



**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 YEARS BACHELORS DEGREE IN ZOOLOGY
/ FOUR YEARS
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- SEC1 Waste Management Techniques
				UG-ZOO-VAC 2 Sustainable Development Goals- Life Below Water and On Land.		
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- SEC2 Bio Entrepreneurs hip
III	UG-ZOO-201 Fundamentals of Animal and Human Genetics	UG-ZOO-203 Inheritance Pattern of Genetic traits and Diseases	UG-ZOO- MDC3 Aquarium maintenance: Freshwater and Marine fishes	--	--	UG-ZOO- SEC3 Biological 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 Fish Farming and Preservation Techniques	--	--	--	--	--
V	UG-ZOO-301 Health & Nutrition	UG-ZOO-VOC2 Nutrition and Dietetics	--	--	--	--
	UG-ZOO-302 Developmental Biology	--	--	--	--	--
	UG-ZOO-303 Environmental Toxicology and Evolutionary Biology	--	--	--	--	--

	UG-ZOO-PRJ Project(a)	--	--	--	--	--
VI	UG-ZOO-304 Molecular geneticsand Basics of Forensic Science	UG-ZOO-VOC3 Application of techniques in wildlife monitoring	--	--	--	--
	UG-ZOO-305 Wildlife Biology andEthology	--	--	--	--	--
	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 contrast the life processes in chordates and non-chordates.

Course Learning Outcomes:

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

CLO1: Identify Non-Chordates from Chordates based on morphological and anatomical features

CLO2: Identify and classify Non-Chordates and Chordates upto Class/Order level

CLO3: Understand the basis of life processes

CLO4: Be able to use taxonomic keys to identify Non-Chordates and Chordates

Context:

Module I: Introduction to diversity and classification of lower Non-Chordates

[Contact Hours 15]

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 Onychophora

Module II: Diversity of higher Non-Chordates & Introduction to Phylum Chordata and its classification

[Contact Hours 15]

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

Module III: Diversity of Vertebrates and classification up to Order level

[Contact Hours 15]

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

Practicals

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, nests 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. Practical assessments [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.*
5. Cleveland HJ, Larry R, Keen S, Larson A and Eisenhour D (2020). *Animal Diversity. McGraw Hill Science.*
6. Sinha AK, Adhikari Sand Ganguly BB(2022). *Biology of Animals Volume II. New Central Book Agency*

Reference 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: 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 distinguishing characters of classes of organisms and understand how the evolutionary process progressed from simple to complex forms.

Course Learning Outcomes:

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

CLO1: Understand the basic concepts of animal kingdom, taxonomy and nomenclature

CLO2: Identify and Classify Non-Chordates and Chordates

CLO3: Identify distinguishing characters of Classes

CLO4: Be able to use taxonomic keys to identify Non-Chordates and Chordates

Context:

Module I: Introduction to Non-Chordates and study of its diversity

[Contact Hours 15]

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 Onychophora

Unit 4: Deeper understanding of classification through activities (E- Posters on classes of above mentioned Phyla / Presentations)

Module II: Diversity of higher Non-Chordates & Introduction to Phylum Chordata and its classification

[Contact Hours 15]

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)

Module III: Diversity of Vertebrates and classification

[Contact Hours 15]

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)

Practicals

1. Identification of representative organisms of Non-Chordates **[08 hours]**

2. Identification of representative organisms of Chordates (local sps) **[08 hours]**
3. Observation: Prawn appendages, mouthparts of cockroach, scales and chromatophores in fishes, nests 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. Practical assessments **[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.*
5. *Cleveland HJ, Larry R, Keen S, Larson A and Eisenhour D (2020). Animal Diversity. McGraw Hill Science.*
6. *Sinha AK, Adhikari Sand Ganguly BB(2022). Biology of Animals Volume II. New Central Book Agency*

Reference 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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MULTIDISCIPLINARY COURSE

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 over-dose. It will also help to understand food labels and diet plans for different age groups.

Course Learning Outcomes:

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

CLO1: Explain the nutritional requirements of humans

CLO2: Correlate diet with diseases related to nutrient deficiency or overdose

CLO3: Perform tests for assessing food quality

Context:

Module I: Introduction to Food and Nutritional requirements

[Contact Hours 15]

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 and proteins

Unit 3: Micronutrients-Vitamins and minerals

Module II: Diet Related Diseases

[Contact Hours 15]

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).

