, and W. L. Haskell Physical Activity and Health, 2 nd ed. Human Kinetics, 2012. 5. S. Rodey, Food Science and Nutrition, 2 nd ed. Oxford University Press, 2018.	

Course Outcomes:	At the end of the course, students will be able to: <ol style="list-style-type: none">1. Explain the constituents of food.2. List the components of a balanced diet, special nutritional requirements in various age groups and the diet related disorders in humans.3. Plan a meal with ideal dietary requirements for various stages of life.4. Demonstrate understanding of health and wellness.
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Name of the Programme: B.Sc. Zoology

Course Code: ZOO-132

Title of the Course: Environmental Health

Number of Credits: 03

Effective from AY: 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	1. To define and describe the key components, including genesis and spatial scales of environmental health. 2. To bring out the link between environment and human health, in the light of contemporary climate change including Indian context.	
Content:	<p>MODULE I Introduction to Environment Health: Concept of ecology and ecological connectedness. Are humans exempted from ecological rules and limitations? A reflection. Earth's Carrying Capacity, ecosystem services, and ecological footprints. Consequences of replacing 'earth capital' with 'manufactured capital'. Scope and definition of Environmental Health Changing context of Environmental Health concept: Ancient ages, age of industrialization, modern era of science and technology Brief idea of spatial scales of environmental health: Global, regional and local Concise account of the drivers of environmental health</p> <p>MODULE II Environmental Links of Disease and Infirmity: Brief idea of the following Pollution induced diseases: Minamata disease, Itai Itai disease, Arsenicosis, Asthma, Allergy, Cancer, and disorders caused by Endocrine Disruptors Life style related diseases: Diabetes, Obesity, Hypertension, Stroke, Dietary deficiencies and excesses, depression and suicides Climate Change driven weather extremes and health: Heat strokes, Zoonotic spillover, Post-traumatic stress disorders following natural calamities, Water borne diseases: Hepatitis, Cholera, Poliomyelitis, Gastroenteritis, Vector borne diseases: Malaria, Filariasis, Chikunguniya, Dengue, Leishmaniasis Parasitic Diseases: Amoebic Dysentery, Pinworm infection, Hookworm Infection Impact of war and terrorism on health: Fall out of Nuclear weapons, Chemical agents, Biological agents, Gulf war Syndrome</p> <p>MODULE III Practice of Environmental Health: Precaution: A New Environmental Health Paradigm: Forecaring principle (<i>Vorsorgeprinzip</i>) and 'Polluter Pays' Principle Integrating environmental health concerns in Public Health Model: Case studies of 'Swachh Bharat Abhiyan' and 'Mission Indradhanush' Clean Production and circular Economy Brief idea of Environmental Health Indicators and Health Impact Assessment 'One Health'- Sustainable Development Goal 3</p>	<p>15 hours</p> <p>15 hours</p> <p>15 Hours</p>

Pedagogy:	Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools. Fundamental theoretical concepts will be explained by practical demonstration.
References/ Readings:	<ol style="list-style-type: none"> 1. J. Conant, and P. Fadem, A Community Guide to Environmental Health. Hesperian Foundation, 2008. 2. R. H. Friis, Essentials Of Environmental Health (Essential Public Health), 3rd ed. Jones and Bartlett Publishers, 2018. 1. S. K. Adhikari, A Textbook of Environmental Health. Samiksha Publication, 2019. 2. F. R. Spellman, and R. M. Bieber, Environmental Health and Science Desk Reference. U.S.: Government Institutes Inc., 2012. 3. H. Koren, and M. Bisesi, Handbook of Environmental Health and Safety (2 Vols Set): Principles And Practices. Lewis Publishers, 2002. 4. M. G. Robson, W. A. Toscano, Q. Meng, and D. A. Kaden, Risk Assessment for Environmental Health, 2nd ed. CRC Press, 2023. 5. J. Selendy, <i>Water and Sanitation Related Diseases and the Environment: Challenges, Interventions and Preventive Measures</i>. Wiley Blackwell, 2011. 6. H. Frumkin, Environmental Health from global to local. John Wiley & Sons, Inc., 2005. 7. N. Nandini, Environment & Public Health. Sapna Book House, 2018. 8. E. Hutchinson, Environment, Health and Sustainable Development. Sari Kovats Publisher Open University Press, 2017.
Course Outcomes:	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain and appreciate local regional and global Environmental Health issues. 2. Relate the contemporary health issues with extant environmental status. 3. Get an insight into environmental drivers of diseases. 4. Promote and practice environmental health to achieve SDG 3 on One Health.

