



**Parvatibai Chowgule College of Arts and Science
(Autonomous)**

Accredited by NAAC with Grade 'A+'
Best Affiliated College-Goa University Silver Jubilee Year Award

DEPARTMENT OF ZOOLOGY

**SYLLABUS FOR
UNDERGRADUATE PROGRAMME
THREE YEAR BACHELORS DEGREE IN ZOOLOGY
/ FOUR YEAR
HONOURS IN ZOOLOGY**

(To be implemented from the Academic Year 2023-2024 onwards)

COURSE STRUCTURE

SEMESTER	MAJOR CORE	MINOR/ VOCATIONAL	MULTIDISCIPLINARY COURSE (MDC)	VALUE ADDED COURSES (VAC)	(AEC)	SKILL ENHANCEMENT COURSE (SEC)
I	UG-ZOO-101 Animal Diversity: Non Chordates & Chordates	UG-ZOO-102 Introduction to Animal Diversity	UG-ZOO-MDC 1 Nutrition & Diet plans	UG-ZOO- VAC 1 Environment Protection Practices	--	UG-ZOO-SEC 1 Waste Management Techniques
II	UG-ZOO-103 Cell and Molecular Biology	UG-ZOO-104 Techniques Of Cell Study & Chemistry	UG-ZOO-MDC 2 Techniques of Fish Preservation and Processing.	--	--	UG-ZOO-SEC 2 Bio Entrepreneurs hip
III	UG-ZOO-201 Fundamentals of Animal and Human Genetics	UG-ZOO-203 Inheritance Pattern of Gentic Traits and Diseases	UG-ZOO- MDC3 Aquarium maintenance: Freshwater and Marine fishes	--	--	UG-ZOO- SEC3Biologic al Data Analysis
	UG-ZOO-202 Biochemistry and Metabolic Regulation	--	--	--	--	--
IV	UG-ZOO-204 Endocrinology & assisted reproductive technologies	UG-ZOO-VOC1 Aquaculture and Fisheries	--	--	--	--
	UG-ZOO-205 Basic Microbiology and Fundamentals of Animal Biotechnology	--	--	--	--	--
	UG-ZOO-206 Immunology	--	--	--	--	--
	UG-ZOO-207 Aquaculture, Fish preservation and fish processing	--	--	--	--	--
V	UG-ZOO-301 Health & Nutrition	UG-ZOO-VOC2 Nutrition and Dietetics	--	--	--	--
	UG-ZOO-305 Wildlife Biology and Ethology	--	--	--	--	--
	UG-ZOO-306 Human Physiology	--	--	--	--	--
	UG-ZOO-PRJ Project(a)	--	--	--	--	--
VI	UG-ZOO-304 Molecular genetics and Basics of Forensic Science	UG-ZOO-VOC3 Application of techniques in wildlife monitoring	--	--	--	--
	UG-ZOO-305 Wildlife Biology and Ethology	--	--	--	--	--

***Implementation of fourth year (Semester VII & VIII) is subject to approval from DHE**

	UG-ZOO-306 Human Physiology	--	--	--	--	--
	UG-ZOO-PRJ Project (b)	--	--	--	--	--
VII	UG-ZOO-401 Research Methodology – Biological Sciences	UG-ZOO-VOC4 Computation of Biological data	--	--	--	--
	UG-ZOO-402 Ornamental Fisheries	--	--	--	--	--
	UG-ZOO-403 Techniques in Biological Research	--	--	--	--	--
	UG-ZOO-404 Wildlife Enumeration technique	--	--	--	--	--
VIII	UG-ZOO-405 Transgenic Animal Technology	UG-ZOO-VOC5: Learner centric T- L-E pedagogies	--	--	--	--
	UG-ZOO-406 Ecotourism	--	--	--	--	--
	UG-ZOO-407 Learner centric T-L-E pedagogies for Biological sciences	--	--	--	--	--
	UG-ZOO-408 Tissue Engineering	--	--	--	--	--

SEMESTER I

DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE: ANIMAL DIVERSITY: NON-CHORDATES & CHORDATES

COURSE CODE: UG-ZOO-101

MARKS: 100 [75 –Theory ; 25- Practicals]

CREDITS: 04 [03 –Theory; 01- Practical]

CONTACT HOURS: THEORY : 45 HOURS (03 LEC/WEEK)
PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)

COURSE OBJECTIVES: This course will give insight to be familiar with the different non-chordate and chordate phyla, know the general and distinguishing characters of each of them, study how the different systems evolved in their complexity and enable students to compare and contrasts the life processes in chordates and non-chordates.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:
CO1: Be familiar with identification of the non-chordates from chordates.
CO2: Identify the non-chordates and chordates and classify them upto the class/order level.
CO3: Understand the basis of life processes
CO4: Able to appreciate the process of evolution and understand how it progressed from simple, unicellular cells to complex, multicellular organisms.

