



SWAMI VIVEKANAND
SUBHARTI
UNIVERSITY
UGC Approved Meerut



Ordinance No. :- V-141-B-6

(Approved in Academic Council meeting held on 11.03.2026
Proposed to be ratified in forthcoming executive council)

Evaluation Scheme and Syllabus

of

M.Sc. Zoology

TWO YEAR POST GRADUATE

PROGRAM

(AS PER NEP-2020)

Keral Verma Subharti College of Science

Swami Vivekanand

SUBHARTI UNIVERSITY

Meerut

(Effective from session 2025-26)

K. V. Subharti College of Science
S V Subharti University
NH-58, Bypass Road, Meerut

MASTER OF SCIENCE (ZOOLOGY)

Programme Objectives (POs):

The M.Sc. Zoology programme aims to:

1. Provide comprehensive understanding of the animal kingdom from taxonomy to molecular biology, evolution, physiology, ecology, parasitology, and aquatic sciences.
2. Train students in laboratory skills, biostatistics, instrumentation, bioinformatics, and research methodology to address zoological problems scientifically.
3. Enhance awareness regarding biodiversity conservation, climate change, and sustainable use of biological resources along with ethical research practices.
4. Equip learners for employment in education, healthcare, aquaculture, environmental management, agriculture-based industries and advanced research sectors.
5. Instil scientific curiosity and problem-solving mindset through project-based learning, enabling graduates to pursue higher studies, entrepreneurship, and continuous professional development.



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Programme Learning Outcomes (PLOs / POs)

After successful completion, a postgraduate in Zoology will be able to:

PO Code Programme Learning Outcome (PO)

- PO1** – Demonstrate deep understanding of animal diversity, structure-function relationships, evolution, genetics, biochemistry, physiology, and developmental mechanisms.
- PO2** – Perform advanced laboratory techniques including molecular biology, microscopy, biochemical assays, ecological surveys, physiological analysis, and parasitological diagnostics.
- PO3** – Design experiments, perform data analysis using biostatistics and bioinformatics, interpret results, and prepare research papers and reports.
- PO4** – Apply scientific reasoning to identify zoological issues related to environment, aquaculture, parasitology, biodiversity loss and propose sustainable solutions.
- PO5** – Use scientific software, databases (BLAST, EMBL, GenBank), digital tools for data acquisition, and statistical decision-making.
- PO6** – Analyze effects of pollution, climate change, invasive species, parasites, and human activities on ecosystems and contribute to conservation initiatives.
- PO7** – Present scientific information effectively through seminars, outreach, and collaborative research activities.
- PO8** – Demonstrate laboratory safety, ethical handling of animals, and responsible research conduct in accordance with global standards.
- PO9** – Acquire job-oriented skills for roles in teaching, research labs, aquaculture industries, environmental agencies, biomedical sectors, and pursue entrepreneurial ventures (e.g., fishery, sericulture, apiculture).
- PO10** – Continue professional development through higher studies, competitive exams, and technology adoption in the life sciences sector.



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KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Zoology

Credit Distribution Table M.Sc. Zoology (Session 2025-26 onwards)

		I	II	Internship after II Sem	III	IV	Total
1	Core Course	16	16		8	4	44
2	Practical	8	8		8		24
3	Seminar	2					2
4	DEC				8	8	16
4	CHM		2				2
6	OEC				2		2
7	EEC					2	2
8	Internship			4			4
9	Project Work					12	12
	Total	26	26	4	26	26	108



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Evaluation Scheme for First Year

SEM: I													
Batch:2025-26			SEM:I										
S.No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			Quiz/PT/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Core Course 1	MSZY-101	Animal Taxonomy and Economic Zoology	4	0	0	4	5	10	15	70	100	
2	Core Course 2	MSZY-102	Non-chordata	4	0	0	4	5	10	15	70	100	
3	Core Course 3	MSZY-103	Cell and Molecular Biology	4	0	0	4	5	10	15	70	100	
4	Core Course 4	MSZY-104	Evolutionary Biology	4	0	0	4	5	10	15	70	100	
5	Practical I (Based on CC 1 & 2)	MSZY-105P	Practical 1	0	0	8	4	5	10	15	70	100	
6	Practical II (Based on CC 3 & 4)	MSZY-106P	Practical 2	0	0	8	4	5	10	15	70	100	
7	Seminar I	MSZY-107S		0	0	4	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	35	70	90	455	650	









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SEM: II													
Batch:2025-26			SEM:II										
S.No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance	Internal Assessment	External Assessment	Total	Remark	
				L	T	P							
THEORY and PRACTICAL SUBJECTS								Attendance (5)	Quiz/PPT/Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)		
1	Core Course 5	MSZY-201	Chordata	4	0	0	4	5	10	15	70	100	
2	Core Course 6	MSZY-202	Mammalian Physiology	4	0	0	4	5	10	15	70	100	
3	Core Course 7	MSZY-203	Genetics	4	0	0	4	5	10	15	70	100	
4	Core Course 8	MSZY-204	Biochemistry	4	0	0	4	5	10	15	70	100	
5	Practical III (Based on CC 5 & 6)	MSZY-205P	Practical 3	0	0	8	4	5	10	15	70	100	
6	Practical IV (Based on CC 7 & 8)	MSZY-206P	Practical 4	0	0	8	4	5	10	15	70	100	
7	CHM I		constitution of India	2	0	0	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	35	70	90	455	650	

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SEMESTER-I

Core Course

COURSE NAME: ANIMAL TAXONOMY AND ECONOMIC ZOOLOGY	MSZY-101
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Credits = L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: This paper is aimed to introducing the students for the salient features of Taxonomy and Economic Zoology.

Course Content:

UNIT- 1

- a. **Science of taxonomy-** Definition, concepts, history, scope and applications of biosystematics.
- b. **Principles of Zoological Classification-** Theories of biological classification and their history, hierarchies of categories and the higher taxa 14 hrs.

UNIT - 2

- a. **Concept of species-** Species category, different concepts and intraspecific categories. **Modern trends in taxonomy.** Behavioral taxonomy- chemotaxonomy. Cytotaxonomy and molecular taxonomy. 12 hrs

UNIT -3

- a. **Procedures in taxonomy-** Taxonomic collections, Process of identification procedure of classifying, description and publication.
- b. **Principals and application of zoological nomenclature-** origin of code, Rules of zoological nomenclature (ICZN), interpretation of rules of nomenclature. 14 hrs

UNIT- 4

- a. **Animal as food** – Fish products, dairy products, piggery, pearl, leather and wool industry.
- b. **Domestic animals-** Poultry, cattle and Pisciculture. 10 hrs

Unit- 5

- a. **Economic insects-** Apiculture, sericulture, insect pests and integrated pest management.
- b. Biological control and biological indicators. 10 hrs

Suggested Literature:

1. M.Kato. The Biology of Biodiversity. Springer.
2. E.O. Wilson, biodiversity. Academic Press, Washington.
3. G.G. Simpson, Principle of animal taxonomy. Oxford IBH Publishing company.
4. E. Mayer. Elements of Taxonomy. Oxford IBH Publishing company.
5. E.O. Wilson. The diversity of Life (The College edition W.W. Northem & Co.
6. V.C. Kapoor. Theory and Practice of Animal Taxonomy. Oxford & IBH Publishing Co.

Course Learning Outcomes:

- CO- 1** Classify animals on the basis of their relation to other animals by body structure, external characters, development and DNA.



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- CO- 2** Apply the International rules of Nomenclature to give a scientific name to animals which are found during research.
- CO- 3** Understand the economic importance of animals.
- CO- 4** Understand and demonstrate the internal anatomy of various animals, biodiversity and related indices



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Core Course

COURSE NAME: NON-CHORDATA	COURSE CODE: MSZY-102
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: This paper is aimed to introducing the students for structure & function of Invertebrate.