Practicals

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. Titrimetric 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):
 - a. Identify nutrient rich sources of foods, their seasonal availability and price
 - b. Study of Nutrient labels of selected foods **[08 hours]**
6. Practical assessments **[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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VALUE ADDED COURSE

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 Learning Outcomes:

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

CLO1: Understand the basic rules and regulations governing environment conservation and protection.

CLO2: Identify means of waste reduction and resource conservation

Context:

Module I:

[Contact Hours 15]

Unit 1: Introduction to environmental Pollution

Unit 2: Environment protection laws and laws governing individual/societal responsibilities towards environment

Unit 3: Individual efforts: Waste disposal at homes, Going organic, Upcycling

Module II:

[Contact Hours 15]

Unit 4: Individual efforts towards: 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: 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.

Reference books:

1. Chandrappa R and Das DB(2012).Solid Waste Management: Principles and Practice.Springerpublishers.
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-LedConservation
4. Hendon J(2019).Environmental Conservation and Management. Syrawood Publishing House

VALUE ADDED COURSE (VAC)

Course Title: Sustainable Development Goals – Life Below Water and On Land

Course Code: UG-ZOO-VAC 2

Marks: 50 [50-Theory]

Credits: 02 [02-Theory]

Contact Hours: Theory: 30 hours (02 lectures /week)

Course Objectives:

The course intends to highlight the understanding of Sustainable Development Goal 14 and 15 including significance, historical context and key objectives related to preservation of life below water and on land.

Course Outcomes:

On completion of the course, the students will be able to:

CLO1: Gain comprehensive understanding of SDG 14 and importance of Oceans and marine life

CLO2: Understand SDG 15 and importance of biodiversity on land

Context:

Module I: Sustainable Development Goal 14

[Contact Hours 15]

Unit 01: Overview of SDG 14: Life Below Water, Historical context and significance, Key objectives and targets.

Unit 02: Importance of Oceans and marine life, Threats to marine ecosystem: Pollution, Climate change and Ocean Acidification; Conservation strategies and marine protected areas.

Unit 03: Challenges in Global fisheries, Overfishing and its consequences, Sustainable fishing practices and management, Innovation in sustainable fisheries

Unit 04: Impact of tourism on coastal areas, Sustainable tourism practices and supporting coastal communities

Unit 05: Policies addressing SDG 14

Module II: Sustainable Development Goal 15

[Contact Hours 15]

Unit 06: Overview of SDG 15: Life on Land, Historical context and significance, Key objectives and targets

Unit 07: Importance of biodiversity on land, Threats to terrestrial ecosystems, Conservation strategies and protected areas

Unit 08: Causes and consequences of Deforestation, Reforestation initiatives and sustainable forestry practices

Unit 09: Importance of recognizing and respecting indigenous land rights, Collaborative approaches for land conservation

Unit 10: Connection between land use and climate change, Sustainable land management practices for climate mitigation, Carbon sequestration in forests and other ecosystems

Reference Books:

1. Morton, S., Pencheon, D., and Squires, N. (2017). *Sustainable Development Goals (SDGs), and their implementation. A national global framework for health, development and equity needs a systems approach at every level. In British Medical Bulletin. 124: 81-90 .doi: 10.1093/bmb/ldx031*

2. Department of Economic and Social Affairs. (2023). *The Sustainable Development Goals Report. The United Nations. Special Edition. ISBN 978-92-1-101460-0. Retrieved from <https://unstats.un.org/sdgs/report/2023/The->*

SKILL ENHANCEMENT COURSE

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 wastemanagement, offering hands on experience on techniques of managing waste and helping students understand the importance of reducing, reusing and recycling.

Course Learning Outcomes:

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

CLO1: Understand concept of types of waste, its transport and disposal.

CLO2: Explain waste treatment methods and laws governing waste management

CLO3: Identify means of reducing waste production.

Context:

Module I: Introduction to waste management

[Contact Hours 15]

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.

Module II: Waste management techniques

[Contact Hours 15]

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.

Practicals

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. Practical assessments [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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SEMESTER II

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 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 Learning Outcomes:

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

CLO1: Understand the fundamentals of Cell Study methods and biomolecules

CLO2: Understand membrane structure, ultrastructure and functions of Cellular components

CLO3: Explain cell signaling pathways and mechanisms of cellular transport

CLO4: Perform a variety of molecular and cellular biology techniques

Context:

Module I: Techniques Of Cell Study and Cell Chemistry

[Contact Hours 15]

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, amino acids, Nucleotides.

Macromolecules in cells: Nucleic acids, proteins, Polysaccharides, glycogen, fats.

