Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(An Autonomous College)

Reaccredited by NAAC with 'A+' Grade

Choice Based Credit System with Multiple Entry and Multiple Exit Option

(NEP-2020)

Syllabus For

Master of Science

Part - I

Fisheries

Semester I and II

(Syllabus to be implemented from Academic Year 2022-23)

Course Structure

M. Sc. I Semester I

Level	Semester	Course Code	Course Category	No. of Lectures Per Week	Credits
8	I	MZFT 101	Theory	4	4
		MZFT 102	Theory	4	4
		MZFT 103	Theory	4	4
		CCS(Elective : Any one among two)			
		MZFT 104:E1	Theory	4	4
		MZFT 104:E2	Theory	4	4
		MZFP 105	Practical	4	4
		MZFP 106	Practical	4	4
		AECC- I		2	2
		SEC - I		2	2
Total					**28**

Semester II

Level	Semester	Course Code	Course Category	No. of Lectures Per Week	Credits
8	II	MZFT 201	Theory	4	4
		MZFT 202	Theory	4	4
		MZFT 203	Theory	4	4
		CCS(Elective : Any one among two)			
		MZFT 204:E1	Theory	4	4
		MZFT 204:E2	Theory	4	4
		MZFP 205	Practical	4	4
		MZFP 206	Practical	4	4
		AECC- I		2	2
		SEC - I		2	2
Total					**28**

Course Structure M.Sc. II

Level	Semester	Course Code	Course Category	No. of Lectures Per Week	Credits
9	III	MZFT 301	Theory	4	4
		MZFT 302	Theory	4	4
		MZFT 303	Theory	4	4
		MZFT 304	Theory	4	4
		DSC (Elective : Any one among two)			
		MZFP 305	Practical	4	4
		MZFP 306	Practical	4	4
		SEC- III		2	2
		SEC - IV		1	1
		Research Training (20 to 40 Working Days)			1
Total					**28**

SEC – III: Start-Ups and Entrepreneurship: An approach for Sustainable Economy

Level	Semester	Course Code	Course Category	No. of Lectures Per Week	Credits
9	IV	MZFT 401	Theory	4	4
		MZFT 402	Theory	4	4
		MZFT 403	Theory	4	4
		MZFT 404 **(Elective : Any one among two)**	Theory	4	4
		MZFP 405	Practical	4	4
		MZFP 406	Practical	4	4
		SEC – V (C-III)		2	2
		SEC-VI Internship / Industrial Training (30 to 60 Working Days)			1
		MOOCs / SWYAM / NPTEL			1
Total					**28**

Class	M.Sc.I	M.Sc.II	Total
Credits	**56**	**56**	**112**

Semester I

MZT 101: Biosystematics and Biodiversity

CourseObjectives:

1. To define taxonomy, and various tasks of taxonomists.
2. To summarize the different concept of species for taxonomic identification of the species.
3. To understand the concepts of hotspot diversity and roles to conserve that diversity.
4. To know the roles played by NGOs, and different communitiesin conserving the biodiversity.

Credits=4	**MZT 101 Biosystematics and Biodiversity**	**No. ofhours perunit/ credits**
UNIT-I	**Unit I - Taxonomy** **Introduction to taxonomy,** Stages and importance of taxonomy; Problems, Aim and Tasks of Taxonomy. **Modern Trends in Taxonomy:** Morphological approach, immature stages and Embryological approach, Ecological, behavioral and Cytological approach. **Methodologies in systematic :** Molecular markers for detection/evaluation of polymorphism, RFLP, RAPDetc.	**(15)**
UNIT-II	**Concept of species:** **Introduction,** Typological, Biological, Nominalistic, Evolutionary and recognition species concept with conclusions, taxonomic identification. **Zoological nomenclature:** Origin of the code, international code of Zoological nomenclatures rules of nomenclature. Species and their number, polytypic species, Subspecies, other intraspecific group, super species.	**(15)**
UNIT-III	**Biodiversity Science:** Evolution of biodiversity, Factors promoting high diversity, Endemism and Hotspots, Measures of Bio-diversity, Values of Biodiversity, Uses and Importance of Biodiversity. **Evaluation of priorities for conservation of habitats and species:** Selection criteria for protection of species–species quality, Hotspots, Conservation indices.	**(15)**

