



**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)

Annexure A
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 Genetic Traits and Diseases	UG-ZOO- MDC3 Aquarium maintenance: Freshwater and Marine fishes	--	--	UG-ZOO- SEC3 Biologic 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 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 genetics and Basics of Forensic Science	UG-ZOO-VOC3 Application of techniques in wildlife monitoring	--	--	--	--
	UG-ZOO-305 Wildlife Biology and Ethology	--	--	--	--	--
	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 diet 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 price• Study 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

SEMESTER
III

DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE:	FUNDAMENTALS OF ANIMAL AND HUMAN GENETICS
COURSE CODE :	UG-ZOO-201
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 is intended to provide solid understanding of concepts and principles of genetics as it applies to animals and humans. Students will receive good foundation of chromosome structure, its aberrations and inheritance patterns of traits and disease which will help one to develop conceptual skills to address questions in genetic research.
COURSE OUTCOME :	Upon successful completion of the course, students will be able to CO1: Describe the basic structure of genes and chromosomes. CO2: Relate an organism's genotype and phenotype and explain the role of genes in inheritance. CO3: Associate knowledge of genetic principles to the phenomena which occur in humans with reference to genetic inheritance. CO4: Construct and analyze pedigrees to determine mode of inheritance of disorders and traits

CONTENT:

MODULE I: Transmission Genetics	UNIT 1: MODES OF INHERITANCE <ul style="list-style-type: none">• Mendels laws of inheritance, test cross, back cross• Gene interactions: 9:3:3:1/12:3:1 / 9:3:4/9:6:1 / 9:7 / 15:1 / 13:3, lethal genes, penetrance.• Inheritance of Multiple Alleles and Multiple Genes	15 Hours
	UNIT 2: PATTERN OF INHERITANCE BY PEDIGREES <ul style="list-style-type: none">• Construction of Pedigrees• Analysis of Pedigree analysis: autosomal dominant, autosomal recessive, X-Linked dominant, X-linked recessive, Y-linked, Mitochondrial inheritance• Sex limited and Sex influenced and multifactorial inheritance disorders in	

humans

MODULE II:
Chromosome Structure
and Abnormalities in
Humans

UNIT 3: CHROMOSOME STRUCTURE

- Chromosome morphology- chromatid, centromere, secondary constriction, chromomere
- Heterochromatin and euchromatin
- Chromosome structure and organization.
- Human chromosomes and karyotype.

15 Hours

UNIT 4: CHROMOSOMAL ABERRATION

- Numerical aberrations: Types- Aneuploidies and Euploidies, Mosaicism
- Structural Abnormalities: Types-Deletions, inversions, Translocations, duplications.

MODULE III:
Gene Mutations,
Sex Determination

UNIT 5: GENETIC MUTATIONS

- Characteristics of mutations
- Classification of mutations (Spontaneous, Induced) molecular basis of mutations
- Mutagens – physical and chemical

15 Hours

UNIT 6: SEX DETERMINATION

- Environmental Sex Determination – hormonal, egg size, incubation temperature.
- Chromosomal sex determination - XX and XO, XO and XX, ZW and ZZ, XX and XY, Diploid female and Haploid male, single gene effect.
- Molecular basis of sex determination: Geneic imbalance, Sex index, Intersex and gynandomorphs, X/A Ratio. Sex determination by Y linked genes, Dosage compensation, X-inactivation.

PRACTICAL: 01 CREDIT (30 HRS)

MAX MARKS: 25

1	Verification of Mendel's laws - monohybrid cross	01
2	Verification of Mendel's laws - dihybrid cross	01
3	Manual Karyotyping of human chromosome plates: 1) Normal Male and Female 2) Downs syndrome	02
4	Drosophila Culture technique	03
5	Study of Mutants of Drosophila	01
6	Exercises for Multiple alleles and Multiple genes	02
7	Construction and analysis of pedigrees	02
8	Practical Assessment	03

REFERENCES

1. Gardner EJ, Simmons MJ and Snustad DP (2013): *Principles of Genetics, Eighth Edition*, John Wiley Publication, Singapore.
2. De Robertis EDP, De Robertis EMF (2012): *Cell and Molecular Biology, Eighth Edition*. Wolter Kluwer Publication, Philadelphia.
3. Singh BD (2014): *Fundamentals of Genetics. Second Edition*, Kalyani Publishers, New Delhi.
4. Lewis R (2009): *Human Genetics, Concepts and Applications, Seventh Edition*. McGraw-Hill International Edition, New York.
5. Gangane SD (2009): *Human genetics, Third Edition*, Reed Elsevier India Pvt Ltd., Haryana India.
6. Gardner A, Davies T (2010): *Human Geentics, Second Edition*, Scion Publishing Ltd, UK.
7. Marcus A (2011): *Genetics*, MJP Publishers, Chennai.
8. Verma PS and Agarwal VK (2014): *Cell Biology Genetics Molecular Biology Evolution & Ecology*. S Chand and Company PVT LTD, New Delhi.
10. Kothari ML, Mehta L, Roychoudhury SS (2009): *Essentials of Human Genetics, Fifth edition*, University Press Pvt. Ltd. Hyderabad.

REFERENCE BOOKS FOR PRACTICALS:

1. Gangane SD (2009): *Human genetics, Third Edition*, Reed Elsevier India Pvt Ltd., Haryana India.
2. Marcus A(2011): *Genetics*, MJP Publishers, Chennai.
3. Gardner A, Davies T (2010): *Human Genetics, Second Edition*, Scion Publishing Ltd, UK.
4. Lewis R (2009): *Human Genetics, Concepts and Applications, Seventh Edition*. McGraw-Hill International Edition, New York

DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE:	BIOCHEMISTRY AND METABOLIC REGULATION
COURSE CODE :	UG-ZOO-202
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 :	To understand the basic principles that govern the functioning of living systems To know the structure of biomolecules and the role they play in governing life processes through the pathways To be familiar with enzymes and their activities
COURSE OUTCOME :	Upon successful completion of the course, students will be able to: CO1: Understand better the chemical basis in life. CO2: Know the basic principles that govern the functioning of living systems CO3: Be familiar with enzymes and their activities CO4: Appreciate better the interactions between the biological molecules.