Name of the Programme: B.Sc. Zoology

Course Code: ZOO-133

Title of the Course: Public Health and Hygiene

Number of Credits: 03

Effective from AY: 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	1. To explain the importance of hygiene in maintaining public health 2. To contrast between communicable and non-communicable diseases	
Content:	MODULE I: Introduction to Public health and hygiene History and Scope of public health system, Definition of health and components of public health, malnutrition and measures of malnutrition, over nutrition, Substance abuse and its control measures, Adulteration of food and its harmful effects, Hygiene-Definition, types (Personal and Social hygiene) and importance.	15 hours
	MODULE II: Communicable and Non-communicable diseases Definition; Causes, Symptoms and Control measures of common Food and Water Borne Diseases (Jaundice, Cholera, Traveller's diarrhoea, Typhoid), Sexually transmitted diseases and infections (HIV-AIDS, Genital herpes, Hepatitis-B, Syphilis, Gonorrhoea), Zoonotic and Vector borne diseases (COVID-19, Rabies; Malaria, Dengue), Lifestyle habits and their effects on health.	15 hours
	MODULE III: Community Health Prophylaxis through health education, Population control and Family welfare, Contraceptive methods. Consanguineous marriages - implications, mental health and common mental disorders, prevention and possible interventions, stress management, vaccination programs, Health indicators and National Health Care and hygiene Programmes.	15 hours
Pedagogy:	Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools. Fundamental theoretical concepts will be explained by practical demonstration.	
References/ Readings:	1. G. R. Seage, Essentials of Epidemiology in Public Health. Jones and Barlett publisher, 2018. 2. K. Dass, Public Health and Hygiene. Notion Publishers, 2021. 3. M. J. Schneider, Introduction to Public Health. Jones and Barlett Publisher, 2020. 4. R. L. Goldsteen, K. Goldsteen, and T. Dwelle, Introduction to Public Health: Promises and Practice. Springer Publishing Co inc., 2014. 5. W.C. C. Pares, The Science of Hygiene: A Textbook of Laboratory practise for Public Health Students, Forgotten Publisher, 2019.	
Course Outcomes:	At the end of the course, students will be able to: 1. Discuss aspects of public health and hygiene. 2. Summarise information about various communicable and non-communicable diseases. 3. Describe personal and community prophylactic measures to combat various diseases. 4. Explain various aspects of community health.	

Name of the Programme: B.Sc. Zoology
Course Code: ZOO-134
Title of the Course: Environmental Ethics
Number of Credits: 03
Effective from AY: 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	<ol style="list-style-type: none"> To define ethics and describe its relationship with our environmental perspectives and actions. To compare western and Indian environmental ethics and understand current trends 	
Content:	<p>MODULE I Introduction to Ethics and ethical Theories Meaning of Ethics World Views: Earth Wisdom & Planetary Management View Utilitarianism Rights Theory Divine Command Theory Natural Law Virtue Theory Moral Theory</p> <p>MODULE II Values in Environmental ethics The Idea of Anthropocentrism Environmental Justice and Sustainability Ethics and Sentient Animals Ethical Biocentrism Holistic Ethics: Eco-centrism Holistic Ethics: Species Wildness Value Value-Pluralist Views Eco-feminism Environmental Pragmatism</p> <p>MODULE III Current trends, Western and Indian Eco-ethics Environmental ethics links with other disciplines and technologies Environmental Ethics of restoration and climate change Ethics of Species preservation, assisted migration, and climate change Gaia Theory Deep Ecology Lynn White’s critique of anthropocentric faith, and Theology with Ecological Perspective A reflection on Environmental ethics in Indian culture. Building an ‘Earth Community’</p>	<p>15 hours</p> <p>15 hours</p> <p>15 Hours</p>
Pedagogy:	Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools. Fundamental theoretical concepts will be explained by practical demonstration.	
References/ Readings:	<ol style="list-style-type: none"> Biodiversity Project, Ethics for a Small Planet: A Communications Handbook. Biodiversity Project, 2022. C. Palmer, K. McShane, and R. Sandler, Environmental Ethics. Annual Review of Environment and Resources. 39:419–42, 2014. K. K. Smith, Exploring Environmental Ethics. Springer, 2018. S. Miller, Gaia Connections: An Introduction to Ecology, Ecoethics, and Economics, 2nd ed. Rowman & Littlefield Publishers, 2003. R. Sandler, Environmental Ethics: Theory in Practice. Oxford University 	