Unit- IV	**Biodiversity Conservation**: Loss of biodiversity, listing of threatened biodiversity, Threats to biodiversity, Role of NGOs, Colleges and Universities. IUCN Guidelines for Red List categories and criteria (version 7.0), Red List of Indian Flora and Fauna.	**(15)**

CourseOutcomes:

1) Student will be able to define taxonomy, and various tasks of taxonomists.
2) They can summarize the different concept of species for taxonomic identification of the species.
3) They can understand the concepts of hotspot diversity and roles to conservethat diversity.
4) They will know the roles played by NGOs, and different communitiesin conserving the biodiversity.

References:

1) Alston, R.E. and B.L. Turner (1963): Biochemical systematics Prentices Hall Inc. Englewood Cliffs, N.J. 404 pp.
2) Avise, J.C. (1974): Systematic value of Electrophoretic data. Syst. Zool. 23 (4): 465 – 481.
3) Benazzi, M. (1973): Cytotaxonomy and evolution, General remarks vertebrate evolution. Ed. A.B. Chiarelli and Campus Academic Press, London and N.Y. pp. 1-3.
4) Blomback, B and M. Blomback (1968): Primary structure of animal proteins as a guide in taxonomic studies. In chemitaxonomy and serotaxonomy (ed.) Hawkers pp. 3 – 20.
5) Camp, W.H. (1951): Biosystematics Britania 7: 113 – 127.
6) CHamberlin, W.J. (1952): Entomological Nomenclature and Literature 3rd edition Dubuvuelowa William C. Brown Co.
7) Cole, A.J. (1969): Numerical taxonomy proceedings of the colliquiinnumerical taxonomy held in the University of St. Andrews Sept. 1968. AcademicPress, N.Y 324 pp.
8) Hennig, W. (1966): Phylogenetic systematics Univ. Illinois Press III, 263 pp.
9) Heywood, V.H. (1973): Taxonomy and Ecology Systematics Association special Vol. 5 Academic Press, London, and New York 370 pp.
10) Huxley, J.S. (ed.) The New Systematics Oxford Uiv. Press London 538 pp.

Course: MZT 102Ecology & Environmental Pollution

CourseObjectives:

1. To describe behavioral and physiological mechanisms by whichorganisms interact with other organisms and with their physical environment.
2. To explain the importance of biodiversity to ecosystems, energy flow.
3. To understand the role and sources of pollutants.
4. To get to know about the sources of pollution and their pollutants along with their control measures.

Credits=4	**MZT 102 Ecology& Environmental Pollution**	**No. ofhours perunit/ credits**
UNIT-I	1 Habitat and Niche: Concept and types of habitat, Ecological niche, Niche widthand overlap. 2 Species interaction: Types of interactions, inter specific competition, Symbiosis. 3 Community ecology: Types and nature of communities, Structure of community, Community dominance, edge and ecotones.	**(15)**
UNIT-II	1. Ecological Succession: Types and Patterns of succession,Climax. 2. Ecosystem: Structure and Functions of ecosystem, Primaryproduction. 3. Environmental Impact Assessment: Definition and scope, characteristics, objectives, components,methodology,procedureforobtainingEIAclearance,preparation of EIA document. Biogeochemical Cycles	**(15)**
Unit- III	**Concept, Scope and Definitions of Environmental Pollution** - Types of pollutants- based on physical properties, forms, causes of environmental pollution, pollution in relation to public health (Air, water, pesticide and radiation pollution). **Air pollution** -Definition, sources, principle air pollutants, effects of air pollutants. **Smog -** Classical smog and industrial pollution, photochemical smog and vehicular emission. Prevention and control of air pollutants.	**(15)**

	Environmental Legislation: Central and state boards for the prevention and control of environmental pollution, powers and functions of pollution control boards, penalties and procedure, duties and responsibilities of citizens for environmental protection, Wildlife Protection Act 1972.	
Unit -IV	**Water pollution**- Definition, Sources of water pollution, Types of water pollutants and their effects, BOD, COD water pollution control, Sewage treatment. **Soil pollution**- Sources, effects of soil pollutants and remedial measures. **Radioactive pollution** - Types, sources and effects of radiation. **Agricultural pollution**- Farm animal waste, Soil erosion plants residues, agrochemical- fertilizers and pesticides.	**(15)**

CourseOutcome:

1. Students will be able to describe behavioral and physiological mechanisms by which organisms interact with other organisms and with their physical environment.
2. They will explain the importance of biodiversity to ecosystems, energyflow.
3. They will understand the role and sources of pollutants.
4. They will l get to know about the sources of pollution and their pollutants along with their control measures.