CONTENT:

MODULE I: Fundamentals of biochemistry and Carbohydrate metabolism	Unit 1: pH, Buffer and thermodynamics • Principles of pH, buffer, • Introduction to thermodynamics • Laws of thermodynamics Unit 2: Enzymes • Classification and properties of enzymes • Enzyme kinetics • Michaelis Menten Equation, • Enzyme inhibition Unit 3: Carbohydrate: • Carbohydrate structure • Aerobic and anaerobic glycolysis • Citric acid cycle • Glycogenesis,	15 Hours
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- Glycogenolysis
- Gluconeogenesis
- Pentose phosphate pathway
- Disorders: Diabetes mellitus

MODULE II: Lipid and Protein metabolism

UNIT 4: LIPID

15 Hours

- structure and classification,
- Fatty acid synthesis
- Fatty acid oxidation(saturated and unsaturated)
- Metabolism of glycerophospholipids
- Sphingolipids, cholesterol
- Disorders: fatty liver types (NAFL, AFL)

UNIT 5: Protein

- Protein Structure(primary, secondary, tertiary)
- Classification of Proteins
- Amino acid biosynthesis
- Nucleotide biosynthesis
- Amino acid catabolism
- Urea cycle
- Fate of carbamoyl P,
- Disorders: Hyper uricemia

MODULE III: Nucleotide metabolism and integration of metabolism

UNIT 6: NUCLEIC ACID

15 Hours

- Biosynthesis of purine and pyrimidine (de novo and salvage pathway)
- Degradation of purine and pyrimidine

UNIT 7: Interconversions of biomolecules

- Interconversions between the three principal Components
- Metabolism in starvation: Carbohydrate, lipid, proteins (The feed/fast cycle)

PRACTICAL: 01 CREDIT (30 HRS)

MAX MARKS: 25

1	Principle and working of spectrophotometer	01
2	Estimation of reducing sugars DNSA method	01
3	Estimation of protein – Folin Lowry's method	01
4	Estimation of fatty acids by titration method	01
5	Separation of lipids by thin layer chromatography	02
6	Colorimetric estimation of liver glycogen of chick by Anthrone method	02
7	Effect of substrate concentration on amylase activity	02
8	Estimation of DNA by DPA method	02
9	Practical Assessment	03

REFERENCE BOOKS

1. David, L.N. and Cox, M. Michael (2008) *Lehninger principles of biochemistry*. W.H. Freeman and Company, New York.
2. Delvin, T.M. (1997). *Textbook of biochemistry with clinical correlations*. Wiley liss.
3. Harvey, A.R. and Ferrier, D. (2011). *Lippincott's Illustrated Reviews Biochemistry*. Wolters Kluwer, Lippincott Williams and Wilkins. 5th Edition.
4. Pratt, W.C. and K. Cornely 2003 *Essential Biochemistry* Wiley Publications third edition

REFERENCE BOOKS FOR PRACTICALS:

Plummer, M. and D.T. Plummer (1988) *Introduction to practical biochemistry*. Tata McGraw Hill Education ,UK.

MINOR CORE COURSE

COURSE TITLE: **INHERITANCE PATTERN OF GENETIC TRAITS AND DISEASES**

COURSE CODE: UG-ZOO-203

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

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

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

COURSE OBJECTIVES: This course is intended to provide solid understanding of Inheritance pattern of Genetic Traits and Diseases. Students will receive good foundation of inheritance patterns of traits and disease, genetic alterations in human genome, its effects and diagnosis.

COURSE OUTCOME: Upon successful completion of the course, students will be able to
CO1: Relate an organism's genotype and phenotype and explain the role of genes in inheritance.
CO2: Associate knowledge of genetic principles to the phenomena which occur in humans with reference to genetic inheritance.
CO3: Construct and analyse pedigrees to determine mode of inheritance of disorders and traits.
CO4: Understand the impact of changes occurring at gene level on human health and its diagnosis.

CONTENT:

MODULE 1: Transmission Genetics	UNIT 1: MODES OF INHERITANCE 15 hours <ul style="list-style-type: none">• Mendel's laws of inheritance, test cross, back cross• Gene interactions: 9:3:3:1/12:3:1 / 9:3:4/9:6:1 / 9:7 / 15:1 / 13:3, lethal genes, penetrance.• Inheritance of Multiple Alleles and Multiple Genes UNIT 2: PATTERN OF INHERITANCE BY PEDIGREES <ul style="list-style-type: none">• Construction of Pedigrees• Analysis of Pedigree analysis: autosomal dominant, autosomal recessive, X-Linked dominant, X-linked recessive, Y-linked, Mitochondrial inheritance• Sex limited and Sex influenced and multifactorial inheritance disorders in humans
MODULE 2:	UNIT 3: CHROMOSOME AND KARYOTYPE 15 hours

**HUMAN
KARYOTYPE
AND
CHROMOSOME
DISORDERS**

- Chromosome structure and organization.
- Normal human karyotype: Karyotype preparation & banding techniques, band numbering scheme, human genome sequencing & human genome project.

UNIT 4: CHROMOSOME DISORDERS

- Non-disjunction of autosomal chromosomes: Trisomy 21, Trisomy 18 & Trisomy 13 syndrome.
- Non-disjunction of sex chromosomes: Turner's syndrome, Klinefelter's syndrome, XXY males.
- Deletions & duplications with examples
- Inversion & Translocation with examples

**MODULE 3:
GENETIC
DISORDERS
AND DIAGNOSIS**

UNIT 5: GENETIC DISORDERS

15hours

- Inborn Errors of Metabolism: Phenylketonuria, Galactosemia, Alkaptonuria
- Single gene mutation: Cystic fibrosis, Huntington disease, Haemophilia
- Multifactorial: Breast Cancer
- Uniparental Disomy: Angelman Syndrome and Prader-Willi Syndrome

UNIT 6: DIAGNOSIS

- Prenatal Diagnosis - Amniocentesis, chorio-villus sampling and Ultrasonography
- Genetic counselling

PRACTICAL: 01 CREDIT (30 HRS)

MAX MARKS: 25

1	Verification of Mendel's laws - monohybrid cross	01
2	Verification of Mendel's laws - dihybrid cross	01
3	Manual Karyotyping of human chromosome plates: 1) Normal Male and Female 2) Edward syndrome	03
4	Slide Agglutination Reaction (blood groups – A / AB / O with Rh)	01
5	Observation of permanent slides of chromosomal aberrations/Observation of ultrasound abnormalities	01
6	Exercises for Multiple alleles and Multiple genes	02
7	Construction and analysis of pedigrees	03
8	Practical Assessment	03

REFERENCE BOOKS FOR THEORY:

- 1) Gardner EJ, Simmons MJ and Snustad DP (2013): *Principles of Genetics, Eighth Edition*, John Wiley Publication, Singapore.
- 2) De Robertis EDP, De Robertis EMF (2012): *Cell and Molecular Biology, Eighth Edition*. Wolter Kluwer Publication, Philadelphia.
- 3) Singh BD (2014): *Fundamentals of Genetics. Second Edition*, Kalyani Publishers, New Delhi.
- 4) Lewis R (2009): *Human Genetics, Concepts and Applications, Seventh Edition*. McGraw-Hill International Edition, New York.
- 5) Gangane SD (2009): *Human genetics, Third Edition*, Reed Elsevier India Pvt Ltd., Haryana India.
- 6) Gardner A, Davies T (2010): *Human Genetics, Second Edition*, Scion Publishing Ltd, UK.
- 7) Marcus A (2011): *Genetics*, MJP Publishers, Chennai.
- 8) Verma PS and Agarwal VK (2014): *Cell Biology Genetics Molecular Biology, Evolution & Ecology*. S Chand and Company PVT LTD, New Delhi.
- 9) Kothari ML, Mehta L, Roychoudhury SS (2009): *Essentials of Human Genetics, Fifth edition*, University Press Pvt. Ltd. Hyderabad.