Course Content:

UNIT-1

- a. **Protozoa:** General characters, outline classification, organelles in protozoa locomotion in protozoa and reproduction in protozoa.
- b. **Porifera:** Important features, outline classification, structural peculiarities, skeleton and regeneration in sponges. 11 hrs

UNIT-2

- a. **Cnidaria:** Important features, outline classification, Polymorphism in cnidarians coelenterates, gradation of mutagenesis, skeleton in coelenterates and coral reefs.
- b. **Ctenophora:** Important features, outline classification, general organization and affinities.
- c. **Helminths:** Important features, outline classification platyhelminths and nemathelminths. 13 hrs

UNIT-3

- a. **Annelida:** Important features, outline classification, segmentation and coelome, excretory system and regeneration.
- b. **Arthropoda:** Important features, outline classification, Integumentary system, respiratory system and larval forms in crustacean.
- c. **Onychophora:** Important features, outline classification, general organization and affinities. 14 hrs

UNIT-4

- a. **Mollusca:** Important features, outline classification, shell, foot and its modification torsion and detorsion in gastropoda.
- b. **Echinodermata:** Important features, outline classification, body wall and skeleton, larval forms and regeneration. 12 hrs

UNIT-5

- a. **Minor non coelomata phyla:** General organization, classification, and affinities of phylum rotifer and acanthocephalan.
- b. **Minor coelomate phyla:** General organization, classification and affinities of phylum chaetognatha, pogonophora, Phoroida and brachiopoda.
- c. **Hemichordata:** General organization classification and affinities. 10 hrs

Suggested Literature:

1. Hyman, L.H. The invertebrates. Vol. I protozoa through Ctenophora, McGraw Hill Co.,



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New York.

2. Barrington, E.J.W. Invertebrate structure and function. Thomoes Nelson and sons Ltd. London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
4. Hyman, I. H. the Invertebrates. Vol. 2 Mc Graw Hill. Co., New York.
5. Hyman, L.H. The Invertebrates Vol. 8, McGraw Hall. Co., New York. & London.
6. Barnes, R.D. Invertebrate Zoology, III edition, W.b. Saunders Co., Philadelphia
7. Russel Hunter, W.D.A biology of higher invertebrates, the Macmillan co. Ltd. London.
8. Hyman, L.H. The invertebrates smaller coelomate groups. Vol. V Mc Graw Hill Co. New York.
9. Read, C.P. Animal Parasitism. Prentice Hall Inc., New Jersey.
10. Sedddgwick, A. a. Student text book of Zoology. Vol. I, II, and III Central book Depot, Allahabad.
11. Parker, T.J. Haswell, W.A. Text book of Zoology, Macmillan co., London.

Course Learning Outcomes:

- CO- 1 Understand the structure and organization of invertebrate animals.
- CO- 2 Explain modifications in various functions of animals during transition from invertebrates to vertebrates.
- CO- 3 Discuss the evolutionary significance of larval forms of invertebrates.
- CO- 4 Identify invertebrates and homology, analogy and modifications of mouthparts in relation to feeding habits.



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Core Course

COURSE NAME: CELL AND MOLECULAR BIOLOGY	COURSE CODE: MSZY-103
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: This course will provide knowledge about the complex organization in the eukaryotic cell and the molecular mechanisms of the cellular processes that exist in all cell types.

Course content:

UNIT -1

- a. **Introduction to the cell**– Cell theory, Ultrastructure of the cell, Prokaryotic vs Eukaryotic cells, organization of eukaryotic cells, cell cycle, cyclin dependent kinases (Cdks) cell cycle and cancer.
- b. **Cell membrane**– Models of the fine structure of bio-membrane including detailed fluid mosaic model, organization of lipids & proteins. Specific membrane proteins, functions of plasma membrane transport, diffusion, and active transport pumps uniports, symports and antiports). 13 hrs

UNIT -2

- a. **Cytoskeleton**– Structure and dynamics of microtubules, actin filaments (microfilaments), intermediate filaments, cilia & flagella
- b. **Cell organelles**- origin, structure and functions of mitochondria, ribosome, Golgi complex, endoplasmic reticulum, lysosome, centrosome, endosome and peroxysomes
- c. **The nucleus**– Nuclear envelope, nucleolus, Chromosome type structure, chemical composition and functions of chromosomes. 13 hrs

UNIT -3

- a. **Prokaryotic and eukaryotic genome**– Fine structure of DNA, DNA Replication, Biosynthesis of DNA, Protein synthesis (Transcription, translation and regulation of gene regulation Genetic code) 10 hrs

UNIT -4

- a. **Cell communication**– Cell-cell signaling, cell surface receptors, Second messenger system, Kinase pathways, signaling from plasma membrane to nucleus (signal transduction).
- b. **Cell adhesion & cell junctions**- Cellular affinity, Cell adhesion molecules(CAMS), Ca⁺⁺ dependent cell–cell adhesion. Ca⁺⁺ independent cell-cell adhesion, cadherins, selectins integrins, cell junctions. 13 hrs

UNIT -5

- a. **Cell division**– Mitotic cell division, Cell death – Necrotic cell death, Programmed cell death (apoptosis) and their mechanisms.
- b. **Cell commitment**– Specification of cell fate by progressive cell-cell interaction. 11 hrs



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Suggested Literature:

1. Molecular Cell Biology, Lodish et al., W.H. Freeman and Company (8th Ed. 2016)
2. Molecular Biology of the Cell, Alberts et al., W.W. Norton and Company (6th Ed. 2014)
3. Molecular Biology, Weaver R. F., McGraw-Hill Education (5th Ed. 2011)

Course Learning Outcomes:

The students will:

- CO- 1 Be able to understand how the cell functions as a unit of life.
- CO- 2 Gain knowledge about the techniques and experiments that contributed to the understanding of molecular mechanisms of the cellular processes.
- CO- 3 Be able to draw parallels between the physiological processes at the cellular and organismic levels.
- CO- 4 Appreciate the importance of cell-cell adhesion and the extracellular matrix in the evolution of multicellular organisms.
- CO- 5 It majorly emphasizes the concepts of central dogma of molecular biology spanning from DNA Replication till Protein Synthesis and Reverse transcription.



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Core Course

COURSE NAME: EVOLUTIONARY BIOLOGY	COURSE CODE: MSZY-104
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Credits = L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: The primary objective of the course is to impart appreciation for different life forms on earth and drive home the relationship between different living forms both at the genetic and the ecological level.

Course content:

UNIT -1

- Origin of Life including aspects of pre-biotic environment, Abiotic and Biotic Evolution, Theories of Organic Evolution, Emergence of Evolutionary Thoughts.
- Origin and evolution of economically important microbes and animals (Horse & Elephant) 12 hrs.

UNIT - 2

- Distribution of Animals: Distribution with Space, Distribution with time.
- Dispersal of Animals: Means, Barriers, Migration. 12 hrs

UNIT - 3

- Concepts of Evolution: Micro Evolution, Macro Evolution, Phylogenetic Gradualism.
- Molecular Evolution: Concepts of natural evolution, molecular divergence and molecular clock; molecular tools in phylogeny: origin of new genes and proteins: gene duplication and divergence. 12 hrs

UNIT- 4

- Mechanism of Evolution: Isolating Mechanism, Speciation, Alopaticity and Sympatricity: Convergent Evolution: Sexual Selection: Co-evolution, Natural Selection,
- Adaptation- Introduction, Adaptive Radiation and Modifications, Coloration & Mimicry. 13 hrs

UNIT-5

- Evidences in favour of organic evolution.
- Evolution of Horse. Elephant and Man. 11 hrs

Suggested Literature:

- Evolution, Barton, N. H., Briggs, D. E.G., Eisen, J. A., Goldstein, A. E., Patel, N. H., Cold Spring Harbor Laboratory Press, New York, USA
- Evolution, Hall, B. K. and Hallgrimsson, B., Jones and Bartlett Publisher, Sudbury, USA
- Evolution, Futuyma, D. J., Sinauer Associates, Inc., Sunderland, USA
- What Evolution Is, Mayr, E., (2001), Basic Books, New York, USA

Course Learning Outcomes:

- CO- 1 Knowledge of evolution would facilitate in assessing the potential disease causing organisms and thus be able to design effective disease control strategies.



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CO- 2 The students would be able to suggest beneficial alterations in agricultural crops and livestock through variability studies.