References:

1. Fundamentals of Ecology- Dash and Dash.
2. Basic Ecology- Odum E. P
3. Fundamentals of Ecology- Odum E.P
4. Modern concepts of ecology- K. D.Kumar.
5. Concepts of Ecology- H. D. Kumar.
6. Ecology- P. D.Sharma.
7. Environmental pollution Half, Rinehart and Winston, New York (1977)- LaurentHodges.
8. PandeyKamleshwar.,ShuklarJ.P.andTrivediS.P.(2005):FundamentalofToxicology.New Central book agency PVT. LTD.Kolkata

Course: MZT 103 Fish Cell and Molecular Biology

CourseObjectives:

1. To explain the models of membrane structure and diffusionof molecules passing through it.
2. Togive original example of pattern of protein secretion and its intracellular transportthrough vesicles.
3. To demonstrate the structure and function of cell organelles.
4. To criticize importance of cell cycle, checkpoints and signal transductionpathway.

Credits=4	**MZT 103 Fish Cell and Molecular Biology**	**No. ofhours perunit/ credits**
UNIT-I	**Membrane Structure and Function** 1. Structure of model membrane, lipid bilayer and membrane proteindiffusion, 2. Osmosis, ion channels, active transport, membranepump Cell-cell adherence, Gap junction, ECM,Integrin	**(15)**
UNIT-II	**Secretary Pathway:** 1. ER-structure (SER, RER), transport. 2. Ribosomes, polysomes, free ribosomes, membrane associated ribosomesand secretary pathway. 3. Vesicles involved in intracellulartransport.	**(15)**
Unit- III	**Cellular respiration & degradation:** 1. Peroxisomes – structure andfunctions. 2. Endosomes – late and early – structure, formation, assembly &components. 3. Lysosomes – structure &polymorphism. 4. Proteasomes – types structures, assembly &functions. 5. Mitochondria -structure, assemblycomponents. Role of cyt.p.450 in detoxification (XenobioticTransformation)	**(15)**

Unit -IV	**Nuclear Components:** 1. Nucleus – EM.Structure. 2. Nuclear envelope – structure &function. 3. Chromosomes – Packaging of genome, genetic mapsand nucleolus. 4. Heterochromatin. **Cell cycle division and signal transduction:** 1. Cell cycle – cyclins&cyclin dependent kinases & checkpoints. 2. Cytoskeleton & intracellular movement – microtubule,MTOC. 3. Micro filaments & intermediatefilaments. 4. G protein and G protein coupled Signal transductionpathway.	**(15)**

CourseOutcomes:

1. They will be able to explain the models of membrane structure and diffusionof molecules passing through it.
2. They will give original example of pattern of proteinsecretion and its intracellular transport through vesicles.
3. They will be able to demonstrate the structure and function of cell organelles.
4. They will criticize importance of cell cycle,checkpoints and signal transductionpathway.

References:

1. Molecular biology of the Cell –Bruce Albert Pub. By Garland Pub. Inc.NewYork &London.
2. Molecular Cell biology – LodishBerk, Matsudaira, Kaiser, Krleger(2004) pub. By W,.H. Freeman & Company, NewYork.
3. Molecular cell biology – Gerald carp (2005) pu. By John Wiley&Sons.
4. Avers C.J. (1986)/ latest edition) Molecular Cell Biology, Addison-Westey, Reading inMassachusettes.
5. Baserga, R (1985)/ latest edition) The Biology of CellReproduction. Harward University Press Cambridge,Massachuselts
6. Beck, F. and J.B. Lloyd (eds) (1974) The Cell in Medical Science,AcademicPress,London.
7. Callan, H.G (1986)/ latest edition) Lampbrush Chromosomes Springer –verlagNewYork.
8. Chambliss, G(ed)(1980)/latest edition) Ribosanes – Structure,