REFERENCE BOOKS FOR PRACTICALS:

- 1) Gangane SD (2009): *Human genetics, Third Edition*, Reed Elsevier India Pvt Ltd., Haryana India.
- 2) Marcus A(2011): *Genetics*, MJP Publishers, Chennai.
- 3) Gardner A, Davies T (2010): *Human Genetics, Second Edition*, Scion Publishing Ltd, UK.
- 4) Lewis R (2009): *Human Genetics, Concepts and Applications, Seventh Edition*. McGraw-Hill International Edition, New York.

MULTIDISCIPLINARY COURSE (MDC)

COURSE TITLE: **AQUARIUM MAINTENANCE: FRESHWATER AND MARINE FISH**

COURSE CODE: UG-ZOO-MDC3

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:

- To learn the basic principles, themes and steps involved in setting up and maintaining an aquarium.

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

CO1: To understand the basics of Aquarium maintenance and comprehend the key skills to set up an aquarium.

CO2: To be able to identify and differentiate the different aquarium/ornamental fishes.

CO3: To be able to formulate fish food that provides with complete nutritional benefits.

CO4: To analyse the required budget to set up a well maintained home aquarium.

CONTENT:

MODULE 1: Introduction to Fish Aquarium & Maintenance	Unit 01: History of fish keeping, Importance and Potential scope Unit 02: Types of aquaria and setup (Salinity, Temperature & Location, Aquarium accessories) Unit 03: Aquarium Filters and types of filtration methods (Mechanical, Chemical & Biological – Nitrogen Cycle) Unit 04: Types of aquarium feed – Live and Artificial feed Unit 05: Precautions to be taken for an ideal aquarium, Study of zoonotic diseases of ornamental fishes and their control.	15 hours
MODULE 2: Introduction to Freshwater and Marine Ornamental Fishes and	Unit 05: Characters, sexual dimorphism, habits and breeding of Freshwater ornamental fishes - Guppy, Neon fish, Gold fish, Angel fish, siamese fighting fish, barbs, Rasboras, Betta fish, Danios fishes, tetras, Gouramis, loaches and suckermouth catfish Unit 06: Characters, sexual dimorphism, habits and breeding of Marine ornamental fishes- Anemone fish, Moorish idol and Butterfly fish	15 hours

plants

Unit 07: Ornamental aquatic plants

Unit 08: Criteria of selection for aquarium fishes and plants

PRACTICAL: 01 CREDIT(30 HRS)

MAX MARKS: 25

1	Visit to 02 aquarium outlets to document the ornamental fishes	02
2	Visit to 02 aquarium outlets to investigate type of aquaria commonly preferred by customers	01
3	Aquaria manufacturing	02
4	Create a fish tank with the right parameters for fresh water fishes.	02
5	Preparation and composition of formulated fish feeds	01
6	Aquaria glass painting	01
7	Create a fish tank with the fishes of your choice and setup and give detailed justification for the choice. Add a report.	03
8	Practical assessment	03

REFERENCE BOOKS:

- 1) Carcason, R.H. (1977). *A field guide to the Coral Reef Fishes of the Indian and West Pacific Oceans*. Published by Harper Collins Distribution Services.
- 1) Dick Mills (1987). *Illustrated Guide to Aquarium Fishes*. Published by Galley and Price, an imprint of W.H. Smith and Sons Limited, England.
- 2) Dick Mills and Gwynne Vevere (1982). *Tropical Aquarium Fishes*. Published by Salamander Books Limited. London.
- 3) Guy N. Smith (1979). *Profitable Fish Keeping*. Published by Saiga Publishing Company, Limited.
- 4) Hawlins, A.D. (1981). *Aquarium Systems*. Published by Academic Press Inc.
- 5) K.L.Tekrival and A.A. Rao (1999). *Ornamental aquarium fishes of India*.- TFH United Kingdom.
- 6) Ratjak, K. and Zukal, R. (1971). *Aquarium Fishes and Plants*. Published by Littlehampton Book Services Ltd.
- 7) Spotte and John Wiley, S. (1979). *Seawater Aquariums- The Captive Environment*. Published by John Wiley & Sons.
- 8) Stephen Spotte (1985). *Marine Aquarium Keeping*. A Wiley-Interscience Publication.
- 9) Vincent B. Hargreaves (1978). *The Tropical Marine Aquarium*. Mc-Graw-Hill Book Company. New York.

SKILL ENHANCEMENT COURSE (SEC)

COURSE TITLE:	BIOLOGICAL DATA ANALYSIS
COURSE CODE:	UG-ZOO-SEC3
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 help students understand the fundamental concepts of biological data collection, visualize data through graphical representation, analyse and interpret the outputs using statistical tests and familiarise themselves with the applications of programming language in academic research and industry.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Understand the different methods of data collection and representation. CO2: Analyse and interpret the data using appropriate statistical tests. CO3: Use programming language and its applications in academic research.

CONTENTS:

THEORY: 02 CREDITS

Module I:	UNIT 01: INTRODUCTION TO STATISTICS	15 hours
Introduction to Biological Data Collection and Data Representation	<ul style="list-style-type: none">• Introduction to Statistics• Scope of Statistics• Applications of Statistics in Biology• Basic concept of Population and Sample	
	UNIT 02: DATA COLLECTION AND SAMPLING	
	<ul style="list-style-type: none">• Data and its types (Primary data and Secondary data)• Categorical and Numerical variables• Levels of Measurement (nominal, ordinal, interval, ratio)• Methods of sampling (Random and Non-Random Sampling)	
	UNIT 03: SUMMARISING DATA	
	<ul style="list-style-type: none">• Descriptive statistics• Measures of Central Tendencies (Mean, Median, Mode, and Quartiles)• Measures of Dispersion (Range, Standard deviation and Variance)	

Module II:
Concept of Hypothesis
testing and designing
study

UNIT 04: DATA ORGANISATION AND REPRESENTATION

- Tabulations –frequency tables
- Graphical representations (Pie Chart, Bar graphs, Histograms, Line graphs and Scatter plots)

UNIT 05: PROBABILITY DISTRIBUTION, SKEWNESS AND KURTOSIS 15 hours

- Types of probability distributions (Binomial, Normal, and Poisson distribution)
- Skewness (positively skewed and negatively skewed distribution)
- Kurtosis (Leptokurtic , Platykurtic and Mesokurtic)

UNIT 06: TESTING OF HYPOTHESIS

- Inferential Statistics
- Testing of Statistical Hypothesis (null and alternate hypothesis)
- Level of significance (P value)
- Type I and Type II errors

UNIT 07: TESTS OF SIGNIFICANCE, CORRELATION AND REGRESSION

- Tests of significance – parametric and non-parametric tests
- Chi-square test (X^2 test)
- Analysis of Variance (ANOVA)
- Student's t-test
- Wilcoxon Rank Sum test and Kruskal-Wallis test
- Correlation and its types- positive, negative, linear and non-linear correlation
- Introduction to simple linear regression

UNIT 08: STATISTICAL SOFTWARES

- Basics of MS Excel
- Introduction to Programming language – R and R Studio

PRACTICAL: 01 CREDITS (30 HRS)

SR.NO.	PRACTICALS	
1	Basics of MS Excel : <ul style="list-style-type: none"> • Introduction to MS Excel • Entering, editing and formatting data. • Basic arithmetic functions (mean, standard deviation, standard error) • Understanding and creating formulas • Creating frequency distribution tables • Data representation (bar graphs, scatter plots, histograms, pie charts) • Preparing CSV format excel sheet (to be used for R studio) 	05
2	Basics of R Studio programming language: <ul style="list-style-type: none"> • Downloading and installing R and R studio 	07

- Introduction to the Working Directory
- Installing R packages
- Importing data from Microsoft Excel (CSV file)
- Variables, Functions and Vectors
- Descriptive statistics (mean and standard deviation)
- Data visualization (histograms and bar charts)
- Performing ANOVA, chi-square test and student's t test

3

Practical Assessment (PA) - Project-based learning: Data collection and interpretation using statistical software.