CONTENT:

Module I: Introduction to diversity and classification of lower Non-Chordates	Unit 1: Introduction to Non-Chordates: Characteristics and Concepts Unit 2: Taxonomical Hierarchy and Nomenclature of animals Unit 3: General characters of Phyla and classification up to class level for the following: Porifera, Cnidaria, Platyhelminthes, Aschelminthes, Annelida and Onycophora	15 hours
ModuleII: Diversity of higher Non Chordates & Introduction to Phylum Chordata and its classification	Unit 4: General characters of Phyla and classification up to class level for the following: Arthropoda, Mollusca, Echinodermata and Hemichordata Unit 5: Introduction to Chordates: Characteristics and outline classification Unit 6: Protochordata: General characters and classification up to class level Unit 7: Division Agnatha: Ostracodermi and Cyclostomata	15 hours
Module III: Diversity of Vertebrates and classification up to Order level	Unit 8: General characters and classification up to Order level for the following: Unit 9: Superclass Pisces: Chondrichthyes and Osteichthyes Unit 10: Superclass Tetrapoda: Class Amphibia, class Reptilia, Class Aves and Class Mammalia	15 hours

PRACTICAL: 01 CREDIT

MAX.MKS:25 (30 Hrs)

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|----|---|----------|
| 1. | Identification of representative organisms of Porifera, Cnidaria, Platyhelminthes, Aschelminthes, Annelida, Onychophora, Arthropoda, Mollusca, Echinodermata and Hemichordata | 08 hours |
| 2. | Identification of representative organisms of protochordates to Mammalia (local sps) | 08 hours |
| 3. | Mountings/Observation: Prawn appendages, mouthparts of cockroach, scales and chromatophores in fishes, nest in birds. | 04 hours |
| 4. | Field trip to terrestrial /Aquatic habit/wildlife sanctuary to study the animal diversity in their natural habitats | 04 hours |
| 5. | PA | 06 hours |

REFERENCE BOOKS:

1. *Ruppert EE, Fox RS, Barnes RD. (2019). Invertebrate Zoology. Thomson Press India Ltd 7th Edition.*
2. *Jordan, E. L. and Verma, P.S. (2022). Invertebrate Zoology. S. Chand & Co. Pvt. Ltd. New Delhi.*
3. *Pechenik J.A.(2015). Biology of the invertebrates. Tata McGraw hill Publishing company limited, New Delhi .*
4. *Jordan, E. L. and Verma, P.S. (2022). Chordate Zoology. S. Chand & Co. Pvt. Ltd. New Delhi.*
6. *Cleveland HJ, Larry R, Keen S, Larson A and Eisenhour D (2020). Animal Diversity. McGraw Hill Science.*
7. *Sinha AK, Adhikari Sand Ganguly BB(2022). Biology of Animals Volume II. New Central Book Agency*

REFERENCE BOOKS FOR PRACTICALS:

- 1) *Lal SS (2019).Practical Zoology. Rastogi Publications, New Dehli.*
 - 2) *Lal SS (2022).Practical Zoology For B.Sc. First Year. Rastogi publications, Meerut India.*
 - 3) *Lal S.S. (2019) A textbook of practical zoology vertebrate. Rastogi publications, Meerut India.*
 - 4) *Sinha AK, Adhikari Sand GangulyBB(2022). Biology of Animals Volume II. New Central Book Agency*
 - 5) *Verma PS(2022). A Manual of Practical Zoology: Chordates S. Chand & Co. Pvt. Ltd. New Delhi.*
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DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE:	CELL AND MOLECULAR BIOLOGY
COURSE CODE:	UG-ZOO-103
MARKS:	100 [75 –Theory ; 25- Practicals]
CREDITS:	04 [03 –Theory; 01- Practical]
CONTACT HOURS:	THEORY : 45 HOURS (03 LEC/WEEK) PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)

COURSE OBJECTIVES: This course will give firm and rigorous foundation in the principles of modern molecular and cellular biology. It discusses the fundamental processes that enable cells to grow, move and communicate and will cover topics such as cell architecture, cell chemistry, cell division, functions and cell cycle. Students will also learn current molecular biological techniques that are used to study cell biology. Laboratories will focus both on exercises that help illustrate cellular phenomena, as well as on the introduction of techniques and procedures commonly utilized in modern cell and molecular biology research.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:

- CO1: Have an understanding of cell, it's organelles and their function.
- CO2: Demonstrate deeper understanding of what 'life is and how it functions at cellular level.
- CO3: Contrast cellular membrane structure and function, fine structure and function of cell organelles.
- CO4: Perform a variety of molecular and cellular biology techniques.