Function& Genetics University of Park Press,Baltimore.
9. Edmunds, L.N. 1984 / latest edition- Cell Cycle Clock, Marcel Dekker, NewYork.
10. Edmunds, L.N. 1987/ latest edition. Cellular & Molecular Basis ofBiological Clocks Springer – VerlagBerlin.
11. Gomperts, B.D.(latest edition) PlusmaMembrance Academic press, NewYork.
12. Henning, W (ed) 1987/ latest edition Structure &Functionof Eukaryotic Chromosanes Springer – Verlag,Berlin.
13. Moens, P.B. (ed) 1987/ latest edition Meiosis Academic Press,Orlands, Florida, USA.
14. Nomura, M.A./Tissiers&P. Lengyel (eds). 1974 Latest edition – Ribosomes Cold Spring Harber Laboratory Press, New York.

MZT 104: E1 Sustainable Aquaculture

CourseObjectives: Students will be able to

1. Understand trends in global and Indian aquaculture.
2. Study sustainability and development in aquaculture.
3. Know about strategies for sustainability
4. Studyguiding principles to sustainable aquaculture development.

Credits=4	**MZT 104: E1 Sustainable Aquaculture**	**No. ofhours perunit/ credits**
UNIT-I	**Present scenario and problems:** Trends in global and Indian aquaculture; different farming systems; intensive systems and constraints - environmental degradation and disease outbreaks.	**(15)**
Unit -II	**A Sustainability and development:** Systems approach and its application in aquaculture with special reference to resource-poor systems; Role of aquatic resources in food and nutrition; Aquatic resource and livelihood systems. **B Socio-economic issues:** Conflicts over water and land use; conflicts of interest between aqua farmers and fishermen; resistance from local public; anti-dumping duties	**(15)**
Unit- III	**Strategies for sustainability:** Sustainability concept; food security; biosecurity; organic farming; integrated farming; responsible aquaculture; rotational aquaculture; bioremediation; role of biotechnology, traceability. Application of renewable energy in aquaculture - solar energy, wind, and tidal energy, Seed certification, Sustainable use of antibiotics.	**(15)**

Unit -IV	**Economic viability:** export vs. domestic marketing, value addition. **Guiding principles to sustainable aquaculture development:** Coastal Aquaculture Guidelines Source Book, FAO Code of Conduct for Responsible Fisheries; Holmenskollen Guidelines for Sustainable Aquaculture.	**(15)**

CourseOutcomes: Students should be able to

1. Understand trends in global and Indian aquaculture.
2. Study sustainability and development in aquaculture.
3. Know about strategies for sustainability
4. Study guiding principles to sustainable aquaculture development.

References:

1) Bardach JE. 1997. Sustainable Aquaculture. John Willey & Sons.
2) Bardach JE, Rhyther JH & Mc. Larney WO. 1972. Aquaculture Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons.
3) Beets WC. 1990. Raising and Sustaining Productivity of Small-Holder Farming Systems in the Tropics. Agbe Publ.
4) Edwards P, Little DC &Demaine H. (Eds.). 2002. Rural Aquaculture. CABI.
5) FAO 2001. Planning and Management for Sustainable Coastal Aquaculture Development. FAO.
6) Imai T. 1978. Aquaculture in Shallow Seas. Progress in Shallow Sea Culture. Amerind Publ.
7) James PM. 1983. Handbook of Mariculture. Vol. I. Crustacean Aquaculture. CRC Press.
8) Leung P, Lee CS &O'Bryen JP. (Eds.). 2007. Species and System Selection for Sustainable Aquaculture. Blackwell Publ.
9) Midlen& Redding TA. 1998. Environmental Management for Aquaculture. Chapman & Hall.
10) Selvamani BR &Mahadevan RK. 2008. Aquaculture, Trends and Issues. Campus Books International.