03

Design a questionnaire using Google Forms and collect data from at least 50 audiences on the given topic. Analyze the data collected using appropriate descriptive statistics and interpret your results accordingly. Submit this project in the form of a report including the following: Introduction, Methodology, Results, Discussion, and Conclusion.

REFERENCE BOOKS:

1. Gurumani, N. (2019). *An Introduction to BIOSTATISTICS. Second Revised edition. M.J.PPublishers. Chennai.*
2. Rastogi, B.V. (2015). *Biostatistics. Third Revised edition. Medtech. Chennai.*
3. Antonisamy, B. , Christopher,S. , and Samuel,P. (2010). *Biostatistics: Principles and Practise. Tatta McGraw Hill Education Pvt Ltd. New Delhi.*
4. Whitlock, M.C. and Schluter,D. (2014). *The Analysis of Biological Data. 2nd Edition, W. H.Freeman & Company.*
5. Rosner, B. (2016). *Fundamentals of Biostatistics. Eight Edition. Cengage Learning, Boston, USA.*
6. Taveras, J.L. (2016). *R for Excel Users: An Introduction to R for Excel Analysts. CreateSpaceIndependent Publishing Platform*

REFERENCE BOOKS FOR PRACTICALS

1. Alexander,M. Kusleika, D. Walkenbach,J. (2019). *Excel 2019 Bible : The ComprehensiveTutorial Resource. John Wiley & Sons, Inc. Indianapolis.*
2. Taveras, J.L. (2016). *R for Excel Users: An Introduction to R for Excel Analysts. CreateSpaceIndependent Publishing Platform.*
3. James, G. (2013). *An introduction to statistical learning with application in R. Vol. 112. NewYork: Springer.*
4. Acharya, S. (2020). *Data Analytics using R. McGraw Hill Education.*

SEMESTER

IV

DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE: **ENDOCRINOLOGY AND ASSISTED REPRODUCTIVE TECHNIQUES**

COURSE CODE: UG-ZOO-204
MARKS: 100 [75 –Theory; 25- Practical]

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

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

COURSE OBJECTIVES: This course is intended to provide an understanding of the endocrine organs and physiology of human reproduction and infertilities associated. underlying principles of hormone functions. Students will gain an insight into the current and important issues in endocrinology, prenatal diagnosis and ethics and laws pertaining to reproductive technology.

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

CO1: Associate hormones to body growth, metabolism, reproduction and development.
CO2: To understand the underlying principles and disorders associated with hormone functions.
CO3: Learn techniques of histology and tissue identification
CO4: Correlate the infertility causes to the functioning of human reproductive tract.
CO5: Propose appropriate options of reproductive technologies
CO6: Know about various prenatal diagnostic options for overcoming infertility or ensuring health pregnancy outcome.
CO7: Understand the laws pertaining to reproductive technology

CONTENTS:

MODULE 1: INTRODUCTION AND TECHNIQUES IN ENDOCRINOLOGY 15 hours
Introduction to Endocrine system

- Aim and scope of endocrinology
- Hormones- Classification, structure and functions.
- Regulation of hormone secretion: feedback mechanisms (positive, negative, short and long loop)
- Techniques in endocrinology - Histology, Histochemistry, Immunocytochemistry, In-situ hybridisation, Radio immune assay, surgical techniques.

UNIT 2: ANATOMY AND HISTOLOGY OF ENDOCRINE GLANDS

- Pituitary, Pineal gland, Thyroid, Parathyroid, Thymus, Adrenal, Endocrine pancreas, GI tract, Endocrine hypothalamus, Gonads, Placenta

MODULE 2:
Endocrine conditions
and
Introduction to
Reproductive biology

UNIT 3: ENDOCRINE CONDITIONS

15 hours

- Calcium and Glucose Homeostasis.
- Growth factors - neurotropic growth factors, hematopoietic growth factors, other peptide growth factors.
- Endocrine disorders - goitre, gigantism, dwarfism, cretinism, diabetes mellitus, insipidus

UNIT 4: REPRODUCTIVE BIOLOGY

- Male reproductive system: Anatomy and overview of physiology.
- Female reproductive system: Anatomy and overview of physiology.
- Infertility in males and females: Types, causes (including endocrine basis)

MODULE 3:
Technologies for
ensuring pregnancy
outcome and laws
governing ART

UNIT 5: PRENATAL DIAGNOSIS AND PREIMPLANTATION GENETIC DIAGNOSIS

15hours

- Definition and procedures - Amniocentesis, Chorionic villus sampling, Ultrasonography and Fetoscopy, PIGD
- Assisted reproductive technologies (IUI, IVF, GZIT, ZIFT).
- Cutting-Edge Technologies in Reproductive Biology: Embryo screening and diagnosis, INVO cell, Time Lapse Embryoscope, DNA Fragmentation Index (DFI), Endometrial Receptivity Array (ERA), In-vitro maturation (IVM).

UNIT 6: SURROGACY AND LAWS GOVERNING ART

- Definition, concepts and Types of surrogacies, process and ethics. Commercialization of surrogacy.
- Laws governing Reproductive technologies - PNDR act, gender equality/inequality component of laws governing ART in India.

PRACTICAL: 01 CREDIT(30 HRS)

MAX MARKS: 25

1	Histological slides of Endocrine hypothalamus, Gonads, Placenta Pituitary, Pineal gland, Thyroid gland, Parathyroid, Thymus, Adrenal gland, Pancreas, Ovary, Testis	03
2	Display of Pituitary and gonads in fishes/chick	02
3	Preparation of histological slides using microtomy	04
4	Diagnosis of pregnancy by ELISA test	01
5	Nigrosin-Eosin sperm vitality test	02
6	Practical Assessments	03

REFERENCE BOOKS FOR THEORY:

1. David, N.O. and J.A. Carr (2013) *Vertebrate Endocrinology*. Academic press publications 5th edition.
2. Hadley, M. and Levine, J (2006) *Endocrinology*. Benjamin Cummings 6th edition.
3. Kovacs, J.W. and S.R. Ojeda (2011) *Textbook of endocrine physiology* 6th edition. Oxford university press.
4. Matsumoto, A. and S. Ishi, (1992)(eds). *Atlas of endocrine organs, vertebrates and Invertebrates* springier verlag, Germany.
5. Turner, C.D and Bagnara, J.T., (1994) *General Endocrinology*, 6th Edition, WB Saunder's company, Philadelphia (Saunder's International Students edition).
6. Wilson J.D and Foster D.W (1992) *William's textbook of endocrinology*, 8th edition, WB saunders company, Philadelphia.
7. Yadav, P.R (2004) *Endocrinology*. Discovery Publishing House, New Delhi.
8. Jones R and Lopez KH. (2013). *Human Reproductive biology*, 4th Edition, Academic Press. ISBN: 9780123821850 99(E book available).
9. Bittar E. (1998). *Reproductive Endocrinology and Biology*, Vol 12. Elsevier Science.
10. Gardner DK. (2011). *Human Assisted Reproductive Technology*. Cambridge University Press.
11. Rao KA, Howard C and Fischer R. (2016). *Principles & Practices of Assisted Preproductive Technology*. Jaypeedigital publishers.

DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE: BASIC MICROBIOLOGY AND FUNDAMENTALS OF ANIMAL BIOTECHNOLOGY

COURSE CODE: UG-ZOO-205

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: To provide a comprehensive survey of microbiology with basic information on bacteria and learn the fundamentals of biotechnological techniques.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:
CO1: Gain basic information on bacteria, its culture and importance
CO2: Have knowledge about various biological tools used in Biotechnology
CO3: Have knowledge about various biotechnological and molecular techniques
CO4: Gain working knowledge of basic bacterial laboratory techniques

CONTENT:

MODULE 1: UNIT 01: INTRODUCTION TO MICROORGANISMS 15 hours
Microbiology

- Bacteria Structure
- Identification of bacteria (morphological types)
- Nutritional types
- Reproduction in bacteria
- Nutritional requirements- media and its maintenance

UNIT 02: ISOLATION AND CULTURE OF BACTERIA

- Cultivation of bacteria
- Different methods of isolation and maintenance of pure cultures
- Culture characteristics

UNIT 03: USE OF MICROORGANISMS IN BIOTECHNOLOGY: AN OVERVIEW

- Production of valuable substances
- Fuel Production
- Recovery of minerals and oils
- Microorganisms in bioassays
- Food and agriculture sector
- Medicine and health

MODULE 2:
Tools in
Biotechnology

UNIT 04: SCOPE AND IMPORTANCE OF
BIOTECHNOLOGY

15 hours

- Biotechnology: Definition
- Old and Modern Biotechnology: An overview
- Biotechnology: Scope and Importance

UNIT 05: NUCLEIC ACID ENZYMOLOGY

- Restriction enzymes and Ligases
- Alkaline Phosphatase, Polynucleotide kinase, and Terminal Transferases
- S1 Nuclease, Polymerases and Reverse transcriptase

UNIT 06: GENE CLONING VECTORS

- Plasmids, Bacteriophages, Cosmids
- Shuttle and expression vectors

MODULE 3:
Genetic
Engineering

UNIT 07: TECHNIQUES IN GENETIC
ENGINEERING

15 hours

- Gene transfer methods
- Methods of Labeling Nucleic acids
- Nucleic acid Hybridization
- Polymerase chain reaction
- Genomic library
- Colony and Plaque Hybridization

UNIT 08: RECOMBINANT DNA
TECHNOLOGY

- Procedure/Technique

UNIT 09: BLOTTING TECHNIQUES

- Southern Blotting
- Northern Blotting
- Western Blotting

UNIT 10: DNA SEQUENCING TECHNIQUES

- Chemical Degradation method
- Chain termination method
- Automated Sequencing

PRACTICAL: 01 CREDIT(30 HRS)

MAX MARKS: 25

1)	Introduction to basic laboratory techniques in Microbiology Laboratory	01
2)	Staining of Microorganisms (Gram staining, negative staining)	02
3)	Preparation of culture media for bacteria (Plates, Slants, deeps, Broth)	03
4)	Isolation of pure colonies of Bacteria (streak plate method – 3 Quadrant And 5 Quadrant methods)	02
5)	Identification of Products of metabolic pathways of microbial cells	02
6)	Bacteriological testing of Milk	01
7)	DNA sequencing - Analysis of prints	01
8)	Practical Assessment	03

REFERENCE BOOKS:

- 1) *Dubey RC and Maheshwari DK (2012). A test book of Microbiology. SChand Publishers, New Delhi.*
- 2) *Pelczar MJ, Chan ECS, Krieg NR(2009). Microbiology. Tata Mc Graw Hill, New York.*
- 3) *Prave P, Faust U, Sittig W and Sukatsh DA(2004). Fundamentals of Biotechnology.*
- 4) *Purohit SS(2008). Biotechnology Fundamentals and applications. Agrobios, Jodhpur India.*
- 5) *Ranga MM(2012): Animal Biotechnology. Agrobios, Jodhpur India.*
- 6) *Black JG(2005). Microbiology principles and explorations. John Wiley and sons Inc.*
- 7) *Sullia SB and Shantharam S(2006). General Microbiology. Oxford and IBH Publishing Co Pvt Ltd, NewDelhi.*

REFERENCE BOOKS FOR PRACTICALS

- 1) *Gunasekaran P(2009). Lab Manual in Microbiology. New Age InternationalLtd. Publishers, New Delhi.*

DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE:	IMMUNOLOGY
COURSE CODE:	UG-ZOO-206
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 make the students learn about the structural features of the components of the immune system as well as their functions, and understand the mechanisms involved in immune system development and responsiveness.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to CLO1: Understand the components of the immune system and their function. CLO2: Explain the mechanisms of the immune response. CLO3: Know about the techniques used in detecting immunological diagnosis. CLO4: Perform immunoassays for disease detection.
CONTENTS:	
MODULE 1: Introduction to Immunology	UNIT 1: OVERVIEW OF IMMUNE SYSTEM: 15 hours • Basic concepts in immunology • Components of the immune system UNIT 2: INNATE AND ADAPTIVE IMMUNITY. • Innate immunity- Anatomical barriers/ layers of defense, Cells and molecules involved in innate immunity. • Adaptive immunity- cell mediated and humoral immunity, passive immunity (artificial and natural), Active (artificial and natural), Immune dysfunction.
MODULE 2: Antigens and Immunoglobulins	UNIT 3: ANTIGENS. 15 hours • Antigenicity and immunogenicity, Immunogens, adjuvants and haptens. • Factors influencing immunogenicity • B and T cell epitopes UNIT 4: IMMUNOGLOBULINS • Structure and function of different classes of Immunoglobulin.

- Antigen-Antibody interactions
- Immunoassays, monoclonal & polyclonal antibodies

UNIT 5: MAJOR HISTOCOMPATIBILITY COMPLEX.