CONTENT

<p>Module I: Techniques Of Cell Study And Cell Chemistry</p>	<p>Unit 1: Microscopy: Light Microscopy, Electron Microscopy Unit 2: Cell Study Methods: Cell Fractionation, Chromatography and Electrophoresis. Unit 3: Molecules In Cell: Micromolecules in cells: Sugars, Fatty acids, aminoacids, Nucleotides. Macromolecules in cells: Nucleic acids, proteins, Polysaccharides, glycogen, fats. Unit 4: Chemical Bonds In Biomolecules: Covalent bonds, ionic bonds, noncovalent interactions</p>	<p>15 hours</p>
<p>Module II: Cell Architecture</p>	<p>Unit 5: Membrane Structure And Membrane Proteins: Lipid bilayer – composition and structural organization; Membrane Proteins – structure and function (transmembrane proteins, peripheral membrane proteins): Phospholipids, sphingolipids, Cholesterol in cell membrane. Unit 6: Ultrastructure And Function : Plasma Membrane , Cell matrix (Physical nature and Properties), Nucleus, Mitochondria, Endoplasmic Reticulum, Golgi Complex, Ribosomes, Microsomes, Cytoskeleton</p>	<p>15 hours</p>
<p>Module III: Cellular Transport Of Proteins And Vesicles</p>	<p>Unit 8: Transport across cell membranes: Principle of transmembrane transport (transporters and channels, active and passive transport, osmosis); Transporters and their function- passive transporters, Pumps (Na⁺, K⁺, Ca²⁺) Ion Channels - ion channels activities, regulation of opening and closing of channel; Protein transport into organelles (nucleus, mitochondria, ER). Unit 9: Vesicular transport & cell signalling: Vesicular transport – transport of soluble proteins, Clathrins, vesicle budding, vesicle docking, endocytic pathways, general principles of cell signalling,</p>	<p>15 hours</p>

PRACTICAL: 01 CREDIT

MAX.MKS:25 (30 Hrs)

1.	Introduction to Lab techniques – Pipetting, preparation of buffers and solutions, Lab equipments (use and maintenance), acquaintance with general laboratory practices	04 hours
2.	Cytochemistry: Localisation of Proteins, Carbohydrates & fats	06 hours
3.	Comparison of membrane permeability – Cellophane and Chick intestine.	04 hours
4.	Osmotic studies – Using Human Red blood cells.	02 hours
5.	Permanent slides: Mitotic stages, Meiotic stages , Study of different cell types (animal cells)	08 hours
6.	PA	06 hours

REFERENCE BOOKS:

Essential books:

- 1) *Alberts B, Heald R, Hopkin K, Johnson A, Morgan D, RobertsK, Walter P(2022). Essential Cell biology. Sixth edition. E Book. Norton Illumine.*
- 2) *Alberts B, Hopkins, Lewis J, Raff M, Robertis K, Walter P (2014): Essential Cell Biology, Fourth Edition, Graland Science Taylor & Francis Group, UK.*
- 3) *Lodish H, Berk A, Kaiser CA, Krienger M, Scott MP, Anthony, Bretscher A, Amon A. Scott MP (2013): Molecular Cell Biology, Seventh Edition, W. H. Freeman and Company New York.*
- 4) *Verma PS and Agarwal VK (2022): Cell Biology (Cytology, Biomolecules and Molecular Biology). S Chand and Company PVT LTD, New Delhi.*

Supplementary Reading:

- 5) *Gupta PK (2003): Cell and Molecular Biology, Second Edition, Rakesh Kumar Rastogi for Rastogi Publications, Meerut, New Delhi, India.*
- 6) *Pollard TD, Earnshaw WC, Schwartz JL and Johnson GT (2017).Cell Biology.Third Edition. Elsevier publication.*

REFERENCE BOOKS FOR PRACTICALS:

- 1) *Alberts B, Hopkins, Lewis J, Raff M, Robertis K, Walter P (2014): Essential Cell Biology, Fourth Edition, Graland Science Taylor & Francis Group, UK.*
- 2) *Chaitanya KV(2013).Cell and Molecular biology- A lab manual.PHI Learning Pvt.LtdNew delhi.*

MINOR CORE COURSE

COURSE TITLE: INTRODUCTION TO ANIMAL DIVERSITY

COURSE CODE: UG-ZOO-102

MARKS: 100 [75 –Theory ; 25- Practicals]

CREDITS: 04 [03 –Theory; 01- Practical]

CONTACT HOURS: THEORY : 45 HOURS (03 LEC/WEEK)
PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)