The students would be able to take up functional studies of many organisms



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Core Course

COURSE NAME: PRACTICAL- I

COURSE CODE: MSZY-105P

Credits =L+T+P = (0+0+8)

Total Hours= 60

(Based on MSZY-101 & MSZY-102)

Economic Zoology

1. Study of Life cycle of *Bombyx mori*
2. Study of Life cycle of *Apis*
3. Study of Life cycle of *Odontotermis*
4. Study of Life cycle of *Lacca*

Nonchordates

1. Study of museum Specimens and slides of Non chordates
2. Study of museum Specimens slides of Proto chordates



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Core Course

COURSE NAME: PRACTICAL- II	COURSE CODE: MSZY-106P
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Credits =L+T+P = (0+0+8)	Total Hours= 60
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(Based on MSZY-103 & MSZY-104)

Cell and Molecular Biology

1. To examine the phenomenon of cell permeability using hypotonic, isotonic and hypertonic solution.
2. Study of cell organelles with the aid of slides
3. Preparation of slides of bacteria from curd, milk, and tartar for study of prokaryotic cells.
4. Preparation of buccal epithelium cells slide by using suitable staining technique for study of eukaryotic cell.
5. Buccal smear preparation for localization of mitochondria by using Janus green stain.
6. Study of Mycoplasma, E. Coli, Bluegreen algae
7. preparation of chromosomes from onion root tips for study of mitosis by squash method
8. DNA extraction from onion
9. DNA extraction from banana
10. DNA extraction from human cheek cells

Evolution

1. Study of evolution of Horse through various models
2. Adaptive modification of feet and claws in birds
3. Adaptive modification in mouth parts of insects
4. Study of evolution through homologous and analogous organ



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Core Course

COURSE NAME: CHORDATA

COURSE CODE: MSZY-201

Credits =L+T+P = (04+1+0)

Total Hours= 60

Course Objectives: To understand the general character, different categories, organization and evolutionary relationship in different subphylum of chordates.

Course content:**UNIT-1**

- a. **Protochordata:** Origin & Evolution of Chordate, General Organization & Affinities of Larvacea, Thaliacea and Cephalochordate.
- b. **Vertebrate Ancestry:** Introduction, Origin and Evolution of Vertebrates.
- c. General and Comparative Account of Integumentary system and urinogential system.

12 hrs

UNIT-2

- a. **Fish:** General Character, Special Characters, General Organization and affinities of Obstracoderm & Coelacanthiformes
- b. Amphibia: General Characters, Special Characters, Parental Care, Neoteny

14 hrs

UNIT -3

- a. Reptiles: Origin and evolution of reptiles, Basic skull types and outline classification of reptiles.
- b. Dinosaurs, types and evolutionary significance
- c. Living reptiles- a brief account of Rhynchocephalia. Chelonia, Crocodilia and Squamata.

12 hrs

UNIT-4

Birds: Origin of birds, General Character, Special Characters, Flight Adaption, Modification of beaks (Darwin finches), Migration and territorial Behaviour.

10 hrs

UNIT-5

1. Mammals; General and special Characters of Mammals, Organizaton & Affinities of Prototheria.
2. Mammals: General Organization and Affinities of Marsupialia
3. Mammals: Aquatic Mammals with Reference to Cetaceae.

12 hrs

Suggested Literature:

1. H.H. Newman: The Phylum Chordata
2. Orr, R.T.: Morphology and biology of Reptiles.
3. De Beer, G.R.: Vertebrate Zoology.
4. Romer, A.S.: Vertebrate Body
5. Majupuria, T.S.: Introduction to Chordates.






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Course Learning Outcomes:

- CO- 1 Student should be able to describe unique characters of urochordates, cephalochordates and fishes.
- CO- 2 Student should be able to recognize life functions of urochordates to fishes.
- CO- 3 To understand the ecological role of different groups of chordates.
- CO- 4 To understand the diversity of chordates.



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Core Course

COURSE NAME: MAMMALIAN PHYSIOLOGY	COURSE CODE: MSZY-202
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: Animal physiology is the study of animal structure and function. This course on 'Mammalian Physiology' helps understand how animals work at all levels, ranging from individual cells to the whole integrated organism. The scope of physiology includes elucidation of the function of all cells in all organs and all animals related to nervous, respiratory, circulatory and other physiological systems. The course also has a strong lab component, where certain classical and interesting exercises will be conducted to answer various practical queries in animal physiology.

Course content:

UNIT I

- a. **Blood and circulation-** Blood corpuscles haemopoiesis plasma function blood volume, blood volume regulation, blood groups, haemoglobins
- b. **Cardiovascular system**– anatomy of heart, myogenic heart ECG– its principle and significance, cardiac cycle, blood pressure, Neural and chemical regulation of all above. 13 hrs

UNIT -2

- a. **Nervous System** – Neurons action potential gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
- b. **Sense organ**–Vision, hearing and tactile receptors 12 hrs

UNIT -3

- a. **Respiratory system**– Comparison of respiration in different animals, Transport of gases, exchange of gases, Waste elimination, Neural and chemical regulation of respiration
- b. **Excretory system**– Structure of kidney, Urine formation Urine concentration, Waste elimination, Micturition regulation of water balance, blood volume, blood pressure, electrolyte balance, acid base balance.
- c. **Digestive System**– Digestion, absorption energy balance. BMR 14 hrs

UNIT -4

- a. **Thermoregulation-** Comfort zone, body temperature– Physical, chemical, neural regulation acclimatization
- b. **Stress adaptation** 10 hrs

UNIT-5

- Endocrinology and reproduction-** Endocrine glands basic mechanism of hormone action, hormone and diseases, reproductive processes, neuro endocrine regulation 11 hrs

Suggested Literature:

1. General and Comparative Animal Physiology, Hoar W. S. (ed.), Prentice Hall, India.
2. Comparative Physiology (Handbook of Physiology): Vol. 1, 2, Dantzler, W.H. (ed.) Oxford University Press, New York, USA.



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3. Animal Physiology: Adaptation and Environmental, Nelson K. S. (ed.) Cambridge University Press, Cambridge, UK.
4. Comparative Animal Physiology, Prosser, C.L. & Brown Jr., F.A. (ed.), Saunders.
5. Eckert: Animal Physiology 5th Ed by Randall, David, Burggren, Warren, French, Kathleen (2001)



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Course Learning Outcomes:

CO- 1 After going through this course on 'Mammalian Physiology', the students have a good understanding of how mammals work and how these animals' biology is influenced by the different environments of their niches.

CO- 2 The students will be able to explore an original query in animal physiology.



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Core Course

COURSE NAME: GENETICS	COURSE CODE: MSZY-203
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: Genetics is offered as a core course that provides fundamental knowledge of how organisms, populations and species evolve. Apart from Mendel's laws and basic genetics, at Master's level, this course will provide some of the most incisive analytical approaches that are now being used across the spectrum of the biological disciplines.

Course content:

UNIT- 1

- a. **Mendelian principles**– Dominance, segregation, independent assortment, deviations from Mendelian inheritance.
- b. **Methods of gene Transfer**- Transformation, Conjugation, transduction, bacteriophage types, structure and morphology of T₄ Phage. 12 hrs

UNIT- 2

- a. **Chromosomes**- Structural and numerical alterations of chromosomes, Molecular anatomy of eukaryotic, heterochromatin and euchromatin, giant chromosomes, polytene and lampbrush chromosomes, sex chromosomes.
- b. **Gene-Mapping**- Concept of recombinational, linkage map, cytogenetic map, physical maps, molecular maps, levels of genome mapping, significance of genome mapping. 13 hrs

UNIT 3

- a. **Population genetics**- Gene pool and gene frequencies, Hardy-Weinberg law of genetic equilibrium and changes in gene frequencies.
- b. **Somatic cell genetics**- cell fusion and hybrids-agents and mechanism of fusion, heterokaryon 13 hrs

UNIT-4

- a. **Genetic Techniques**- Cloning, PCR, DNA, sequencing FISH, GISH, DNA-fingerprinting, chromosome walking and application of genetic engineering.
- b. **Genetic code**- Properties of genetic code, codon assignment, chain initiation and termination, mutations and the genetic code. 12 hrs

UNIT 5

- a. **Genetic disorders**- chromosomal disorders. Inborn errors of metabolism. Tay-sachs disease, albinism, phenylketonuria. Lesch-nvhan syndrome.
- b. **Organization of genetic material**- Packaging of DNA as nucleosomes in eukaryotes. Repetitive and unique DNA sequence, split genes. Overlapping genes and pseudogenes. 10 hrs

Suggested Literature:

1. Principles of Genetics, Snustad and Simmons, John Wiley & Sons, USA [Latest



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- edition].
2. Modern Genetic Analysis: Integrating Genes and Genomes, Griffiths, J.F., Gilbert, M., Lewontin, C. and Miller, W. H. Freeman and Company, New York, USA [Latest edition]



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3. Genetics, J. Russell, Benjamin-Cummings Publishing Company, San Francisco, California, USA [Latest edition].