- Structure and function of endogenous and exogenous pathways of antigen presentation

15 hours

MODULE 3:
Immune Responses

UNIT 6: CYTOKINES AND COMPLEMENT SYSTEM

- Properties and functions of cytokines, cytokine-based therapies
- Components and pathways of complement activation

UNIT 7: HYPERSENSITIVITIES, AUTOIMMUNITY AND TRANSPLANTATION

- Gell and Coombs' classification, types of hypersensitivities(overview)
- Autoimmune responses against self-antigens (SLEs), responses to alloantigens and transplant rejection (graft rejection, types and mechanisms of transplant rejection)

UNIT 8: VACCINES

- Types of vaccines -inactivated, attenuated, toxoid, subunit, conjugate, experimental (DNA and recombinant vaccine), monovalent/polyvalent vaccines

PRACTICAL: 01 CREDIT(30 HRS)

MAX MARKS: 25

1	Preparation of serum from goat blood.	02
2	Slide Agglutination Reaction (blood groups – A / AB / O with Rh) Differential count of leukocytes.	02
3	Detection of presence of antigen/antibody - Simple immunodiffusion.	01
4	Antibody Titre determination - Ouchterlony immunodiffusion.	01
5	Antigen-antibody reaction by immunoelectrophoresis.	02
6	Serological tests involving precipitations (Pregnancy & Widal)	01
7	Phagocytosis – WBC (demonstration).	01
8	Practical Assessment	03

REFERENCE BOOKS:

- 1) Abbas KA, Lichtman HA(2016). *Basic Immunology*. V edition. Elsevier Publication.
- 2) David M, Jonathan B, David RB and Ivan R(2006). *Immunology*. VII Edition, Mosby, Elsevier Publication.
- 3) Abbas KA, Lichtman HA (2006). *Cellular and Molecular Immunology*. VI edition. Elsevier Publication.
- 4) Kindt TJ, Goldsby RA, Osborne BA and Kuby J(2006). *Immunology*. VI edition. W H Freeman and company.
- 5) Frank SA(2002). *Immunology and evolution of infectious diseases*. Princeton University Press, Princeton and Oxford.
- 6) Zabriskie JB(2009). *Essential Clinical Immunology*. Cambridge University Press.
- 7) Mohanty SA and Leela SK (2014). *Textbook of Immunology*. Jaypee Brothers Medical Publishers

REFERENCE BOOKS FOR PRACTICALS:

- 1) Talwar GP and Gupta SK(2012). *A handbook of practical and Clinical Immunology*, CBS publishers.

DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE:	FISH FARMING AND PRESERVATION TECHNIQUES
COURSE CODE:	UG-ZOO-207
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:	<ul style="list-style-type: none">• To improve the social and economic benefits derived from aquaculture and fisheries.• To study the role of aquaculture in rural development in solving nutritional security and unemployment.• To familiarize the students with different methods of fish preservation and processing• To acquaint them with techniques and precautions for hygienic fish handling
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Understand conservation and sustainability of aquaculture resources. CO2: Acquainted with various techniques of aquaculture and fish processing. CO3: Know strategies of improving the social and economic benefits derived from aquaculture and fisheries. CO4: Initiate business enterprise in area of aquaculture.

CONTENTS:

MODULE 1: Introduction to Fisheries and Aquaculture	UNIT 1:INTRODUCTION TO FISHERIES 15 hours
	<ul style="list-style-type: none">• Inland fisheries• Marine fisheries• Coastal/Inshore fisheries• Offshore and Deep sea fisheries• Crustacean and Molluscan Fisheries
	UNIT 2: FISH CULTURE SYSTEM
	<ul style="list-style-type: none">• Overview of different types of fish culture systems (Mono culture, polyculture, composite culture, raceway culture, extensive, semi intensive, intensive, zero water exchange)• Objective of fish culture,• Pond preparation• Selection of species• Stocking of seed

MODULE 2:
Fish culture and
integrated farming

- Feed and feeding,
- Harvesting,

UNIT 3: CAGE AND PEN CULTURE:

15 hours

- Advantage of Fish culture in cages
- Selection of species for cage culture
- Installation of cage – shape ,size and types of cages,
- Pen culture
- Maintenance of cage and pen

UNIT 4: INTEGRATED FISH FARMING SYSTEM

- Principle of integrated Fish farming
- Integration with animal husbandry and farming systems

UNIT 5: VALUE OF FISH

- Economic Importance of Fish: Food value, Fish by-Products.
- Postmortem changes in Fish
- Aquatic Resources and their utilization,
- Value added product: chitin, Chitosan

MODULE 3:
Fish
Handling
and
preservation

UNIT 6: FISH HANDLING

15 hours

- Recent Scenario: Quality Changes and Shelf life of Chilled Fish,
- The effect of Hygiene during handling
- Fish Handling Methods: Organoleptic test, Assessment of Fish Quality,
- Quality assessment of Fresh Fish,
- Quality Assessment of Fish Products
- Postharvest Changes in Fish,
- Fish as vectors of zoonotic diseases

UNIT 7: FISH PRESERVATION

- Reasons for Spoilage of Fishes
- Methods of Fish preservation

PRACTICAL: 01 CREDIT (30 HRS)

MAX MARKS: 25

1	Estimation of Proteins and Lipids form fish tissue	02
2	Determination of moisture and ash content from the fish	01
3	Preparation of fish Fillet	01
4	Study of Fish Parasites – Ectoparasites (gills); endoparasites (gut)	02
5	Method of fish preservation (salting, pickling)	02

6	Morphometric and Meristic study : a key for fish Identification	02
7	Identification of : -Important edible prawns, shrimps and crabs(anytwo) - Important Freshwater and Marine edible fishes- oil sardine, sole fish, white sardine, mullet, Scianera	02
8	Practical Assessment	03

REFERENCE BOOKS FOR THEORY:

- 1) Bal D.V., Rao Virbhadra, K (1984) *Marine Fisheries*, Tata McGraw- Hill Publishing Company Ltd. New Delhi.
- 2) Cushing D.H. (1975) *Marine Ecology and Fisheries*, Cambridge University Press.
- 3) Day, F. (1889) *The Fauna of British India including Ceylon and Burma. Fishes. 2 Vols.*, Taylor and Francis London.
- 4) Khanna S.S. (1984) *An Introduction to Fishes*, Central Book Depot Allahabad.
- 5) Pandey K and Shukla J.P. (2015) *Fish and Fisheries*. Rastogi Publications Meerut-250002
- 6) Sakhare B. Viswas (2007) *Applied Fisheries*. Daya Publishing House Delhi-110035
- 7) Santhanam R (1990) *Fisheries Science*, Daya Publishing House Delhi.
- 8) Santhanam R, Ramanathan N and Jagatheesan G (1990) *Coastal Aquaculture in India*, CBS Publishers and distributors, Delhi.
- 9) Shrivastava C.B.L. (1996) *A Text Book of Fishery Science and Indian Fisheries*. Kitab Mahal 22 A, S.N. Marg, Allahabad.
- 10) Singh B.K. (2008) *Applied Fisheries and Aquaculture*. Swastik Publishers and distributors, Delhi.