COURSE OBJECTIVES: This course will give insight to the diversity of non-chordate and chordates. It will also enable students to know the general and distinguishing characters of classes of organisms and understand how the evolutionary process progressed from simple to complex forms.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:
CO1: Be able to classify and identify the non-chordates.
CO2: Be able to classify and identify the chordates.
CO3: Identify distinguishing characters of classes
CO4: Understand the process of evolution of animal diversity

CONTENT

Module I: Introduction to Non-Chordates and study of its diversity	Unit 1: Introduction to Animal Diversity-Concepts and importance, Binomial nomenclature. Unit 2: Non-Chordates: General Characters, overview of Taxonomical Hierarchy. Unit 3: General characters of and classification (upto class) of: Porifera, Cnidaria, Platyhelminthes, Aschelminthes, Annelida and Onycophora Unit 4: Deeper understanding of classification through activities (E-Posters on classes of above mentioned Phyla / Presentations)	15 hours
Module II: Diversity of higher Non Chordates & Introduction to Phylum Chordata and its classification	Unit 5: General characters of and classification (upto class) of: Arthropoda, Mollusca, Echinodermata and Hemichordata Unit 6: Introduction to Chordates: General Characters and overview of classification Unit 7: General characters and classification up to class level: Protochordates, Agnathans Unit 8: Deeper understanding of classification through activities (E-Posters on classes of above mentioned Phyla/ Presentations)	15 hours
Module III: Diversity of Vertebrates and classification	Unit 9: Higher Vertebrates: General characters and overview of classification Unit 10: Superclass Pisces: General characters of Chondrichthyes and Osteichthyes Unit 11: Superclass Tetrapoda: General characters of Class Amphibia, class Reptilia, Class Aves and Class Mammalia. Unit 12: Deeper understanding of classification through activities (E-Posters on classes of above mentioned Phyla/ Presentations)	15 hours

PRACTICAL: 01 CREDIT

MAX.MKS:25 (30 Hrs)

1.	Identification of representative organisms of Non-chordates	08 hours
2.	Identification of representative organisms of Chordates(local sps)	08 hours
3.	Observation of : Prawn appendages, mouthparts of cockroach, scales and chromatophores in fishes, nest in birds.	04 hours
4.	Field trip to terrestrial /Aquatic habit/wildlife sanctuary to study the animal diversity in their natural habitats	04 hours
5.	PA	06 hours

REFERENCE BOOKS:

1. Cleveland HJ, Larry R, Keen S, Larson A and Eisenhour D (2020). *Animal Diversity. McGraw Hill Science.*
2. Jordan, E. L. and Verma, P.S. (2022). *Invertebrate Zoology. S. Chand & Co. Pvt. Ltd. New Delhi.*
3. Jordan, E. L. and Verma, P.S. (2022). *Chordate Zoology. S. Chand & Co. Pvt. Ltd. New Delhi.*
4. Pechenik J.A.(2015). *Biology of the invertebrates. Tata McGraw hill Publishing company limited, New Delhi .*
5. Ruppert EE, Fox RS, Barnes RD. (2019). *Invertebrate Zoology. Thomson Press India Ltd 7th Edition.*
6. Sinha AK, Adhikari Sand Ganguly BB(2022). *Biology of Animals Volume II. New Central Book Agency*

REFERENCE BOOKS FOR PRACTICALS:

1. Lal SS (2019).*Practical Zoology. Rastogi Publications, New Dehli.*
 2. Lal SS (2022).*Practical Zoology For B.Sc. First Year. Rastogi publications, Meerut India.*
 3. Lal S.S. (2019) *A textbook of practical zoology vertebrate. Rastogi publications, Meerut India.*
 4. Sinha AK, Adhikari Sand GangulyBB (2022). *Biology of Animals Volume II. New Central Book Agency*
 5. Verma PS(2022). *A Manual of Practical Zoology: Chordates S. Chand & Co. Pvt. Ltd. New Delhi.*
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MINOR CORE COURSE

COURSE TITLE: TECHNIQUES OF CELL STUDY & CELL CHEMISTRY

COURSE CODE: UG-ZOO-104

MARKS: 100 [75 –Theory ; 25- Practicals]

CREDITS: 04 [03 –Theory; 01- Practical]

**CONTACT HOURS: THEORY : 45 HOURS (03 LEC/WEEK)
PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)**

COURSE OBJECTIVES: This course will discuss the fundamental processes that enable us to study cell biology. Laboratory work will focus both on exercises that help illustrate cellular phenomena, as well as on the introduction of techniques and procedures commonly utilized in cell biology research.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:

- CO1: Have an understanding of microscopy for cell studies
- CO2: Explain the techniques of cell fractionation, Chromatography and Electrophoresis used for studying cell biology.
- CO3: Contrast cell bonds and their functions in the cells.
- CO4: Perform cellular biology techniques of slide preparation staining and microscopy.