Course Learning Outcomes:

- CO- 1 Genetics course will open up several avenues for students in terms of research and employability.
- CO- 2 Genetics has made extensive use of model organisms, many of which will be used to teach this course. By observing genetic mutations in *Drosophila*, students can correlate phenotype with genotype, understand genetic interaction and their molecular basis.
- CO- 3 Students will be able to set hands on genetic crosses to understand recessive and dominant, segregation, pattern of inheritance and finally evaluating statistical significance by counting the progeny as statistical analysis provides crucial. Insight into many biological processes.
- CO- 4 Students will learn how genetic information is passed on in eukaryotes and prokaryotes, how genes work together in a complex manner in biological system and any alteration can lead to major phenotypic change.
- CO- 5 Students will appreciate the concept of epigenetics as a key mechanism of regulation of gene expression steering development and cell fate that can ultimately be affected in disease condition.



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Core Course

COURSE NAME: BIOCHEMISTRY	COURSE CODE: MSZY-204
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: This paper contributes the overview of the molecular architecture of eukaryotic cells and organelles, including membrane structure and chemical nature of biological macromolecules.

Course contents:

UNIT- 1

- a. Structure of atoms, molecules and chemical bonds
- b. Composition Structure and function of biomolecules (carbohydrates, lipids, proteins nucleic acids vitamins) 11 hrs

UNIT -2

- a. Stabilizing interaction (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.) 10 hrs

UNIT -3

- a. Conformation of proteins (Ramachandran plot, Secondary, tertiary and quaternary structure. domains, motif and folds) 10 hrs

UNIT -4

Metabolism of Carbohydrates, lipids amino acids nucleotides and vitamins 15 hrs

UNIT -5

- a. Principle of catalysis, Enzymes, and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes
- b. Bionergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, and biological energy transducers. 14 hrs

Suggested Literature:

1. Tymoczko JL. And Stryer L. Biochemistry, W.H. Freeman and Company
2. David L. Nelson and Michael, Cox: Lehninger Principles of Biochemistry
3. Jeremy M. Berg: Biochemistry
4. Donald Voet: Fundamentals of Biochemistry: Life at the Molecular Level
5. Fundamentals of Biochemistry, J. L. Jain, S. Chand Publication

Course Learning Outcomes:

- CO- 1 Through this course the students are exposed to importance of biological macromolecules
- CO- 2 They acquire knowledge in the quantitative and qualitative estimation of biomolecules
- CO- 3 They study the influence and role of structure in reactivity of biomolecules
- CO- 4 At the end of the course, the students have a thorough understanding on the role of biomolecules and their functions



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Core Course

COURSE NAME: PRACTICAL-3

COURSE CODE: MSZY-205P

Credits =L+T+P = (0+0+8)

Total Hours= 60

(Based on MSZY-201 & MSZY-202)

Chordates

1. Study of museum specimens of fishes amphibian, reptiles, birds and mammal
2. Study of histological slides of fishes, amphibia reptiles, birds mammal
3. Study of extinct reptiles: Dinosaur: Models
4. Study of wonder vertebrate Animals
5. General methods of microscopic preparation-Killing and narcotization, Fixing, washing, staining, Destaining, dehydration, de-alcoholization, mounting Labelling
6. Microtomy – General Principle

Physiology

7. To identify the components of food.
8. To observe the action of salivary amylase on starch.
9. Estimation of hemoglobin percentage by haemoglobinometer.
10. To enumerate the total number of RBC
11. To enumerate the total number of WBC
12. Determination of ABO blood groups
13. Rh factor.
14. Measurement of blood pressure
15. To determine bleeding time
16. To determine the clotting time of blood.
17. To prepare the haemin crystal of blood
18. Estimation of haematocrit value in blood sample of human.
19. Detection of abnormal constituent of human urine
20. Detection of normal constituent of human urine
21. Study of location of endocrine glands by model diagram of Rat.
22. Study of permanent slides –
 - a. L.S. of Pituitary gland of rat
 - b. T.S. of thyroid gland
 - c. T.S. of parathyroid gland
 - d. T.S. adrenal gland
 - e. T.S. of testis
 - f. T.S. of ovary
 - h. T.S. of pancreas



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Core Course

COURSE NAME: PRACTICAL-4	COURSE CODE: MSZY-206P
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Credits =L+T+P = (0+0+8)	Total Hours= 60
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(Based on MSZY-203 AND MSZY-204)

Genetics

1. Study of Human Karyotype (normal abnormal)
2. Genetic exercises based on monohybrid cross.
3. Genetic exercises based on independent assortment.

Biochemistry

Qualitative techniques:

4. Qualitative analysis of functional group in the given solution of Carbohydrates.
5. Qualitative analysis of function group in given solution of proteins.

Quantitative techniques

6. Calorimetric estimation of glucose in the given solution.
7. Calorimetric estimation of total protein in given solution.

Enzymology:

8. Effect of pH on the action of salivary amylase.
9. Effects of temperature on the action of Salivary amylase.
10. Effect of inhibitor on the action of salivary amylase.
11. Study the activity of Trypsin using fresh tissue extract



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Evaluation Scheme for Second Year

SEM: III													
Batch:2025-26			SEM: III										
S.No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			Quiz/PT/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Core Course 9	MSZ Y-301	Environmental Biology	4	0	0	4	5	10	15	70	100	
2	Core Course 10	MSZ Y-302	Developmental Biology	4	0	0	4	5	10	15	70	100	
3	DEC 1	MSZ Y-303A / MSZ Y-303B	BIOLOGY OF PARASITE-I / Diversity & Behaviour of Fishes	4	0	0	4	5	10	15	70	100	
4	DEC 2	MSZ Y-304A / MSZ Y-304B	PHYSIOLOGY AND BIOCHEMISTRY OF PARASITES / Fish Physiology	4	0	0	4	5	10	15	70	100	
5	Practical V (Based on CC 9 & 10)	MSZ Y-305P	Practical- 5	0	0	8	4	5	10	15	70	100	
6	Practical VI (Based on DEC 1 & 2)	MSZ Y-306A P/ MSZ Y-306B	Practical- 6A/ Practical- 6B	0	0	8	4	5	10	15	70	100	









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		P											
7	OEC 1		To be chosen	2	0	0	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	35	70	90	455	650	









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SEM: IV													
Batch:2025-26			SEM: IV										
S.No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			Quiz/PPT/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Core Course 11	MSZY-401	RESEARCH METHODOLOGY	4	0	0	4	5	10	15	70	100	
2	DEC 3	MSZY-402A/ MSZY-402B	BIOLOGY OF PARASITE-II /AQUATIC RESOURCES AND THEIR CONSERVATION	4	0	0	4	5	10	15	70	100	
3	DEC 4	MSZY-403A/ MSZY-403B	IMMUNOLOGY OF PARASITE / AQUACULTURE	4	0	0	4	5	10	15	70	100	
4	Project Work	MSZY-404R		4	0	8	12	20	30	50	200	300	
5	EEC 1		To be choosen	2	0	0	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	40	70	95	445	650	

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THIRD SEMESTER

Core Course

COURSE NAME: ENVIORNMENTAL BIOLOGY	COURSE CODE: MSZY-301
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: The objective of this course to make awareness among the young students about the surrounding environment, the impact of climate change and its mitigation, and biodiversity.