	Press, 2017. 6. D, Schmitz, and D. C. Shahr, Environmental Ethics: What Really Matters, What Really Works, 3 rd ed. Oxford University Press. 2018.
Course Outcomes:	At the end of the course, students will be able to: 1. Explain and appreciate philosophies of environmental ethics. 2. Evaluate the nuances of eco-ethical values. 3. Practice ethical obligations towards the planet earth, and promote sustainable lifestyles. 4. Assess the various theories of Ethics.

Name of the Programme: B.Sc. Zoology

Course Code: ZOO-141

Title of the Course: Skills for Zoologists

Number of Credits: 03 (01+02)

Effective from AY: 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	1. To recognize skills of observation and data collection in field. 2. To teach protocols of handling hazardous waste, biomedical waste, and biological specimens.	
Content:	<p>MODULE I- Skills for Field Work and Laboratory</p> <p>Introduction to the concept of 'field'. Rationale for the need to acquire field skills and Ethics of sustainable field work. Introduction to basic field instruments (Binoculars, Camera, Spotting-Scope, Range Finders, Hygro-thermometer, Lux meter, Anemometer) and Observational skills. Dress-code and conduct in the field. Use of taxonomic keys/ field guides/ maps. Animal handling, Record keeping and maintaining field diary.</p> <p>Principles and practices of Laboratory safety and conduct - Safety signages, hazards and precautions. Concept of Biosafety levels, Use of personal safety gears; animal/ microbial, chemical and hazardous material disposal. Handling and maintaining biological specimens.</p> <p>Laboratory instruments- Handling, care and applications of Microscopy, Colorimetry/ spectrophotometer, pH meter, Centrifuge, Chromatography, Electrophoresis.</p> <p>Systems of Units; CGS, FPS and MKS, Calculations and related conversions of Metric system- length (1 millimetre, 1 centimetre, 1 decimetre, 1 decametre, 1 hectometre, 1 kilometre, 1 inch, 1 foot, 1 angstrom, 1 fermi, 1 light year, 1 mile);</p> <p>Mass (1 milligram, 1 centigram, 0.01 gram, 1 decigram, 1 decagram, 10 gram, 1 hectogram, 1 kilogram, 1 stone, 1 pound, 1 ounce); Volume (1 milliliter, 1 centiliter, 1 deciliter, 1 decaliter, 1 hectoliter, 1 kiloliter, 1 cubic inch, 1 gallon, 1 cubic foot); Temperature(Celsius, Fahrenheit, Kelvin); Energy (1 BTU (British thermal unit), 1 erg, 1 foot-pound, 1 calorie, 1 kilowatt- hour, 1 electron volt, 1 liter atmosphere)</p> <p>Concentrations: (Percent solutions, ppt, ppm, ppb dilutions, Normality, Molarity and Molality)</p> <p>Practical (Field)</p> <ol style="list-style-type: none">1. Handling field instruments (at least four)2. Use of taxonomic keys and field guides (for any two groups of animals).3. Field survey methods to be demonstrated in field (Sample Area Count, Line Transects, Quadrant Sampling, Point Count and Random survey).4. Collection and preservation of specimens/ samples. <p>Data collection methods – cards/ diary, dictaphone, imagery, and maintenance of Field Diary.</p> <p>Practical (Laboratory)</p> <ol style="list-style-type: none">1. Safety and conduct in a laboratory (Interpretation of safety symbols)	15 hours
Practicals:		60 hrs