MZFT 104:E2 Aquaculture Environment Management

CourseObjectives: Students will be able to

1. Understand soil and water interaction
2. Analyze soil and water quality standards.
3. Study aquatic pollution.
4. Get knowledge of wastewater management

Credits=4	**MZFT 104:E2 Aquaculture Environment Management**	**No. ofhours perunit/ credits**
UNIT-I	**Soil and water interaction:** Physical and chemical properties of soil and water, productivity vs nutrient quality and quantity of soil and water, aquatic microorganisms and their role in carbon, nitrogen, phosphorus and sulphur cycles.	**(15)**
Unit -II	**Soil and water quality standards:** organic and inorganic fertilizers, fertilizer grade, source, rate and frequency of application, biofertilizers, use of treated sewage for pond fertilization, ecological changes taking place after fertilization, primary and tertiary production, utilization of bioactive compounds by microorganisms.	**(15)**
Unit- III	**Aquatic pollution**: Pollutants - Sewage, pesticides, oils, metals, radioactive wastes, biomedical wastes, etc. Common transport processes of pollutants in the aquatic environment; dispersal of pollutants; Algal blooms and their management, Methods of pollution surveys.	**(15)**
Unit- IV	**Wastewater management:** Wastewaters - classification and characteristics of sewage and industrial effluents; Water quality management in culture and hatchery practices, waste discharge standards. Treatment methods for water and waste water; Principles of aeration, chlorination, ozonation and U.V. irradiation.	**(15)**

CourseOutcomes: Students should be able to

1. Understand soil and water interaction
2. Analyze soil and water quality standards.
3. Study aquatic pollution.
4. Get knowledge of wastewater management

References :

1. Adhikari S & Chatterjee DK. 2008. Management of Tropical Freshwater Ponds. Daya Publ.
2. APHA, AWWA, WPCF. 1998. Standard Methods for the Examination of Water and Wastewater, 20th Ed.
3. Boyd, C. E. and Tucker, C. S. 1992. Water Quality and Pond Soil Analysis for Aquaculture, Alabama Agricultural Experimental Station, Auburn University.
4. Boyd CE. 1979. Water Quality in Warm Water Fish Ponds. Auburn University.
5. ICAR. 2006. Handbook of Fisheries and Aquaculture. ICAR.
6. Parsons TR, Maita Y &Lalli CM. 1984. A Manual of Chemical and Biological Methods for Seawater Analysis. Pergamon Press.
7. Rajagopalsamy CBT &Ramadhas V. 2002. Nutrient Dynamics in Freshwater Fish Culture System. Daya Publ.
8. Sharma LL, Sharma SK, Saini VP & Sharma BK. (Eds.). 2008. Management of Freshwater Ecosystems. Agrotech Publ. Academy.
9.Baird DJ, Beveridge MCM, Kelly LA & Muir JF. 1996. Aquaculture and Water Resources Management. Blackwell.
10.Cheremisinoff NP. 2002. Handbook of Water and Waste Water Treatment Technologies. Butterworth – Heinemann.
11.Eckenfelder WW. 2000. Industrial Water Pollution Control. McGraw Hill.
12.Gray NF. 2004. Biology of Wastewater Treatment. Oxford University Press.
13.Trivedy RK. 1998. Advances in Wastewater Treatment Technologies. Global Science.

MZFP 105 (Practical based on paper – MZT 101& 102)

CourseObjectives: Students will be able to

1. Classify specimens from different classes or phyla
2. Describe morphological peculiarities of animals
3. Explain methods of collection and preservation of animals
4. Analyzed different physicochemical parameters of water