Course content:

UNIT-1

- The Environment:** Physical environment: biotic environment; biotic and biotic interactions.
- Habitat and niche:** Concept of Habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning character displacement.
- Biogeography:** Major terrestrial biomes, theory of island biogeography; biogeographical zones of India. 14 hrs

UNIT-2

- Population ecology:** Characteristics of a population: Population growth curves; population regulation: life history strategies (r. and k selection) concept of metapopulation- demes and dispersal. Interdemic extinctions. Age structured population. 12 hrs

UNIT-3

- Ecosystem:** Structure and function: energy flow and mineral cycling (CNP) primary production and decomposition structure and function of some Indian ecosystems; terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine)
- Ecological succession:** Types; mechanisms; changes involved in succession; concept of climax. 12 hrs

UNIT-4

- Applied ecology:** Environmental pollution: global environmental change biodiversity status monitoring and documentation; major drivers of biodiversity change biodiversity management approaches. 12 hrs

UNIT-5

- Conservation biology:** Principles of conservation, major approaches to management Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves) 10 hrs

Suggested Literature:

- Field Sampling: Principles and Practices in Environmental Analysis. 2004. Conklin, A.R. Jr. CRC Press.
- Principles and Standards for Measuring Primary Production. 2007. Fahey, T.J. and Knapp, A.K. Oxford University Press, UK.
- Ecological Modeling. 2008. Grant, W.E. and Swannack, T.M., Blackwell.
- Fundamental Processes in Ecology: An Earth system Approach. 2007. Wilkinson, D.M. Oxford University Press, UK.



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5. Principles of Terrestrial Ecosystem Ecology. 2011. Chaplin, F.S., Matson, P.A. and Vitousek, P.M. Springer.
6. Environmental Chemistry. 2010. Stanley and Manahan, E. CRC, Taylor & Francis. London.
7. Freshwater Ecology: A Scientific Introduction. 2004. Closs, G., Downes, B. and Boulton, A. Wiley-Blackwell publisher, Oxford.

Course Learning Outcomes:

- CO- 1 Students will be exposed to the fundamental aspects of ecology.
- CO- 2 They will get idea about the impact of anthropogenic activities on the environment.
- CO- 3 Students will get idea about the natural resources and their conservation.



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Core Course

COURSE NAME: DEVELOPMENTAL BIOLOGY	COURSE CODE: MSZY-302
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: The main objective of Developmental Biology course is to provide four-dimensional thinking of students to truly understand the patterns and process of embryonic development, body plan, fate map, induction, competence, regulative and mosaic development, molecular and genetic approach for the study of developing embryo which is not necessarily shared with any other disciplines in the biological sciences. The relevance of Developmental Biology to the study of human disease will be exemplified throughout using different model organisms.

Course Content:

UNIT-1

- a. **Introduction-** History background and theories of development, theory of preformation, epigenetic theory, theory of pangenesis, recapitulation theory, germplasm theory, mosaic theory, regulated theory, gradient theory and theory of organizers.
- b. **Parthenogenesis-** Natural Parthenogenesis, arrhenotoky, thelyoky, accidental parthenogenesis, rudimentary parthenogenesis, artificial Parthenogenesis, Parthenogenesis in human being, genogenesis, androgenesis and significance of Parthenogenesis.
- c. **Basic concepts of development:** Potency, commitment, specification, induction competence. Determination and differentiation: morphogenetic gradients; cell fate and cell lineages; stem cells: genomic equivalence and the cytoplasmic determinants; imprinting: mutants and transgenics in analysis of development. 12 hrs

UNIT-2

- a. **Gametes and fertilization-** Spermatogenesis, oogenesis and fertilization.
- b. **Early development-** Cleavage and blastula, Pattern of cleavage, Laws of cleavage, types of cleavage, effect of yolk on cleavage. Physiology of cleavage morula and blastula. 11 hrs

UNIT-3

- a. **Gastrulation-** Process of gastrulation invagination, involution, infiltration, delamination and mechanisms. Accessory processes of gastrulation concrescence and convergence. 12 hrs

UNIT-4

- a. **Metamorphosis-** metamorphosis in insects and amphibians, biochemical and morphological metamorphic changes and hormonal control of metamorphosis.
- b. **Regeneration-** Regenerative potentials in different animal groups, mechanism of regeneration in amphibian and planeria. 13 hrs

UNIT-5

- a. **Aging-** introduction, consequences of aging causes of aging, control of aging through genes and aging of cells in vitro Carrel's immortal cells.



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b. Abnormal development

- i.** Teratology- Causes of abnormal development, therapeutic drugs as teratogens, drug testing experimental teratology.
- ii.** Neoplasia- Etiology, growth and differentiation of tumor cells cell growth and oncogenesis, loss of homeostatic control, growth and invasiveness of placenta. 12 hrs

Suggested Literature:

1. Developmental Biology: Scott F Gilbert [Latest edition].
2. Essentials of Developmental Biology: JMW Slack [Latest edition].
3. Principles of Development: Louis Wolpert [Latest edition].

Course Learning Outcomes:

- CO- 1** Developmental Biology enquires about the fundamental processes that underpin the fertilization of an egg cell and its step-by-step transformation into the fascinating complexity of a whole organism.
- CO- 2** Students learn best by doing and by having the opportunity to put what they have learned into practice. Therefore, using various model organism as a learning tool in Developmental Biology, students will learn how a cell behaves in response to an autonomous determinant or an external signal depends on the combination of transcriptional and posttranscriptional regulators, signaling pathway components, cytoskeletal elements, and other proteins and RNAs that it has synthesized earlier: i.e., on its developmental history.
- CO- 3** Students will also understand that cells only express a proportion of their genome, and that differential gene expression underlies cell differentiation and any alteration in the entire process of development leads to devastating diseases.



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Elective Course

COURSE NAME: BIOLOGY OF PARASITE-I	COURSE CODE: MSZY-303A
Credits =L+T+P = (04+1+0)	Total Hours= 60

Course Objectives: The course aims to give an overview of biological basis of parasitic lifestyles including host responses and parasite evasion of host defense mechanisms. It emphasizes on the evolutionary aspect of host-pathogen interactions leading to host specificity. The students learn about transmission, epidemiology, diagnosis, clinical manifestations, pathology, treatment and control of major parasites.

Course content:

UNIT-1

- a. **Animal Association and Categories:** Introduction, Basis principal & concepts, Symbiosis, Parasitism, Commensalism, Types of parasites.
- b. **Parasitic adaptation:** Evolution of parasitism, Fate of parasite, Adaptation to parasitism. 12 hrs.

UNIT-2

- a. **Host Parasite relationship:** Host specificity, Action of parasite upon their hosts (Effects of parasites upon invertebrates, Effects of parasites upon vertebrates, Effect on the parasite and Effect on the Host. 13 hrs.

UNIT-3

Parasitic Protozoa: Introduction, General classification, Trypanosoma gambiense, Leishmania donovani. 12 hrs.

UNIT-4

- a. **Termatoda:** Introduction, General classification, types of termatodes, Larval forms.
- b. **Termatoda:** *Paragonimus westeramani*.
Termatoda: Blood flukes (*Schistosoma haematobium*, *S. mansoni* & *S. japonicum*) 12 hrs.

UNIT- 5

- a. **Cestoda:** Introduction, General classification.
- b. **Cestoda:** Larval forms.
- c. **Cestoda:** Echinococcus granulosus, Hymenolepis nana & H. diminuta. 11 hrs.

Suggested Literature:

1. Foundations of Parasitology, Roberts L.S. and Janovy J., McGraw-Hill Publishers, New York, USA.
2. Modern Parasitology: A Textbook of Parasitology, FEG Cox., Wiley-Blackwell, U. K.
3. Parasitology: A Conceptual Approach, Eric S. Loker, Bruce V. Hofkin

Course Learning Outcomes:

Upon successful completion of this course the students would be able to:

- CO- 1 Understand the biology behind host-parasite interactions
- CO- 2 Learn about epidemiological concepts of parasitic infections of global importance
- CO- 3 Trained to diagnose, identify and detect some important parasites
- CO- 4 Learn pathological changes associated with parasite infections
- CO- 5 Learn molecular biology concepts unique to parasite infections



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Elective Course

COURSE NAME: DIVERSITY AND BEHAVIOURS OF FISHES	COURSE CODE: MSZY-303B
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: This course introduces the young students to the world of fish diversity. Globally, more than 28000 fish species are available and India has huge fish biodiversity.