	<ol style="list-style-type: none"> 2. Sterilization and handling of laboratory glassware/ fluids/ reagents/ media (dry heat, wet heat, filtration, radiation (UV)) 1. Preparation of solutions. 2. Handling laboratory instruments (at least four) 3. Study of parts of microscope and their functions; types, handling, and use. 4. Types of staining techniques (Simple, Differential, Vital and Negative) 5. Demonstration of microtomy (Tissue fixing, Block making, Ribbon cutting). 6. Chromatography (Paper and TLC) and Gel Electrophoresis (demonstration). 	
Pedagogy:	<p>Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools.</p> <p>Practicals to enhance the theoretical knowledge</p>	
References/ Readings:	<ol style="list-style-type: none"> 1. S. S. LAL, (2019). Practical Zoology Vertebrate. Rastogi Publication. 2. Linville, H. R. (2019) A Guide for Laboratory and Field Work in Zoology 3. Denise M. Harmening. Laboratory Management, Principles and Processes, D.H. Publishing & Consulting Inc.; Third Edition, 2012 9. Biochemical Calculations, 2nd Ed., (1997), Segel Irvin H; John Wiley and Sons, NY. 1. Biophysical Chemistry Principles & Techniques Handbook, (2003), A. Upadhyay, K. Upadhyay, and N. Nath. 2. A photographic guide to Butterflies of Goa. (2007), P. Rangnekar. 3. Birds of the Indian Subcontinent. (2016), R. Grimmett, C. Inskipp, T. Inskipp. 4. Keith Wilson, Principles & Techniques of Practical Biochemistry 5th Edition, Academic Foundation 9. Shivaraja Shankara YM, Ganesh MK, Shivashankara AR, Laboratory Manual for Practical Biochemistry (2013), Jaypee digital. 	
Course Outcomes:	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Demonstrate skills for observations of specimen in the field. 2. Use the common/ basic field and laboratory equipment. 3. Develop strategies to work effectively in 'field' and biological laboratory. 4. Plan safety protocols for 'field' and laboratory work. 	

Name of the Programme: Zoology

Course Code: ZOO-142

Title of the Course: Vermitechnology

Number of Credits:3 (1 + 2)

Effective from AY: 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	1. To explain Vermitechnology as a sustainable bio-enterprise. 2. To create skills to compost organic waste into organic manure	
Content:	MODULE I :Vermitechnology Definition, History, Growth and development of Vermitechnology in India. Significance of Vermitechnology as against chemical fertilizers. Vermicast to Vermicompost. Vermiculture: definition, scope and importance. Techniques of Vermicomposting: indoor, pit and commercial Vermiwash: preparation and application Vermimeal and its nutritive value. Future perspective of Vermitechnology. Crop nutritive value of Vermicompost. Biology of Earthworms: Morphology and anatomy, reproductive system and life cycle. Earthworm candidates for Vermicomposting. Habitat ecology- epegeic, endogeic and anecic species. Role of earthworms in soil aeration, water retention and decomposing.	15 hours
	Practicals 1. Study of common earthworm species used in Vermitechnology(specimens and digital sources). 2. Visit to vermicomposting farm. 3. Study of life stages and development of <i>Eisenia fetida</i> (Digital). 4. Preparing for vermicomposting setup (material gathering) 5. Study of Vermicompost equipments and bed preparations. 6. Hands on training of Vermicomposting 7. Segregation of Vermicompost and earthworms 8. Air drying, sieving, packaging and storage of vermicompost. 9. Preparation of Vermiwash 10. Field application of compost and Vermisaline and study its effect on plant growth 11. Estimation of phosphate content from Vermicompost 12. Estimation of moisture content from Vermicompost 13. Setting up of a mini Vermicomposting unit 14. Study of earthworm diseases and enemies.	60 Hours
Pedagogy:	Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools. Fundamental theoretical concepts will be explained by practical demonstration.	
References/	1. Jordan and Verma (2009), Invertebrate Zoology, Chand and Company.	