REFERENCE BOOKS FOR PRACTICALS:

1. Chandy, M (1970) *Fishes*, National Book Trust, India, New Delhi.
2. Day, F. (1889) *The Fauna of British India including Ceylon and Burma. Fishes. 2 Vols.*, Taylor and Francis London.
3. R.J. Ranjit Daniels (2002) *Freshwater Fishes of Peninsular India*, Universities Press (India) Pvt. Ltd. Hyderabad.
4. Sakhare Viswas B. (2007) *Applied Fisheries*, Daya Publishing House Delhi.
5. Sharma U and S.P. Grover (1982) *An Introduction to Indian Fisheries*, Dehradun India.
6. Srivasava C.B.L. (1986) *A Text Book of Fishery Science and Indian Fisheries* Kitab Mahal Allahabad

DISCIPLINE SPECIFIC CORE COURSE (MINOR/ VOCATIONAL)

COURSE NAME:	AQUACULTURE AND FISHERIES
COURSE CODE	UG-ZOO-VOC1
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:	To improve the understanding of conservation and sustainability of living resources To improve the social and economic benefits derived from aquaculture and fisheries. To study the role of aquaculture in rural development in solving nutritional security and unemployment. Empowerment of fishery and entrepreneurship development
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Understand conservation and sustainability of aquaculture resources. CO2: Acquainted with various techniques of aquaculture. CO3: Know strategies of improving the social and economic benefits derived from aquaculture and fisheries. CO4: Initiate business enterprise in area of aquaculture.

CONTENTS:

MODULE I: Introduction to Fisheries	UNIT 1: INLAND FISHERIES: <ul style="list-style-type: none">• Riverine ;Reservoir fisheries; Lakesterine fisheries; Cold water fisheries	15 hours
	UNIT 2: MARINE FISHERIES: <ul style="list-style-type: none">• Estuarine fisheries:The catadromous fishes (<i>Polynemous indicus,P.tetradactylus</i>) and anadromous fishes(<i>Hilsa ilisha,Pama pama,Polynemous paradiseus</i>)• Coastal fisheries or Inshore fisheries: Elasmobranch fishery and Teleost fishery• Offshore and Deep sea fisheries: Pomfrets(<i>Pampus,Stromateus</i>) <i>Eleutheronema tetradactylus</i>(rava).	
	UNIT 3: CRUSTACEAN AND MOLLUSCAN FISHERIES: <ul style="list-style-type: none">• Prawn fisheries in Goa: Penaeid and Palaemonid groups.• Crab fisheries in Goa• Edible oyster fisheries in Goa	

- Mussel fisheries in Goa

MODULE II: Integrated Fish Farming and Aquaculture **UNIT 4: INTEGRATED FISH FARMING SYSTEMS:** **15 hours**

- Principle of integrated Fish farming
- Integration with animal husbandry and farming systems.

UNIT 5: INDUCED BREEDING:

- Selection of site; Design and Layout of fish farm;
- Freshwater and brackish water;
- pond construction;
- Pond maintenance;
- Prevention of fish diseases;
- Control of aquatic weeds, predatory and Weed fishes
- Aquatic insect;
- Harvesting.

UNIT 6: FISHING METHODS:

- Marine Fishing Crafts and Gears used in Goa.
- Inland Fishing Crafts and Gears used in Goa

MODULE III: Fish culture system

UNIT 7: FISH CULTURE SYSTEM:

15 hours

- Overview of Mono culture, polyculture, composite culture, raceway culture, extensive, semi intensive, intensive, zero water exchange,
- Objective of fish culture,
- Pond preparation,
- Selection of species,
- Stocking of seed,
- Feed and feeding,
- Harvesting,
- Bionomics of fish culture

UNIT 8: CAGE AND PEN CULTURE:

- Advantage of Fish culture in cages
- Selection of species for cage culture, Installation of cage – shape ,size and types of cages,
- Pen culture,
- Maintenance of cage and pen

PRACTICAL: 01 CREDIT (30 HRS)

MAX MARKS: 25

1	Morphometric and Meristic study : a key for fish Identification	04
2	Identification of : -Important edible prawns, shrimps and crabs(anytwo)	03

	- Important Freshwater and Marine edible fishes- oil sardine, sole fish, white sardine, mullet, Scianera	
3	Estimation of Fecundity by Frequency Polygon method from a Marine Fish	01
4	Food and Feeding of Fish by analysis of gut content	01
5	Field based:	03
	• To study different types of gear and craft	
	• To study fish breeding	
	• Study of aquarium and larvivorous fishes	
6	Practical Assessment	03

REFERENCE BOOKS FOR THEORY:

- 11) Bal D.V., Rao Virbhadra, K (1984) *Marine Fisheries*, Tata McGraw- Hill Publishing Company Ltd. New Delhi.
- 12) Cushing D.H. (1975) *Marine Ecology and Fisheries*, Cambridge University Press.
- 13) Day, F. (1889) *The Fauna of British India including Ceylon and Burma. Fishes. 2 Vols.*, Taylor and Francis London.
- 14) Khanna S.S. (1984) *An Introduction to Fishes*, Central Book Depot Allahabad.
- 15) Pandey K and Shukla J.P. (2015) *Fish and Fisheries*. Rastogi Publications Meerut-250002
- 16) Sakhare B. Viswas (2007) *Applied Fisheries*. Daya Publishing House Delhi-110035
- 17) Santhanam R (1990) *Fisheries Science*, Daya Publishing House Delhi.
- 18) Santhanam R, Ramanathan N and Jagatheesan G (1990) *Coastal Aquaculture in India*, CBS Publishers and distributors, Delhi.
- 19) Shrivastava C.B.L. (1996) *A Text Book of Fishery Science and Indian Fisheries*. Kitab Mahal 22 A, S.N. Marg, Allahabad.
- 20) Singh B.K. (2008) *Applied Fisheries and Aquaculture*. Swastik Publishers and distributors, Delhi.

REFERENCE BOOKS FOR PRACTICALS:

7. Chandy M (1970) *Fishes*, National Book Trust, India, New Delhi.
8. Day F. (1889) *The Fauna of British India including Ceylon and Burma. Fishes. 2 Vols.*, Taylor and Francis London.
9. R.J. Ranjit Daniels (2002) *Freshwater Fishes of Peninsular India*, Universities Press (India) Pvt. Ltd. Hyderabad.
10. Sakhare Viswas B. (2007) *Applied Fisheries*, Daya Publishing House Delhi.
11. Sharma U and S.P. Grover (1982) *An Introduction to Indian Fisheries*, Dehradun India.
12. Srivastava C.B.L. (1986) *A Text Book of Fishery Science and Indian Fisheries* Kitab Mahal Allahabad