Course content:

Unit 1.

Origin, Evolution and Distribution of major groups of fishes, Evolutionary Strategies, Gene and Genome Duplication, Evolutionary Genetics, Biogeographical Distribution, Methods employed in Phylogenetic Studies and Fish Identification. 15 hrs

Unit 2.

Comparative anatomy of skin, scales and fins, digestive system, circulatory system, 10 hrs

Unit 3.

Respiratory system including accessory respiratory organs, urinogenital system and immune system. 15 hrs

Unit 4.

Behaviour in relation to feeding, schooling, migration, courtship, mating and parental care. Adaptations and Symbiotic associations. 10 hrs

Unit 5.

Sources of Aquatic Pollution, Impact of pollution on aquatic organisms, Impact of exotic fish species and GMOs on aquatic biodiversity, Fishes and their relationship with abiotic and biotic factors. 10 hrs

Suggested Literature:

1. Biology of Fishes. 2008. Bone, Q. and Moore, R., Talyor and Francis Group, CRC Press, U.K.
2. The Diversity of Fishes. 1994. G.S. Helfman, B.B. Collette & D.E. Facey (Eds) Blackwell Sceince, USA.
3. Readings in Ichthyology. 1979. M.S. Love and G.M. Cailliet (eds). Prentice-Hall of India.
4. The Senses of Fish Adaptations for the Reception of Natural Stimuli. 2004. von der Emde, R., Mogdans, J. and Kapoor, B. G., Narosa Publishing House, New Delhi, India.

Course Learning Outcomes:

CO- 1 Students will learn the identification of fishes using classical morphological method as well as advanced molecular tools.



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Elective Course

COURSE NAME: PHYSIOLOGY AND BIOCHEMISTRY OF PARASITES	COURSE CODE: MSZY-304A
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: The course aims to give an overview of physiology and biochemistry of different system of parasites like their nutrition, excretion, growth, nervous and reproduction.

Course content:

UNIT-1

- a. **Nutrition:** Uptake and digestion in protozoa, trematoda, cestoda and nematode. Metabolism, Carbohydrate. 12 hrs

UNIT-2

- a. **Parasitic reproduction:** Asexual, sexual reproduction, synchronization of parasite with host reproduction, *in vitro* cultivation of parasite.
b. **Egg shell:** Formation in helminthes, chemistry of egg shell formation, role of Mehli's glands. 12 hrs.

UNIT-3

- a. **Excretion:** Nitrogen excretion and water and ionic regulation in parasites.
Nervous system and sense organs: Morphology of nervous system and sense organs, nervous transmission and behavioral coordination. 13 hrs.

UNIT-4

- a. **Parasite transmission:** Mechanism of host selection and its consequence, penetration and circadian rhythm.
b. **Ecology of Parasitism:** Niche biology, population dynamics, negative interaction, problems of escape and dispersal, problem of mate finding. 15 hrs

UNIT-5

- Growth and establishment of parasite:** Hatching, establishment, site selection, migration. 08 hrs.

Suggested Literature:

1. Modern Parasitology: A Textbook of Parasitology, FEG Cox. Wiley-Blackwell, U. K.
2. Parasitology: A Conceptual Approach, Eric S. Loker, Bruce V. Hofkin
3. Franklin A. Neva and Harold W. Brown 2003. Basic Clinical Parasitology, 7th ed., Prentice Hall Int.
4. Animal Agents and Vectors of Human Diseases, 1985. Paul C. Beaver and Rodney C. Jung, 5th ed., Lea & Febiger.
5. Google image demonstration parasitic stages and life cycles

Course Learning Outcomes:

Upon successful completion of this course the students would be able to:

- CO- 1 Understand the nutrition of parasites and nervous system.
CO- 2 Learn about growth and establishment of parasite within their host
CO- 3 Learn about the mechanism how parasite found their host and penetrates and about their habitat and niche.



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Elective Course

COURSE NAME: FISH PHYSIOLOGY	COURSE CODE: MSZY-304B
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: Various physiological aspects of fish viz. respiration, feeding, digestion, reproduction, immunology, etc. are included in the second paper,

Course content:

Unit 1.

- a) Swimming and Buoyancy: Propulsive systems, swimming modes, strategies for buoyancy regulation.
- b) Internal Transport and Homeostasis: Gas exchange. Aquatic and aerial respiration, cardiovascular physiology, osmoionic regulation. Acid-base balance. 14 hrs

Unit 2.

- a) Growth and Metabolism: Regulation of food intake by neuropeptides and hormones, environmental factors and feed intake, digestive physiology and nutrient digestibility in fishes, nutritional energetic.
- b) Immunity: Development of immune system, cells and tissues of the fish immune system, Modulators of fish immune responses, Humoral and cell mediated immune defense, Fish antibody molecules and their effector functions. Host-parasite interaction, immune-evasion mechanisms of fish pathogens. 14 hrs

Unit 3.

Sensory Physiology and Coordination: Photoreception, Olfaction, Perception of mechanical and electrical stimuli, Endocrine glands and neuroendocrine coordination. 12 hrs

Unit 4.

Reproductive physiology: Reproductive strategies, Environmental factors regulating reproductive cycles, Hormonal and molecular mechanisms of oogenesis and spermatogenesis, Ovulation, spawning and spermiation, Fertilization and development. 14 hrs

Unit 5.

Stress Physiology: Effect of abiotic, biotic and xenobiotic stresses on fish immune system, Adaptation to extreme temperature, Hypoxia. 6 hrs

Suggested Literature:

1. Encyclopedia of Fish Physiology. 2011. Anthony P. Farrell, E.D. Stevens, J.J. Cech & J.G. Richards (Eds). Academic Press, UK.
2. Fish Physiology. (Series) W.S. Hoar and D.J. Randall (Series Eds). Academic Press, UK.
3. The Physiology of Fishes. 2013. Evans, D. H. and Claiborne, J. D., Taylor and Francis Group, CRC Press, UK.

Course Learning Outcomes:

- CO- 1 The knowledge of physiology equips the young generation for the propagation of fish.
- CO- 2 The students will be exposed to the modern immunological technique that is the need of the day to control disease related problems in the field.



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Core Course

COURSE NAME: PRACTICAL-5	COURSE CODE: MSZY-305P
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Credits =L+T+P = (0+0+8)	Total Hours= 60
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(Based on MSZY-301 & MSZY-302)

Environmental Biology

1. To determine the texture of given soil sample.
2. To determine the moisture present in the given soil sample.
3. To determine the Ph of given soil sample.
4. To determine the temporary hardness of a given sample of water.
5. To determine the amount of dissolved oxygen in the given sample of pond water.
6. Study of grassland communities by quadrat Method by working out frequency density, and abundance of organism
7. Study biotic component of a pond by collection and identification of plants and animals.

Developmental Biology

8. Study of spermatogenesis by model diagram
9. Study of oogenesis by model diagram
10. Study of fertilization by model diagram
11. cleavage pattern by model diagram
12. Study of slides T.S. passing through testis of mammal
13. Study of slides T.S. passing through ovary of mammal



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Elective Course

COURSE NAME: PRACTICAL-6	COURSE CODE: MSZY-305AP
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Credits =L+T+P = (0+0+4)	Total Hours= 60
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(Based on MSZY-303A & MSZY-304A)

Biology of Parasites-I:

1. Study of prepared slides and museum specimens of selected parasites of representative groups of protozoans, helminths and arthropods.
2. Demonstration of *in vitro* culture of *Plasmodium*, infection of mice with *Plasmodium*, chasing the process of infection by histopathology and immune reactions.
3. Culturing insect parasitic nematode, and chasing the lifecycle of the nematode on the insect host.
4. Culturing an insect parasitoid and studying their infection on an insect host.
5. Studying the infection of tomato plant by root knot nematode.
6. Study of the morphologic features and diagnostic stages of the different medically important parasites.
7. Demonstrate knowledge of the precautionary measures to prevent transmission of the parasites during the laboratory sessions.
8. To study the different larval forms of cestode.
9. To study the different larval forms of trematode
10. To study the different larval forms of Leishmania
11. To study the different larval forms of Trypanosoma.
12. Demonstrate the skill in preparing thick and thin blood smear.
13. Compute for the degree of parasitemia using thick and thin blood smear.
14. Physiology and Biochemistry of Parasites:
15. To study the growth and establishment of parasites diagrammatically.
16. To study the process of red blood cell invasion by merozoites diagrammatically.
17. To study the egg shell formation in helminths diagrammatically.