Readings:	<ol style="list-style-type: none"> 2. Bhatnagar,R. K. and Patla,R. K. (2007), Earthworm- Vermiculture and Vermicomposting. Kalyanipublishers. 3. Sultan Ahmed Ismail (2005), The earthworm book, India press Goa. 4. H. Panda, (2022). The Complete Technology book on Vermiculture and Vermicompost (Earthworm) with manufacturing Process, machinery equipment details & plant Layout. Asia Pacific Business Press Inc, . 5. K. Singh, G. Nath, R. C. Shukla, D. K. Bhartia, (2014). A textbook of Vermicompost: Vermiwash and Biopesticides. Astral International.
Course Outcomes:	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the biology of earthworms. 2. Identify earthworms used in Vermicomposting. 3. Build a Vermicompost unit. 4. Formulate various Vermiproducts.

Name of the Programme: Zoology

Course Code:ZOO-143

Title of the Course: Aquarium Fish Keeping

Number of Credits: 3 (1+2)

Effective from AY: 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	1. To outline the techniques of rearing /maintaining fishes in an aquarium. 2. To identify the requirements foran Aquarium fabrication	
Content:	<p>MODULE I: Aquarium Fish keeping</p> <p>Introduction: Definition of an Ornamental fish, aquarium, Aquaculture and Aquarists. Benefits of Aquarium Fish Keeping,(1L) Types of Aquarium fishes (Exotic, Endemic and indigenous species; Fresh water& Marine water aquarium fishes; Surface feeders, Column feeders, Bottomfeeders; Carnivores, Omnivores, Herbivores with two examples of each type(2L) Importance of Aquarium Plants (1L) Types of Aquaria (1L) Factors need to consider when selecting Aquarium Fish: Water and Water parameters required;Size of the fish and thefish tank; compatibility(water conditions, behavioural patterns, food requirements and feeding habits; Health of the fish, Aquarium equipment) (1L) Ornamental fish transportation(1L) Types of fish feed (Artificial and Live) (2L) Common aquarium fish diseases (2L) Important points to be considered while choosing a place for aquarium set up : Sunlight,Accessibility, Noise,Visibility, Electrical Sockets, etc. (1L)</p> <p>The potential scope of Aquarium Fish Industry as a Cottage Industry and budget for setting up an Aquarium Fish Farm as a Cottage Industry(3L)</p> <p>PRACTICAL:</p> <ol style="list-style-type: none">1. Study (Origin, Habits, habitat, common characters and colour pattern, Feed and feeding behaviour, Sexual dimorphism and breeding behaviour) of common Aquarium fishes such as- Guppy, Molly, Sword tail, Gold fish, Angel fish, Anemone fish and Butterfly fish. (Specimens/ Pictures/ Photos)2. Study of aquarium plants: Ceratophyllum, Java Moss, Vallisneria , Hydrilla sp. (Specimens/ Pictures/ Photos)3. Types of aquariums: Community aquarium, Planted aquarium, Fresh water aquarium, Marine water aquarium. (Pictures/ videos)	<p>1 Credit (15 hours)</p> <p>60 Hrs</p>
	<ol style="list-style-type: none">1. Types of Aquarium tanks: Stand alone, Cabinet aquarium, Aquarium stand, Wall aquarium, Floor aquarium and Public aquarium. (Pictures/ Photos)2. Study of aquarium accessories: Aquarium Lights, Water filters, Water areator, Aquarium thermometer and heater, Aquarium substrates, Aquarium decors, etc (Specimens/ Pictures)	