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Annexure B
COURSE STRUCTURE

**POST GRADUATE DIPLOMA PROGRAMME IN CLINICAL GENETICS AND
 MEDICAL LABORATORY TECHNIQUES (PGDCG&MLT) 2023 2024**

MES ER	COURSE CODE	DISCIP INE SPECIFIC CORE (DS)	DISCIPLINE SPECIFIC ELECTIVE (DSE) (ANY 01)	NUMBER OF CREDITS	CONTACT HOURS	MARKS
I	PGDP-CGMLT-DSC-401	Clinical Biochemistry I		Theory = 02 Practical = 02	Theory = 30 Practical = 60	Theory = 50 Practical = 50
	PGDP-CGMLT-DSC-402	Clinical Biochemistry II		Theory = 02 Practical = 02	Theory = 30 Practical = 60	Theory = 50 Practical = 50
	PGDP-CGMLT-DSC-403	Clinical Microbiology (General and Systematic)		Theory = 02 Practical = 02	Theory = 30 Practical = 60	Theory = 50 Practical = 50
	PGDP-CGMLT-DSC-404	Hematology and Transfusion Medicine		Theory = 02 Practical = 02	Theory = 30 Practical = 60	Theory = 50 Practical = 50
	PGDP-CGMLT-DSI-401		Internship at Hospital/Clinics.	04	120	Report/ Portfolio = 100
	PGDP-CGMLT-DSE-401		SWAYAM course: Analytical Techniques	Theory = 04 credits	Swayam Online	Theory = 100
	PGDP-CGMLT-DSE-402		SWAYAM course: Essentials Of Biomolecules: Nucleic Acids And Peptides	Theory = 04 credits	Swayam Online	Theory = 100
I	PGDP-CGMLT-DSC-405	Clinical Genetic Techniques I		Theory = 02 Practical = 02	Theory = 30 Practical = 60	Theory = 50 Practical = 50
	PGDP-CGMLT-DSC-406	Clinical Genetic Techniques II		Theory = 02 Practical = 02	Theory = 30 Practical = 60	Theory = 50 Practical = 50
	PGDP-CGMLT-DSC-407	Clinical Parasitology, Mycology and Virology		Theory = 02 Practical = 02	Theory = 30 Practical = 60	Theory = 50 Practical = 50
	PGDP-CGMLT-DSC-408	Clinical Pathology and Histopathology		Theory = 02 Practical = 02	Theory = 30 Practical = 60	Theory = 50 Practical = 50
	PGDP-CGMLT-DSI-402		Internship at Hospital/Clinics.	04	120	Report/ Portfolio = 100
	PGDP-CGMLT-DSE-403		SWAYAM course- Biomolecules: Structure, Function In Health And Disease	Theory = 04 credits	Swayam Online	Theory = 100
	PGDP-CGMLT-DSE-404		SWAYAM course- Immunology	Theory = 04 credits	Swayam Online	Theory = 100

DISCIPLINE SPECIFIC CORE COURSE: CLINICAL BIOCHEMISTRY II

COURSE CODE: PGDP-CGMLT-DSC-402

MARKS: 100 [50 – Theory : 50 – Practical]

CREDITS: 04 [02 – Theory : 02 – Practical]
CONTACT HOURS THEORY :30 HOURS (02 LEC/WEEK)
 PRACTICALS :60 HOURS (02 PRACTICAL / WEEK)

COURSE OBJECTIVES:

- Testing, observing and analyzing blood function test
- Knowledge about the Clinical aspects and use of it during performance of test.

COURSE OUTCOME

On completion of the course the student should be able to:

CO 1: Understand and explain clinical significance of metabolism of biomolecules.

CO 2: Explain the significance of function tests of body systems

CO 3: Perform Chemical examination of body fluids.

CO 4: Conduct Liver, Thyroid and Kidney function tests.

PGDP-CGMLT-DSC-402: CLINICAL BIOCHEMISTRY II

MODULE	TOPICS	CONTACT HOURS
Module 1: Carbohydrate, Protein, Lipid Metabolism	<ul style="list-style-type: none"> • Carbohydrate metabolism: Clinical aspects of Regulation of Blood sugar and Diabetes • Protein metabolism: starvation, and protein energy malnutrition • Lipid metabolism : Clinical aspects of lipid profile, atherosclerosis. 	10
Module 2: Function Tests 1	<ul style="list-style-type: none"> • Gastric function tests. • Pancreatic function tests. • Cardiac function test 	10
Module 3: Function Tests 2	<ul style="list-style-type: none"> • Liver function tests. • Thyroid function tests. • Kidney function test 	10

**PRACTICAL COMPONENT OF PGDP-CGMLT-DSC-402: CLINICAL
BIOCHEMISTRY II**

[DURATION - 02 HRS/WEEK]

Practical

No. of
Practicals

15

Lab Based Practical works:

1. Chemical analysis of saliva.
2. Chemical analysis of gastric juices
3. Estimation of blood sugar: Enzymatic method (GOD POD, Folin -Wu tube, Glucometer, GTT and its interpretation
4. Routine urine analysis.
5. Complete urine analysis.
6. Kidney function tests:
 - a. Estimation of serum urea using Diacetyl-monoxime method.
 - b. Estimation of serum Creatinine using Jaffe's method.
 - c. Estimation of serum uric acid.
7. Lipid profile tests:
 - a. Estimation of serum cholesterol.
 - b. Estimation of serum triglycerides.
8. Liver function tests:
 - a. Estimation of serum Bilirubin.
 - b. Estimation of serum Proteins by Biuret method.
 - c. Estimation of serum Albumin by BCG method.
 - d. Estimation of serum alkaline phosphatase.
 - e. Estimation of SGOT.
 - f. Estimation of SGPT.
9. Pancreatic function test: Serum Amylase

15

Activity Based Practical Works- Analysis of reports:

1. CSF Examination.
2. Renal Clearance test.
3. Kidney function test.
4. Cardiac function test.
5. Case studies: Diabetic profile, Lipid profile, Gastric disorders, Pancreas disorders, Cardiac disorders, Liver disorders, Thyroid disorders, Kidney disorders.

REFERENCE BOOKS FOR PRACTICALS:

1. Mukherjee KL (1988) Volume II: Medical Laboratory Technology, Tata McGraw-Hill Publishing Company Ltd. New Delhi.
2. KamatG(2011). Practical manual of Hematology. Jaypee Brothers Medical Publishers Pvt Ltd, New Delhi.
3. Pankaja Naik (2010). Biochemistry. Jaypee Brothers Medical Publishers Pvt Ltd, New Delhi, 3rd Edition.
4. Praful B. Godkar, Darshan P. Godkar (2003) Textbook of Medical Laboratory Technology, Bhalani Publishing House, Parel Mumbai, II Edition.

Annexure I: UG

(Summary of changes incorporated in the existing approved syllabus if any)

Semester	Course Title	Existing (Indicate only the unit where the change is proposed)	Changes Proposed	Specify the reason for the change
IV	UG-ZOO-207: Aquaculture, Fish Preservation and Fish Processing	Course Title: Aquaculture, Fish Preservation and Fish Processing	Course Title: Fish Farming and Preservation Techniques	Course title is repetitive in the course structure.

Annexure I: PG
(Summary of changes incorporated in the existing approved syllabus if any)

Semester	Course Title	Existing (Indicate only the unit where the change is proposed)	Changes Proposed	Specify the reason for the change
I	Clinical Biochemistry II	PGDP-CGMLT-DSC-402: CLINICAL BIOCHEMISTRY II: Activity Based Practical 1-3 activities.	PGDP-CGMLT-DSC-402: CLINICAL BIOCHEMISTRY II: Addition of Practical 4 and 5: Cardiac Function Test & Case studies on Diabetic profile, Lipid profile, Gastric disorders, Pancreas disorders, Cardiac disorders, Liver disorders, Thyroid disorders, and Kidney disorders.	To offer more knowledge and exposure to the students on diseases and their diagnostic tests