Credits=4	**SEMESTER-I** **MZFP 105 (Practical based on paper – MZT 101& 102)**	**No. ofhours perunit/ credits**
	1. Study of museum specimens and slides invertebrate's phyla (onerepresentative from each class) for biosystematics &biodiversity. 2. Study of museum specimens of chordates phylum (one representative fromeach class) for Biosystematicsandbiodiversity. 3) Identification of insects/ molluscs with the help of keys up to orders. 4). Identification of insects/ molluscs with the help of keys up to families. 6. Identification of animals with the help of keys up to families (fish/amphibian with the help of preserved specimens / models /pictures). 7. Methods of collection and preservation ofanimals. 8. Visit to ZSI/fields. 9. Study of inter relationships parasitism, symbiosis, commensalisms(2-3 examplesFromeach). 10. Study of endangered species. (Models, pictures,charts.). 11. Study of adaptations in animals from Pisces, amphibian, reptilian, birds& mammals (2-3 examples fromeach). 12. Visits to sanctuaries and National parks to study wild lifemanagement. 13. Study biodiversity of platue by Quadrate& transect method, Shannon indexand Simpsons index 14. Detection of heavy metal by Atomic absorptionSpectrophotometer 15. Use of software for identification of plants &animals. 16. Assessing existing data base onwww. 17. Harnessing information through Internet	

	regardingBiodiversity. 18. Preparation of culture media isolation of DNA from plants &animals. 19. Study of microbes isolation, culture and staining from soil &water. 20.Identification of planktons from different watersamples 21. Determination of DO, CO2 Hardness, Chloride, Alkalinity of freshwaterand sewage water.(Physicochemicalparameters) 22. Determination of COD of sewagewater. 23. Determination of BOD of sewagewater. 24. Estimation of inorganic phosphate and nitrate from watersample. 26. Qualitative and quantitative estimation of Zooplanktons. 26. Detection of heavy metal from the watersample. 27. Practical set on the network – internet, protein information, Genome&Chromosome database set byteacher. 28. Any other experiment set by the concernedteacher	

Course Outcomes: Students should be able to

1. Classify specimens from different classes or phyla
2. Describe morphological peculiarities of animals
3. Explain methods of collection and preservation of animals
4. Analyzed different physicochemical parameters of water

Reerences:

1. Alston, R.E. and B.L. Turner (1963): Biochemical systematics Prentices Hall Inc. Englewood Cliffs,N.J. 404 pp.

2. Avise, J.C. (1974): Systematic value of Electrophoretic data. Syst. Zool. 23 (4): 465 – 481.

3. Benazzi, M. (1973): Cytotaxonomy and evolution, General remarks vertebrate evolution. Ed. A.B.Chiarelli and Campus Academic Press, London and N.Y. pp. 1-3.

4. Blomback, B and M. Blomback (1968): Primary structure of animal proteins as a guide in taxonomicstudies. In chemitaxonomy and serotaxonomy (ed.) Hawkers pp. 3 – 20.

5. Camp, W.H. (1951): Biosystematics Britania 7: 113 – 127.

6. Ernst Mayr (1969): Principles of Systematics Zoology TMH Ed. Tata McGraw Hill Publishingcompany Ltd. Bombay NewDelhi.

7. Primack,R.B.(1950):AprimerofconservationbiologY3rdeditionSinuerAssociates Inc. PublishersSunderland Massachutts USA.

8. Ray Samitan Ray A.K. (2006): Biodiversity and Biotechnology New Central Book Agency (P) Ltd.

9. Theory and practice of animal taxonomy- V. C. Kapoor

MZFP 106 Practical based on paper – MFT 103 & MFT 104

Course objectives: Students will be able to

1. Identify various types of nucleus from WBCs and Liver.
2. Demonstrate different types of glycosaminoglycans from tissue.
3. Prepare different models model for sustainable aquaculture
4. Analyze different soil and water parameters

Credits=4	**MZP 106 (Practical based on paper – MZT 103& MFT 104)**	**No. of hours per unit/ credits**
	1. Demonstration of extracellular material a. Collagen, b. Elastin 2. Demonstration of Glycosaminoglycans in the extracellular material using a. AB-1 b. AB-2.5 c. PAS d. AF +AB 2.5 (Sialic Acid) e. $MgCl_2$ influence on alcinopoilia. 3. Study of cell Organelles. a. Nucleus demonstration by i) Basic Dyes: TB, HE, Methylene blue. ii) Feulgen reaction Effect of temperature 4. Lysosome demonstration (Acid phosphatase and any other method) 5. Golgi bodies demonstration (Cajal Method) 6. Effect of tonicity of solutions on plasma membrane – Isotonic, Hypotonic, Hypertonic b) Fragility test of RBC & Osmotic Resistance.	
	Practical based on paper–MZFT 104 E_1	