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Elective Course

COURSE NAME: PRACTICAL-6	COURSE CODE: MSZY-305BP
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Credits =L+T+P = (0+0+4)	Total Hours= 60
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(Based on MSZY-303B & MSZY-304B)

Diversity and Behaviors of Fishes

1. Identification of fishes including a detailed study of local fish fauna.
2. Identification of Indian common fish faunal resources from cold water, warm water, brackish water, marine water and ornamental fishes.
3. Types of scales, fins and otoliths.

Fish Physiology

4. Display of visceral organs; preparation of fish skeleton; alizarine preparation.
5. Dissection of Weberian ossicles and their association with internal ear and air bladder in representative fishes.
6. Comparative study of digestive enzymes of herbivore, carnivore and omnivore fishes.
7. Dissection of cranial nerves of selected fishes.
8. Study of accessory respiratory organs.
9. Collection of body fluids (blood sampling; urine collection; gamete collection).
10. Oxygen consumption in relation to body size/stress/anesthesia.
11. Bulk-staining of hypothalamic nuclei.
12. Extraction, isolation and characterization of plasma vitellogenin and egg-yolk proteins.
13. Gametogenesis and *in vitro* meiotic oocyte maturation.



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FOURTH SEMESTER

Core Course

COURSE NAME: RESEARCH METHODOLOGY	COURSE CODE: MSC-ZOO-401
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: The main objectives of this paper are to expose students to state of the art instrumentation, to introduce them to the principles and methods of various instruments used in biology and to prepare them to use these techniques in their own research. The course is a combination of lectures and demonstrations on basic principles and applications of the Spectrophotometers, Chromatographs and Electrophoresis system. With the aid of computer system and software, the students are also given hands on training in bioinformatics. Also, this paper is to acquire knowledge on the preparation of research manuscripts etc.

Course content:

UNIT-I:

BIostatistics & BIOinformatics Collection and analysis of biological data - mean, median, mode Standard deviation, Standard error, Coefficient of variation, Student 't' test, Skewness, Kurtosis, Chi - square, Correlation, Regression and ANOVA. Internet - Worldwide Web - Search Engines - their functions. Boolean searching - file formats. Biological data bases - sequence and structure - date retrieval - searching source data bases - sequence similarity searches - FASTA and BLAST, claustral and phylip. 14 hrs

UNIT-II:

SPECTROSCOPY Absorption and Emission principles - Principle and application of UV-visible, Spectrofluorometer, flame photometer, Atomic Absorption and emission spectrophotometers, NMR and Mass spectrometer in Biology. 12 hrs

UNIT-III:

CHROMATOGRAPHY & ELECTROPHORESIS Principles and Application of Chromatography: Paper, Thin layer, column, Ion Exchange, Gel filtration, Gas Liquid, HPLC and affinity. Principles and Application of Electrophoresis: Paper, Agarose, PAGE, SDS PAGE and Iso-Electric focusing. 13 hrs

UNIT-IV:

MICROSCOPY Principles, construction and biological uses of phase contrast, fluorescence, scanning and transmission electron microscopes. 10 hrs

UNIT-V:

PREPARATION OF MANUSCRIPTS Preparation of index cards-Reference collection - preparation of thesis - preparation of Scientific paper for publication in a Journal. Internet and e-journals. Computer aided techniques for data analysis, data presentation and slide preparation. 11 hrs

Suggested Literature:

1. Anderson, Durston and Polle.1970. Thesis and Assignment writing. Wiley Eastern Ltd., New Delhi.
2. Comir and Peter Wood Ford.1979. Writing scientific papers in English. Pitman Medical Publishing Co., London.



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3. Ewing, G.W. 1988. Instrumental methods of chemical analysis, McGraw Hill Book Company.
4. Daniel, M. 1989. Basic biophysics for biologists. Agro-Botanical Publishers, India.
5. Skoog, A., Douglas, J. and Leary, J.J. 1992. Principles of Instrumental Analysis. Sanders Golden Sunburst Series, Philadelphia.
6. Day, R.A. 1994. How to write and publish a scientific paper. Cambridge University Press, London. Palanichamy, S. and M. Shanmugavelu.1997. Research methods in biological sciences. Palani Paramount Publications, Tamil Nadu, India.
7. Wilson and Walker. 2000. Practical biochemistry - principles and techniques. Cambridge University Press.
8. Milton, J.S. 1992. Statistical methods in Biological and Health Sciences. McGraw Hill Inc., New York.
9. Gupta, S.P. 1988. An easy approach to statistics. Chand & Co., New Delhi. M.Sc. Zoology: Syllabus (CBCS) 46
10. Gurumani, N. 2006. Research Methodology for Biological Sciences. MJP Publishers, Chennai.
11. Veerakumari, L. 2006. Bioinstrumentation. MJP Publishers, Chennai.

Course Learning Outcomes:

Students studying this course will be able to

- CO- 1 Discuss different methodologies and techniques used in research work.
- CO- 2 Explain basic computer skills necessary for the conduct of research.
- CO- 3 Assess the basic function and working of analytical instruments used in research
- CO- 4 Propose the required numerical skills necessary to carry out research.



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Elective Course

COURSE NAME: BIOLOGY OF PARASITE-II

COURSE CODE: MSZY-402A

Credits =L+T+P = (04+1+0)

Total Hours= 60

Course Objectives: The course aims to give an overview of general morphology, classification, life cycle of nematodes, medically important insects and nematode relation to plants.

Course Contents:

UNIT-1

- a. General organization, classification & general pattern of life cycle of Nematodes (animal, plant parasitic & Entomopathogenic), Parasitic adaptation

Introductory Nematology: Introduction, General Morphology, Economic importance, Types of plant nematodes, Host range, Biology. 13 hrs.

UNIT-2

- a. **Family- Strongyloidae:** Strongyloides stercorales

- b. **Family- Ancylostomatidae:** Ancylostoma duodenale.

Famil- Filaridae: Wuchereria bancrofti. 10 hrs.

UNIT-3

- a. **Techniques in Nematology:** Methods of sampling (Soil & plant samples), Methods of extracting nematodes from soil & plant samples, Methods of processing nematodes for observation.

Plant nematode relationship: Host parasite relationship, Mechanism involved in injury & histopathology of infected tissue, Interaction with other microorganism, Brief structure, life cycle, epidemiology, pathogenicity and control of root knot & cyst Nematodes.

14 hrs.

UNIT-4

Acanthocephala- General organization & classification. 08 hrs.

UNIT-5

- a. **Medically important insects:** Arthropods and vectors of human diseases (mosquitoes, lice, flies & ticks); Mode of transmission of pathogen by vectors, chemical, biological and environmental control of arthropoid vectors.

Insects carrying vesication, Urtrication and Venomenization. 15 hrs.

Suggested Literature:

1. Chitwood, B. G., and Chitwood, M. B. 1974. Introduction to nematology. University Park Press, Baltimore, London, Tokyo. 334 pp.
2. Franklin A. Neva and Harold W. Brown 2003. Basic Clinical Parasitology, 7th ed., Prentice Hall Int.
3. Animal Agents and Vectors of Human Diseases, 1985. Paul C. Beaver and Rodney C. Jung, 5th ed., Lea & Febiger.
4. Google image demonstration parasitic stages and life cycles

Course Learning Outcomes:



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- CO- 1 The knowledge will equips the students about general morphology and life cycle of plant parasitic nematodes.
- CO- 2 They will learn the technique to extract nematodes from soil and plants.
- CO- 3 They will know the relationship between nematodes and plants.
- CO- 4 Students will get knowledge about medically important insects.