CONTENT

Module I: Animal Cell Architecture And Techniques Of Cell Study	Unit 1: Overview of Animal Cell Architecture (ultrastructure of cell organelles) Unit 2: Microscopy: Light Microscopy, Electron Microscopy Unit 3: Cell Study Methods: Cell Fractionation, Chromatography and Electrophoresis.	15 hours
Module II: Cell Molecules And Chemistry	Unit 4: Molecules In Cell: Micromolecules in cells: Sugars, Fatty acids, aminoacids, Nucleotides. Unit 5: Macromolecules in cells: Nucleic acids, proteins, Polysaccharides, glycogen, fats. Unit 6: Chemical Bonds In Biomolecules: Covalent bonds, ionic bonds, noncovalent interactions	15 hours
Module III: Cellular Transport In Animal Cells	Unit 8: Principle of Transmembrane transport (transporters and channels, active and passive transport, osmosis) Unit 9: Transporters and their function- passive transporters, Pumps (Na ⁺ , K ⁺ , Ca ⁺) Unit 10: Ion Channels - ion channels activities, regulation of opening and closing of channels. Unit 11: Protein transport into organelles (nucleus, mitochondria,ER). Unit 12: Vesicular transport - Vesicular transport – transport of soluble proteins, Clathrins, vesicle budding, vesicle docking, endocytic pathways	15 hours

PRACTICAL: 01 CREDIT

MAX.MKS:25 (30 Hrs)

1.	Introduction to Lab techniques – Pipetting, preparation of buffers and solutions, Lab equipments (use and maintenance), acquaintance with general laboratory practices	04 hours
2.	Cytochemistry: Localisation of Proteins, Carbohydrates & fats	06 hours
3.	Comparison of membrane permeability – Cellophane and Chick intestine.	04 hours
4.	Osmotic studies – Using Human Red blood cells.	02 hours
5.	Permanent slides: Mitotic stages, Meiotic stages, Study of different cell types (animal cells)	08 hours
6.	PA	06 hours

REFERENCE BOOKS:

Essential books:

1. *Alberts B, Heald R, Hopkin K, Johnson A, Morgan D, RobertsK, Walter P(2022). Essential Cell biology. Sixth edition. E Book. Norton Illumine.*
2. *Alberts B, Hopkins, Lewis J, Raff M, Robertis K, Walter P (2014): Essential Cell Biology, Fourth Edition, Graland Science Taylor & Francis Group, UK.*
3. *Lodish H, Berk A, Kaiser CA, Krienger M, Scott MP, Anthony, Bretscher A, Amon A. Scott MP (2013): Molecular Cell Biology, Seventh Edition, W. H. Freeman and Company New York.*
4. *Verma PS and Agarwal VK (2022): Cell Biology (Cytology, Biomolecules and Molecular Biology). S Chand and Company PVT LTD, New Delhi.*

Supplementary Reading:

5. *Gupta PK (2003): Cell and Molecular Biology, Second Edition, Rakesh Kumar Rastogi for Rastogi Publications, Meerut, New Delhi, India.*
6. *Pollard TD, Earnshaw WC, Schwartz JL and Johnson GT (2017).Cell Biology.Third Edition. Elsevier publication.*

REFERENCE BOOKS FOR PRACTICALS:

1. *Alberts B, Hopkins, Lewis J, Raff M, Robertis K, Walter P (2014): Essential Cell Biology, Fourth Edition, Graland Science Taylor & Francis Group, UK.*
 2. *Chaitanya KV(2013).Cell and Molecular biology- A lab manual.PHI Learning Pvt.LtdNew delhi.*
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MULTIDISCIPLINARY COURSE (MDC)

COURSE TITLE: **NUTRITION AND DIET PLANS**

COURSE CODE: UG-ZOO-MDC 1

MARKS: 75 [50 –Theory ; 25- Practicals]

CREDITS: 03 [02 –Theory; 01- Practical]

CONTACT HOURS: THEORY : 30 HOURS (02 LEC/WEEK)
PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)

COURSE OBJECTIVES: This course will give an insight into the nutritional requirements of human and diseases associated with nutrient deficiency or order-dose. It will also help to understand food labels and diest plans for different age groups.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:
CO1: Explain the nutritional requirements of human.
CO2: Identify the types of various nutrients in our diet
CO3: Correlate diet with diseases related to nutrient deficiency or overdose.
CO4: Read and interpret food labels.