	1. Visit to conventional aquafarm to see the management of used water; 2. Setting model for sustainable aquaculture (organic farm, integrated farm); 3. Applications of remote sensing and GIS (geographical information system); 4. Economic evaluation of aquaculture practices.	
	Practicalbasedonpaper–MZFT 104 E_2	
	1. Equipments used in soil and water analysis 2. analysis of soil pH and texture; 3. Collection and preservation of wastewater samples; 4. Physicochemical analysis of wastewater - measurements of water temperature, pH, conductivity, salinity, transparency, turbidity, total dissolved and suspended solids 5. Analysis of dissolved oxygen, free carbon dioxide, alkalinity, hardness, phosphorus and nitrogen. , heavy metals and pesticides 6. Visit to a sewage treatment plant, fish processing unit and other industries	

CourseOutcome: Students should be able to

1. Identify various types of nucleus from WBCs and Liver.
2. Demonstrate different types of glycosaminoglycans from tissue.
3. Prepare different models model for sustainable aquaculture
4. Estimate different soil and water parameters

References:

1.Adhikari S & Chatterjee DK. 2008. Management of Tropical Freshwater Ponds. Daya Publ.

2. APHA, AWWA, WPCF. 1998. Standard Methods for the Examination of Water and Wastewater, 20th Ed.

3. Boyd, C. E. and Tucker, C. S. 1992. Water Quality and Pond Soil Analysis for Aquaculture, Alabama Agricultural Experimental Station, Auburn University.

4. Boyd CE. 1979. Water Quality in Warm Water Fish Ponds. Auburn University.

5. ICAR. 2006. Handbook of Fisheries and Aquaculture. ICAR.

6. Parsons TR, Maita Y &Lalli CM. 1984. A Manual of Chemical and Biological Methods for Seawater Analysis. Pergamon Press.

7. Rajagopalsamy CBT &Ramadhas V. 2002. Nutrient Dynamics in Freshwater Fish Culture System. Daya Publ.

8. Sharma LL, Sharma SK, Saini VP & Sharma BK. (Eds.). 2008. Management of Freshwater Ecosystems. Agrotech Publ. Academy.

9.Baird DJ, Beveridge MCM, Kelly LA & Muir JF. 1996. Aquaculture and Water Resources Management. Blackwell.

10.Cheremisinoff NP. 2002. Handbook of Water and Waste Water Treatment Technologies. Butterworth – Heinemann.

11.Eckenfelder WW. 2000. Industrial Water Pollution Control. McGraw Hill.

12.Gray NF. 2004. Biology of Wastewater Treatment. Oxford University Press.

13.Trivedy RK. 1998. Advances in Wastewater Treatment Technologies. Global Science

M.Sc.-I Semester-II
MZFT 201: Physiological Chemistry

CourseObjectives: Students will able to

1. Understand biochemistry of carbohydrates, protein and lipid.
2. To introduce structure, function and organization of various bio-molecules present in the livingcell.
3. Students know the structure and properties of macromolecules that act together to maintain andperpetuate the living systems.
4. Understand the structure and function of nucleic acid.

Credits=4	**SEMESTER-II** **MZFT201– Physiological Chemistry**	**No. ofhours perunit/ credits**
UNIT-I	**Principles of Biological chemistry:** Principles of biophysical chemistry (pH, buffer, reaction kinetics dissociation and association constants) Physical constants, Structure of atoms, molecules and chemical bonds, Vander Waal's electrostatic, Hydrogen bonding and hydrophobic interactions. Thermodynamics, Concept of free energy, Enthalpy, Entropy, Water: Structure and physicochemical properties, Energy rich bonds. Basics of solution preparation: Molarity, Molality, Normality, W/V, % solution, ppm, Stockdilution	**(15)**