Unit 4: Chemical Bonds In Biomolecules: Covalent bonds, ionic bonds, noncovalent interactions

Module II: Cell Architecture

[Contact Hours 15]

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

Module III: Cellular Transport of Proteins and Vesicles

[Contact Hours 15]

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^+ , Ca^{2+}) Ion Channels - ion channels activities, regulation of opening and closing of channel; Protein transport into organelle.

Unit 9: Vesicular transport & cell signalling: Vesicular transport – transport of soluble proteins, Clathrins, vesicle budding, vesicle docking, endocytic pathways, general principles of cell signalling.

Practicals

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. Practical assessments [06 hours]

Reference books:

- 1) *Alberts B, Heald R, Hopkin K, Johnson A, Morgan D, Roberts K, Walter P (2022). Essential Cellbiology. Sixth edition. E Book. Norton Illumine.*
- 2) *Alberts B, Hopkins, Lewis J, Raff M, Robertis K, Walter P (2014): Essential Cell Biology, FourthEdition, 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 RastogiPublications, Meerut, New Delhi, India.*
- 6) *Pollard TD, Earnshaw WC, Schwartz JL and Johnson GT (2017).Cell Biology.Third Edition.Elsevier publication.*

Reference for Practicals:

- 1) *Alberts B, Hopkins, Lewis J, Raff M, Robertis K, Walter P (2014): Essential Cell Biology, FourthEdition, 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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MINOR CORE COURSE

Course Title: Techniques of Cell Study and 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 cellbiology. 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 Learning Outcomes:

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

CLO1: Understand the fundamentals of cell study methods, ultrastructure and functioning of cell organelles

CLO2: Understand biomolecules and their functions

CLO3: Explain cell signaling pathways and mechanism of cellular transport

CLO4: Perform cellular biology techniques of slide preparation staining and microscopy

Context:

Module I: Animal Cell Architecture and Techniques of Cell study

[Contact Hours 15]

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

Module II: Cell Molecules and Chemistry

[Contact Hours 15]

Unit 4: Molecules In Cell: Micromolecules in cells: Sugars, Fatty acids, amino acids, Nucleotides.

Unit 5: Macromolecules in cells: Nucleic acids, proteins, Polysaccharides, glycogen, fats.

Unit 6: Chemical Bonds in Biomolecules: Covalent bonds, ionic bonds, noncovalent interactions

Module III: Cellular Transport in Animal cells

[Contact Hours 15]

Unit 7: Principle of transmembrane transport (transporters and channels, active and passive transport, osmosis);

Unit 8: Transporters and their function- passive transporters, Pumps(Na⁺, K⁺, Ca)

Unit 9: Ion Channels - ion channels activities, regulation of opening and closing of channels

Unit 10: Protein transport into organelle (nucleus, mitochondria, ER)

Unit 11: Vesicular transport – transport of soluble proteins, Clathrins, vesicle budding, vesicle docking, endocytic pathways

Practicals

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. Practical assessments [06 hours]

Reference 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 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. Ltd New delhi.*
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MULTIDISCIPLINARY COURSE

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 Learning Outcomes:

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

CLO1: Gain comprehensive understanding about locally available fishes and Non-Pisces

CLO2: Explain the nutritional values and products obtained from the fishes

CLO3: Perform techniques of Fish processing and preservation.

Context:

Module I: Introduction to Food and Nutritional requirements

[Contact Hours 15]

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)

Module II: Diet Related Diseases

[Contact Hours 15]

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).

Practicals

1. Identification of common local fishes(08) [08 hours]
2. Fish parasites [04 hours]
3. Fish filleting [02 hours]
4. Fish Preservation Technique (salting/pickling) [06 hours]
5. Visit to Fish processing Centre/ Fishing Co-operative Society/ Fishery Institute/ Fish Survey of India/Fish landing Centre/Fish Market [04 hours]
6. Practical assessments [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, Ramashastri 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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SKILL ENHANCEMENT COURSE

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 c ideas, preparing a business plan, and regulations and compliances associated with initiating a business venture, wi on opportunities in biological field.

Course Learning Outcomes:

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

CLO1: Understand basic principles of Entrepreneurship

CLO2: Understand concept of business Proposals

CLO3: Generate Ideas and initiate a Business Plan.

Context:

Module I: Introduction to entrepreneurship

[Contact Hours 15]

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).

Module II: Structure and Regulations

[Contact Hours 15]

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.

Practicals

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 entrepreneur [04 hours]
6. Practical assessments [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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