CONTENT

Module I: Introduction to Food and Nutritional requirements	UNIT 1: Overview of health and nutrition: Definition, Scope of nutrition, food as a source of nutrients, Nutrients and energy, Adequate, optimum and balanced diet, Malnutrition and health. Unit 2:Macronutrients: Definition, Classification and properties of Carbohydrates,lipids,proteins. Unit 3: Micronutrients-Vitamins and minerals.	15 hours
Module II: Diet Related Diseases	Unit 4: Major nutritional deficiency diseases- protein energy malnutrition, Vitamin A deficiency, iron deficiency anemia, iodine deficiency disorders(causes, symptoms, treatment, prevention) Unit 5: Food and water borne diseases, Life style related diseases - obesity, hypertension, diabetes mellitus, polycystic ovarian disease (PCOD) (causes and prevention through dietary/lifestyle modifications). Unit 6: Diet plans for different age groups (Activity based learning).	15 hours

PRACTICAL: 01 CREDIT

MAX.MKS:25 (30 Hrs)

- | | | |
|----|---|----------|
| 1. | To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric e)Honey | 06 hours |
| 2. | Estimation of lactose in milk | 04 hours |
| 3. | Titrametic estimation of: Ascorbic acid estimation in food | 04 hours |
| 4. | Observation of any two pests of grains | 02 hours |
| 5. | Project based Practical with research(any one): <ul style="list-style-type: none">• Identify nutrient rich sources of foods, their seasonal availability and price• Study of Nutrient labels of selected foods | 08 hours |
| 6. | PA | 06 hours |

REFERENCE BOOKS:

- 1) Bamji MS(2019). Text Book of Human Nutrition. 4th edition. Oxford & IBH Publishing Co Pvt.Ltd
 - 2) Bansal R(2021).Food, Nutrition and Hygiene. SBPD Publishing House
 - 3) Gopalan C, Ramashastry BV(2021). Nutritive value of Indian Foods. Published by National Institute of Nutrition, India.
 - 4) Joshi SA(2021). Nutrition and Dietetics. Fifth Edition. Mc.Graw Hill Publishers.
 - 5) Lal H(2022). Textbook of Applied Biochemistry And Nutrition And Dietetics.CBS Publishers & Distributors Pvt.Ltd.
 - 6) Roday S(2018). Food Science and Nutrition. Third edition. Oxford University Press.
 - 7) Srilakshmi B(2019). Dietetics. NEW AGE International Publishers
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MULTIDISCIPLINARY COURSE (MDC)

COURSE TITLE: **TECHNIQUES OF FISH PRESERVATION AND PROCESSING**

COURSE CODE: UG-ZOO-MDC 2

MARKS: 75 [50 –Theory ; 25- Practicals]

CREDITS: 03 [02 –Theory; 01- Practical]

CONTACT HOURS: THEORY : 30 HOURS (02 LEC/WEEK)
PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)

COURSE

OBJECTIVES: This course is designed to familiarize the students with different methods of fish preservation and processing with emphasis on local traditional knowledge. It also gives an insight into the techniques and precautions for hygienic fish handling.

COURSE

OUTCOME: Upon successful completion of the course, students will be able to:
CO1: Obtain understanding of locally available fishes.
CO2: Discuss the economic benefits of fishes.
CO3: Explain the nutritional values and products obtained from the fishes
CO4: Perform some protocols of Fish processing and preservation.

CONTENT

Module I: Introduction to Food and Nutritional requirements	Unit 1: Introduction to Locally available fishes (Marine, Freshwater). Unit 2: Nutritional value of : Pomfret, mackerel, Bombay duck, Sardines, Kingfish, Salmon, catfish, Unit 3: Non Pisces in fishery industry- Crabs, Lobsters, Prawns, Oysters, Mussels. (importance and nutritional value) Unit 4: Activity based learning (Nutrient value of different fishes)	15 hours
Module II: Diet Related Diseases	Unit 5: Introduction to fish processing and preservation (history, control of temperature, control of water activity, microbes, processing fresh fish ,vacuum packaging). Unit 6: Fish preservation techniques – Short term and long term (Chilling/refrigeration, Deep Freezing, Freeze-drying, Salting, Drying, curing, Canning, Smoking, irradiating), Unit 7: Value added Fish products – Fish Liver Oil , Fish Body Oil , Fish Meal, Fish Manure , Fish Flour, Isinglass, Fish Silage , Fish Sausage , Fish Biscuits , Fish Roe and Caviar, Fish pickles, Fish flakes, Fish wafers, fish noodles, Fish sauces etc. Unit 8: Activity based learning (Local techniques of Fish preservation).	15 hours

PRACTICAL: 01 CREDIT

MAX.MKS:25 (30 Hrs)

1	To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric	06 hours
2	Estimation of lactose in milk	04 hours
3	Titrametric estimation of: Ascorbic acid estimation in food	04 hours
4	Observation of any two pests of grains	02 hours
5	Project based Practical with research(any one): <ul style="list-style-type: none">Identify nutrient rich sources of foods, their seasonal availability and priceStudy of Nutrient labels of selected foods	08 hours
6	PA	06 hours