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Elective Course

COURSE NAME: AQUATIC RESOURCES AND THEIR CONSERVATION	COURSE CODE: MSZY-402B
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: This paper Aquatic Resources and their Conservation gives information about the various aquatic resources viz. rivers, lakes, reservoirs, oceans.

Course content:

Unit 1.

Aquatic Resources: Riverine fisheries, Cold water fisheries, Estuarine fisheries, Marine fisheries, Impact of interlinking of rivers on fisheries, Biology of commercially important fishes of India (sardine, mackerel, hilsa, mahseer). Survey of world fisheries, Origin of lakes and lake morphology. Light, temperature, oxygen and other dissolved gases in lakes, pH and redox potential in relation to the aquatic ecosystems. 20 hrs

Unit 2.

Aquatic Organisms: Distribution patterns of planktonic organisms. Phytoplankton-zooplankton relationships. Planktonic community organization in relation to predators. Adaptations of planktonic organisms to different aquatic habitats. Periphytic communities. Benthos. Bio-indicators and Biomonitoring. 10 hrs

Unit 3.

Fishing Techniques: Remote sensing, sonar, radar; crafts and gears. Fishways and screens. 8 hrs

Unit 4.

Stock Assessment and Management: Marking, Tagging and Population enumeration, Length-weight relationship, Age and growth, Fecundity estimation, Application of statistical methods in fisheries, Fish conservation and Fishing laws. 10 hrs

Unit 5.

Post-Harvest Technology - Fish spoilage, rigor mortis, rancidity, enzymatic spoilage, microbial spoilage. Principles and methods of fish preservation, Problems associated with fish preservations, Processing and marketing of fish by-products, Quality control in fish processing industry. 12 hrs

Suggested Literature:

1. Computers in Fisheries Research, 2009. Megrey, B. A. and Moksness, E. Springer, USA.
2. Biological Invasions in Marine Ecosystems Ecological, Management and Geographic Perspectives. 2009. Rilov, G. and Jeffrey, A. C. , Springer-Verlag, Germany.
3. Handbook of Fisheries and Aquaculture. 2013. Indian Council of Agricultural Research, ICAR, DIPA, New Delhi, India.

Course Learning Outcomes:

- CO- 1 The conservation of aquatic resources is most essential in the present scenario of climate change and anthropogenic activities. India has long coastline with many fish landing centers that help in the livelihood and income generation.
- CO- 2 Fish and shellfish identification is the basic requirement of fisheries students. These are very much helpful for their research oriented activity.
- CO- 3 Taxonomic key and evolutionary tree preparation are necessary in different evolutionary research study.



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CO- 4 Students will be able to get idea about the basic information regarding aquaculture management and exploitation of aquatic resources.



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Elective Courses

COURSE NAME: IMMUNOLOGY OF PARASITE	COURSE CODE: MSZY-403A
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: This paper will give an overview of immune system, to identify the cellular and molecular basis of immune responsiveness and host response against parasite.

Course content:

UNIT-1

Cells of immune system: Lymphoid cells (T-lymphocytes, B-lymphocytes), null cells, mononuclear cells, granulocytic cells, mast cells, basophils, dendritic cells, MHC molecules and compliments. 10 hrs

UNIT-2

- a. **Immunoglobulin:** Basic structure of immunoglobulin, fine structure of IgG, IgM, IgA, IgE, Monoclonal antibodies, parasite antigen.
- b. **Antigen antibody interaction:** Strength of antigen-antibody interaction, cross reactivity, precipitation reaction, agglutination reaction. 14 hrs.

UNIT-3

- a. **Immunobiology of Protozoans:** Host response against *Plasmodium* infection during Malaria. 10 hrs

UNIT-4

- a. **Immunobiology of Termatodes:** Immunological response against termatode, *Schistosoma* infection, immunodiagnosis of termatodes.
- b. **Immunology of cestodes:** Immunity of larval and adult cestodes, immunodiagnosis of cestodes. 16 hrs

UNIT-5

Vaccines: Passive immunization, active immunization, designing of vaccines for active immunization, whole organism vaccines, recombinant vector vaccines. DNA vaccines, synthetic vaccines. 10 hrs.

Suggested Literature:

1. Franklin A. Neva and Harold W. Brown 2003. Basic Clinical Parasitology, 7th ed., Prentice Hall Int.
2. Animal Agents and Vectors of Human Diseases, 1985. Paul C. Beaver and Rodney C. Jung, 5th ed., Lea & Febiger.
3. Google image demonstration parasitic stages and life cycles

Course Learning Outcomes:

- CO- 1 Demonstrate the basic knowledge of immunological processes at a cellular and molecular level
- CO- 2 define central immunological principles and concepts
- CO- 3 outline, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity and how they relate
- CO- 4 elucidate the genetic basis for immunological diversity and the generation of adaptive immune responses
- CO- 5 Learn the role of vertebrate innate and adaptive immune system in controlling



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parasites Define the mechanisms of parasite drug resistance
CO- 6 Define the immune evasion strategy employed by certain parasites



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COURSE NAME: AQUACULTURE	COURSE CODE: MSZY-403B
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Credits =L+T+P = (04+1+0)	Total Hours= 60
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Course Objectives: Culture techniques of aquatic organisms from different aquatic resources (freshwater, estuarine and marine) are included in this paper. The environmental and nutritional requirements, reproduction and diseases of cultured species are the core parts of this paper.

Course content:

Unit 1.

- a) Culture of Fish and Shellfish:** Freshwater (carps, catfishes, prawns), brackish water (milk fish, mullets, crabs, shrimps), mariculture (mussels, oysters, sea weeds), fish food organisms (algae; *Artemia*; zooplankton).
- b) Water-quality criteria for Aquaculture:** Role of temperature, pH, salinity, dissolved oxygen, ammonia, nitrite, nitrate, phosphate. 18 hrs

Unit 2.

- a) Integrated Farming:** Fish-cum-livestock farming, paddy-cum-fish farming.
- b) Aquaculture Engineering:** Aquahouse, hatchery, ponds, race ways, recirculating system, cage, pen. 8 hrs

Unit 3.

- a) Fish Seed Technology and Transport:** Natural collection, Bundh breeding, Induced breeding, Global survey of fish breeding practices, Cryopreservation of gametes, Transport of eggs, fry, fingerlings and adults.
- b) Nutrition of Aquatic Animals:** Nutritional requirements of commercially important finfish and shellfish, formulation of fish feed, feeding techniques, role of probiotics and prebiotics in fish nutrition 14 hrs

Unit 4.

- a) Role of Genetics in Aquaculture:** Gynogenesis, androgenesis, triploidy, tetraploidy, hybridization, sex reversal and breeding, production of transgenic fish.
- b) Fish Health:** Infection and diseases in fish, common fish pathogens, and routes of pathogen entry in fish. Fish vaccines-strategy and use in aquaculture. 11 hrs

Unit 5.

- a) Environmental Impact of Aquaculture:** Aquacultural wastes and future developments in waste minimization, environmental consequences of hyper-nutrification.
- b) Extension services:** Basic principles and emerging issues of extension, Role of information and communication technology. 09 hrs

Suggested Literature:

1. Fishponds in Farming Systems. 2007. Zijpp, V. D., Verreth, J. A. J., Tri, L. Q., van Mensvoort, M. E. F., Bosma, R. H., and Beveridge, M. C. M. Wageningen Academic Publishers, Netherlands.
2. Aquaculture Principles and Practices. 2005. Pillay, T. V. R. Second edition, Blackwell Publishing, USA.
3. Aquaculture and Fisheries Biotechnology Genetic Approaches. 2011. Dunham, R. A. CABI Publishing, USA.
4. Fish Defenses. Zaccane. 2010. G., Meseguer, J., Garcia-Ayala, A. and Kapoor, B. G. Science Publishers, USA.

Course Learning Outcomes:

CO- 1 All the basic information gathered in three papers will be utilized in the fourth paper Aquaculture.



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- CO- 2 The study of culture techniques of various aquatic organisms helps in the production of healthy food for human consumption in a sustainable manner and also in employment generation.
- CO- 3 The learners will be aware of all the techniques involved in aquaculture.
- CO- 4 At the end of the course, student can able to gain the knowledge on the aquaculture practices.



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