	<ol style="list-style-type: none"> 3. Identification of live feed organisms -Infusoria, Paramecium, . Daphnia, Bloodworm , Black worm Tubifex and Artemia ((Specimens/ Pictures/ Photos) and Culture of live feed organisms -Paramecium, Euglena and Infusoria any one. 4. Study of different types of formulated feed: Flakes, Crisps, Granules, Pellets, Discs and Vacation blocks. Frozen foods. (Specimens/ Pictures) 5. Formulation of feed by using Pearson square method and preparation of formulated feeds 6. Study of Fish diseases: Fin rot, Swim bladder disease, Fluke, Dropsy and Ich. (Specimens/ Pictures) 7. Setting up of an aquarium 8. Maintenance of Aquarium (Daily, Weekly and Monthly 9. Aquarium water quality check up for pH, Ammonia, Nitrate, Nitrite by using test kit. 10. Visit to Public aquarium/ Aquarium fish division ICAR complex Goa. 	
<p>Pedagogy:</p>	<p>Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools.</p> <p>Fundamental theoretical concepts will be explained by practical demonstration.</p>	
<p>References/ Readings:</p>	<ol style="list-style-type: none"> 1. Ahilan, B., Felix, N. and Santhanam, R. 2008. Textbook of Aquariculture. Daya Publishing House, New Delhi. 2. V. G. Jhingran, Fish and Fisheries of India. Hindustan Publishing Co., 1991. 3. J. D. Jameson, and R. Santhanam. Manual of ornamental fisheries and farming technology. Fisheries College and Research Institute, Thoothukudi, 1996. 4. J. E. Baradach, J. H. Ryther, and W.O. McLarney, Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms. NewYork: Wiley Interscience, 1972. 5. M. Beazley, The complete guide to tropical aquarium fish care. London: Read and Consumes Book Ltd., 1998. 6. R. K. Rath, Freshwater Aquaculture. India: Scientific Publishers, 2000. 	
<p>Course Outcomes:</p>	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the biology of aquarium fishes, their nutritional requirements and care. 2. Identify the requirements for setting up and maintenance of an aquarium. 3. Evaluate aquarium fish diseases based on common symptoms. 4. Demonstrate construction of an aquarium set-up. 	

Name of the Programme: B.Sc. Zoology

Course Code: ZOO-144

Title of the Course: Value Added fish products

Number of Credits: 03 (1+2)

Effective from AY: 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	1.To explain the various value added fish products. 2.To demonstrate skills for preparation of value-added fish products	
Content:	MODULE I : Introduction to value added fish products. 1. Value added fish products: Concept and Purpose, scope, merits and demerits .(2L) 2. Selection of fish candidates (fin and shell fishes) for value addition.(1L) 3. Introduction to common marinated, fermented, battered and braided value added fish products: Fish/ Prawn Pickle,Fish/ Prawn Mole, Prawn Balchao, Fish Parra, Fish fingers, Fish balls, Fish Cutlets, Fish Sandwich, Fish Papad, Fish Soup powder, Fish Wafers, Fish Chakli, Fish sev Fish Samosa, Prawn Pakora, fish sausage, surimi and fish cake (Introductory information such as fishes or shell fishes used, storage & life span, packing and market availability only are to be discussed) (6L) 1. Processes of Mincing, Battering, Breeding and equipment / common ingredients required (2L) 2. Schedule IX of Food Safety and Standards Act (FSS), 2006(1L) 3. Registration and Licensing of Product(1L) 4. Fish product packaging and marketing(2L) PRACTICAL: VALUE ADDED FISH PRODUCTS 1. Determination of quality of fish, using organoleptic tests and Fish cleaning Techniques (Fin fishes and Shell fishes) 2. Study of the common equipment/ ingredients used for mincing,Battering and Breeding 3. Preparation of Fish fingers and Fish balls 4. Preparation of Fish cutlets. 5. Preparation of Fish Pakora, and Fish sandwich, 6. Preparation of Fish Shev and fish Chakali 7. Preparation of fish Papad 8. Preparation of fish and prawn pickle, 9. Preparation of Goan traditional fish product - Fish Parra, 10. Preparation of Fish and Prawn Balchao, 11. Preparation of Fish and Prawn mole 12. Study of packaging material and methods. 13. Visit to commercial value-added fish product manufacturing unit/ Self-help group centre/ Entrepreneur.	01Credit 15 hours
Practicals:		2-Credits 60 Hours
Pedagogy:	Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools. Fundamental theoretical concepts will be explained by practical demonstration and visit to commercial manufacturing units	
References/ Readings:	1. Akhter, N. (2015). Marketing of Fish and Fish Products. Random Publications. ISBN: 9789351116158. 2. Balachandran, K. K. 2001. Post-harvest technology of fish and fish products. Daya Publishing House, New Delhi. 3. Balasundari, S., Raghu, G. and Felix, S. (2018). Fish products and Value addition.	