REFERENCE BOOKS:

1. Biswas KP(2014)Fish Processing and Preservation. Daya Publishing House. New Dehli.
 2. Faridi AZ(2021) Textbook Of Fish Processing Technology. Oxford Book Company Publisher.
 3. Mathew S, Raman M, Rajan PP (2021). Fish, Fishery products analysis. Springer Verlag, Singapore.
 4. Mishra R(2022).Handbook on Fish Processing and Preservation. NPH publishing house, New Dehli.
 5. Prasad TL, Ramaswamy K(2014). Fish Processing Technology. Crescent Publishing House.
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SKILL ENHANCEMENT COURSE (SEC)

COURSE TITLE: WASTE MANAGEMENT TECHNIQUES

COURSE CODE: UG-ZOO-SEC 1

MARKS: 75 [50 –Theory ; 25- Practicals]

CREDITS: 03 [02 –Theory; 01- Practical]

**CONTACT HOURS: THEORY : 30 HOURS (02 LEC/WEEK)
PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)**

COURSE OBJECTIVES: This course aims at familiarizing the students with the techniques of waste management, offering t hands on experience on techniques of managing waste and helping students understand the importance of reducing, reusing and recycling

COURSE OUTCOME: Upon successful completion of the course, students will be able to:
CO1: Understand concept of types of waste, its transport and disposal.
CO2: Write about the laws governing waste management
CO3: Identify means of reducing waste production.
CO4: Perform composting techniques / procedures

CONTENT

Module I: Introduction to waste management	UNIT 1: Overview of types of waste, collection, transport, treatment and disposal of waste. UNIT 2: Waste generated- sources, and management, Storage and collection of different kinds of wastes. UNIT 3: Need for Waste management and effect on the community. UNIT 4: Waste treatment methods: Physicochemical Treatment of Solid and Hazardous Waste, Chemical treatment processes, Biological Treatment of Solid and Hazardous Waste, 3 Rs- Reuse Reduce and Recycle. UNIT 5: Activity on Relevant Regulations governing waste management.	15 hours
Module II: Waste management techniques	UNIT 6: Sewage disposal; Medical waste management. Sources, measures and health effects; disposal options UNIT 7: Bioremediation, ground water contamination and remediation Landfill designing and Incineration. UNIT 8: Radioactive and E- waste management-Sources, measures and health effects. UNIT 9: Organic composting- Methods, Procedure -Microorganisms, materials used, design and maintenance, Biogas UNIT 10: Vermicomposting- Earthworms – biology- life cycle and feeding, predators/pathogen control, requirements of Vermicomposting, initiation and maintenance of Vermicomposting, analysis of compost. UNIT 1: Overview of types of waste, collection, transport, treatment and disposal of waste. UNIT 2: Waste generated- sources, and management, Storage and collection of different kinds of wastes. UNIT 3: Need for Waste management and effect on the community. UNIT 4: Waste treatment methods: Physicochemical Treatment of Solid and Hazardous Waste, Chemical treatment processes, Biological Treatment of Solid and Hazardous Waste, 3 Rs- Reuse Reduce and Recycle. UNIT 5: Activity on Relevant Regulations governing waste management.	15 hours

PRACTICAL: 01 CREDIT

MAX.MKS:25 (30 Hrs)

1	Case study – Regulations governing waste management	02 hours
2	Waste collection /Awareness drive/Visit to Sewage treatment plant/Waste disposal plant	04 hours
3	Leaf composting /Vermicomposting	12 hours
4	Handmade Paper	02 hours
5	Art from waste –Practicing Recycle, Reduce, Reuse.	04 hours
6	PA	06 hours

REFERENCE BOOKS:

1. Chandrappa R and Das DB(2012).Solid Waste Management: Principles and Practice.Springer publishers
 2. Edwards CA, Hendrix P and Arancon N (2014) Biology and Ecology of Earthworms, Springer Publishers.
 3. Edwards CA(2021).Vermicomposting technology. 1st edition, Taylor & Francis Ltd.
 4. Karaca A (2011) Soil Biology: Biology of Earthworms. Springer Publishers.
 5. Sherman R(2018). The Worm Farmer;s handbook. Chelsea Green Publishing Co ltd.
 6. TERI(2014).Waste to resources – a waste Management Handbook. TERI Press, New delhi.
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SKILL ENHANCEMENT COURSE (SEC)

COURSE TITLE: BIO-ENTREPRENEURSHIP

COURSE CODE: UG-ZOO-SEC 2

MARKS: 75 [50 –Theory ; 25- Practicals]

CREDITS: 03 [02 –Theory; 01- Practical]

CONTACT HOURS: THEORY : 30 HOURS (02 LEC/WEEK)
PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)

COURSE OBJECTIVES: This course is designed to familiarize the students the basic skills required for a start-up, have deeper knowledge on generating ideas, preparing a business plan, and regulations and compliances associated with initiating a business venture, with emphasis on opportunities in biological field.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:
CO1: understand concept of business Proposals
CO2: familiar with the methodologies and regulations required to start an enterprise
CO3: Identify opportunities available in life science for start-ups.
CO4: Generate Ideas and initiate a Business Plan.

CONTENT

Module I: Introduction to entrepreneurship	Unit 1: Understanding terminologies: Entrepreneur, Businessman, Entrepreneurship, Enterprise, Start-up, MSMEs, Unicorns, Bioentrepreneurship. UNIT 2: Entrepreneurial competencies, Qualities, skills, resources and personality types influencing business ventures. UNIT 3: Advantages and Disadvantages of Entrepreneurship UNIT 4: Steps of Entrepreneurial Process – Develop Business plan, Acquire finances, meet legal requirements. UNIT 5: Bioentrepreneurship opportunities (Aquaculture/Pisciculture/ Beekeeping/ Ecotourism ventures/livestock (piggery/poultry/dairy).	15 hours
Module II: Structure and Regulations	UNIT 6: Business model canvas – Structure and presentation. UNIT 7: Introduction to Start-Ups: Start-up features, types of start-ups, Steps in initiating Start-up company, evaluating startup potential, Scaling a start-up, registering a startup, National status of startups in India. UNIT 8: Intellectual Property Rights and trademark of biological resources – Types of IPs: Copyrights, Industrial property (patents, trademarks, industrial designs and geographic indications). UNIT 9: Quality, safety and procedural compliances: Quality control, Quality assurance, Quality Improvement and Quality planning. Quality standards(ISO), Quality management principles, procedural compliances.	15 hours

PRACTICAL: 01 CREDIT

MAX.MKS:25 (30 Hrs)

1	Activity on testing entrepreneurial competencies	04 hours
2	Initiating business ideas	04 hours
3	Interactions with successful entrepreneur, Banker/ Angel Investor / workshops on entrepreneurship	06 hours
4	Preparing and presenting Business Plan	06 hours
5	Workshop/seminar/ interaction with entrepreneurs	04 hours
6	PA	06 hours

REFERENCE BOOKS:

1. Patzelt H and Brenner T(2021). Handbook of bioentrepreneurship. Springer Publisher.
 2. Pandey and Shukla (2015) Fish and Fisheries, IIIrd Revised Edition, Rastogi Publications Meerut, India
 3. Sinha D(2021).Introduction to Bioentrepreneurship. IGI Global Publishers.
 4. Singh BK (2018) Applied Fisheries and Aquaculture Swastik Publishers and Distributers Delhi,India
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VALUE ADDED COURSE (VAC)

COURSE TITLE: **ENVIRONMENT PROTECTION PRACTICES**

COURSE CODE: UG-ZOO-VAC 1

MARKS: 50 [50 –Theory]

CREDITS: 02 [02 –Theory]

CONTACT HOURS: THEORY : 30 HOURS (02 LEC/WEEK)

COURSE OBJECTIVES: This course aims at familiarizing the students with the duties and responsibilities of an individual in adopting certain good practices for protection of environment.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:
CO1: Understand the basic rules and regulations governing environment conservation and protection.
CO2: Adopt practices for energy, water and wildlife conservation.
CO3: Identify means of reducing waste production.
CO4: Demonstrate Recycle, Reduce, Reuse. in the daily activities

CONTENT

Module I:	UNIT 1: Introduction to environmental Pollution UNIT 2: Environment protection laws and laws governing individual/societal responsibilities towards environment UNIT 3: Individual efforts : <ul style="list-style-type: none">- Waste disposal at homes- Going organic- Upcycling	15 hours
Module II:	UNIT 4: Individual efforts towards: <ul style="list-style-type: none">- Water conservation,- Energy conservation,- Preventing Air, water & land pollution. Methods of evaluation of air, land and water pollution, Preventing pollution. UNIT 5: Individual efforts towards: <ul style="list-style-type: none">- Reducing Carbon footprint- Practicing Recycle, Reduce, Reuse.- Wildlife conservation/protection efforts including forest fires UNIT 6: Activities related to 3Rs/ case studies on pollution/Environment Impact Assessment.	15 hours

REFERENCE BOOKS:

1. Chandrappa R and Das DB(2012).Solid Waste Management: Principles and Practice.Springer publishers.
2. TERI(2014).Waste to resources – a waste Management Handbook. TERI Press, New delhi.
3. Goodal J(2022).Local Voices, Local Choices: The Tacare Approach to Community-Led Conservation
4. Hendon J(2019).Environmental Conservation and Management. Syrawood Publishing House