	<p>Tamil Nadu Dr. Jayalalithaa Fisheries University. ISBN 9789351249351.</p> <ol style="list-style-type: none"> 4. Gopakumar, K. 2002. Text book of Fish Processing Technology. Indian Council of Agricultural Research, New Delhi. 5. Govindan, T. K. 1985. Fish processing technology. Exford& IBH Publishing Co. Pvt. Ltd., New Delhi. 6. Hall, G. M., 1992. Text book of Fish Processing Technology, ICAR Publication. 7. ICAR, (2016). Goan Seafood Recipes. Broadway Publishing House, Goa. ISBN 9789384298388. 8. Ratnakumar, K. and R. Kavya (2022). Textbook on Fish Processing Technology. Narendra Publishing House, Delhi. 9. Sen, D. P., 2005. Technology of Fishery Products, Fishing Chimes. 10. https://mpeda.gov.in/
<p>Course Outcomes:</p>	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Assess the quality of fish and cleaning techniques. 2. Demonstrate preparation of various local, commercial and homemade value added fish products. 3. Plan licencing and marketing strategie. 4. Create an ecosystem of Bio-entrepreneurship.

Name of the Programme: B.Sc. Zoology

Course Code: ZOO-161

Title of the Course: Dairy Technology

Number of Credits: 04

Effective from AY: 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	1. To appraise dairy technology as a viable livelihood option 2. To identify suitable cattle breeds for milk and milk products	
Content:	MODULE I: Cattle Breeds milk yield and health care Common Indian Buffalo breeds (Murrah, Surti, Jaffarabadi, Mehsana, Pandharpuri, Manda, Sambalpur, Kalhandi) Common Indian and exotic Cow breeds (Gir, Red Sindhi, Sahival, Hallikar, Amritmahal, Shweta, Kapila, Jersey and Holstein) (Emphasis to be given on milk yield and regional suitability) Cattle care: Nutritional needs, shelter requirements, healthcare.	15 hours
	MODULE II: Milk processing Methods of milking Collection of Milk, Preservation and storage Quality check: microbial and nutritive value Generalized practices: Homogenisation, Pasteurisation, UHT processing. Preparation of special milk: Toned, double toned, standardized, Whole milk, flavoured milk.	15 hours
	MODULE III: Dairy products Sensory evaluation of dairy products Traditional Indian dairy products: Dahi, Butter milk, Paneer, Khoya, Rabdi, Basundi Fat rich dairy products: Cream, Butter, Ghee, Cheese Condensed milk and Ice cream Dairy by-products: casein and whey	15 hours
	MODULE IV Identification of cattle breeds (Cows and buffalo four each) Determination of lactose content of milk. Preparation of curds and butter milk. Preparation of Chakka. Determination of adulterants in ghee (Sesame Oil) Determination of salt contents of cheese. Determination of fat contents of cheese, ice-cream by Gerber method. To isolate casein from skimmed milk and to determine nitrogen, protein, phosphorous and sulphur contents. Determination of quality of cheese.	30 hours
Pedagogy:	Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools. Fundamental theoretical concepts will be explained by practical demonstration.	
References/ Readings:	1. Y. H. Hui, Dairy Science and Technology Handbook: Principles and Properties. John Wiley, 2014. 2. S. Singh, Dairy Technology: Milk and Milk Processing. New India Publishing Agency, 2014 3. D. Sukumar, Outlines of Dairy Technology. Oxford, 2011. 4. R. K. Pandey, Production Processing and Marketing of Milk and Milk Products. Astral International, 2013. 5. Milk Industry Foundation, Analysis of Milk and Its Products: A Lab	

	Manual, 2 nd ed. Biotech Books, 2005.
Course Outcomes:	At the end of the course, students will be able to: <ol style="list-style-type: none">1. Identify the various cow and buffalo breeds.2. Assess the quality of milk and milk products.3. Explain the various techniques of processing milk.4. Prepare the various Indian traditional milk products.