UNIT-II	Carbohydrates – Structure, classification and function, Carbohydrate metabolism: Glycolysis, TCA cycle, Electron transfer and ATP generation, Bioenergetics of ATP cycle, glycogenesis, glycogenolysis, gluconeogenesis and Pentose phosphate pathway	**(15)**
UNIT-III	Proteins – structure, classification and function, Biosynthesis and Oxidation of amino acids. Primary structure of proteins and nucleic acids, Conformation of proteins and, Reverse turn and Ramachandran plot. Nucleic acids: DNA, RNA structure, functions and Biosynthesis of nucleotides	**(15)**
UNIT-IV	Lipids- structure, classification and function, Catabolism of fatty acid – Beta oxidation, significance of beta oxidation, Biosynthesis of saturated and unsaturated fatty acids, Biosynthesis of triglyceride, biosynthesis of membrane phospholipids, Biosynthesis of cholesterol, Steroidal hormones- structure and functions.	**(15)**

Course Outcomes: Students should be able to

1. Know the structure and function of different biomolecules
2. Understand the how to form proteins and how to work at molecular level.
3. Understand the metabolic pathways and their role in human bodies.
4. Get knowledge of micro and macromolecules and their concern diseases.

References:

1. A K Anderson- Essentials of physiological chemistry.
2. H. Harper- Review of physiological chemistry.
3. P. Karlson- Introduction to modern biochemistry
4. West E an Todd W- Text book of biochemistry
5. Mahler H and Cordes E – Biochemical chemistry
6. Lehninger's- Biochemistry – COX & Nelson.
7. Reithel F J- Concepts in Biochemistry
8. G H Bell , Je N Davdson and D E Smith- Text book of physiology and biochemistry
9. Mitlon and Toporely- Essentials of biochemistry
10. Outline of Biochemistry by Conn & Stump.

MZFT 202 - Quantitative Biology and Tools and Techniques in Biology

Course Objectives: Students will able to

1. Understand about the termsCentral tendency, correlations, regression and analysis ofvariance.
2. Understand how to apply testing hypothesis, Probability distribution, Student t- test andChi- square test.
3. Understand how to separates molecules by using different techniques.
4. Understand analytical instruments and their applications in biology.

Credits=4	**SEMESTER-II** **MZFT 202 - Quantitative Biology and Tools and Techniques in Biology**	**No. ofhours perunit/ credits**
UNIT-I	1.Introduction, Application in Biology. 2. Measurement of Central tendency. 3. Measures of dispersion. 4. Correlation- Types and methods of correlation. 5. Regression- Regression lines and coefficients. 6. Analysis of Variance (ANOVA).	**(15)**
UNIT-II	1.Probability- Introduction, addition and multiplication theory. 2. Probability distribution- Binomial, Poisson and Normal. 3. Testing of hypothesis. 3.1 Tests of Significance. 3.2 Null hypothesis. 3.3 Alternative hypothesis. 3.4 Level of significance. 4. Student t- test. 5. Chi- square test (X2). 6. Confidence integral.	**(15)**
UNIT-III	Separation techniques: 2. Chromatographic techniques – Chromatography theory & practices, Molecular Sieve chromatography, affinity chromatography, ion exchange chromatography, HPLC, GLC, Thin layer chromatography. 3. Electrophoretic techniques – General principles, support	**(15)**

	media, electrophoresis of proteins and nucleic acids, Isoelectric focusing. 4. Density gradient centrifugation and its application	
UNIT-IV	(A) Analytical instruments and their applications in Biology: 1. Spectroscopy (Spectrophotometry, Spectroflurometry, NMR, ESR). (B) Microscopy, Radiometry &Immunochemical techniques. 1. Light microscope, phase contrast microscope, fluorescence microscope, Electron Microscope (SEM & TEM). 2. Immunoprecipitation, Labelling antibodies, immunoblotting, immunoassays &immunohisto/cytochemistry.	**(15)**

Course Outcomes: Students should be able to

1. Identify analyses appropriate for diverse types of data, and explain their theoretical fundamentals.
2. Describe, present, and critically evaluate analytical methods, models and theories used in publishedresearch
3. Apply and extend analytical methods, models and theories to biological datasets.
4. Acquire skills of separation technique, analytical instrumentation and their applications.

References:

1. Fundamentals of Statistics- Gupta S. C.
2. Basic Biostatistics and its applications- Datta A. K
3. Biostatistics and Biometry- Parihar and Parihar.
4. An Introduction to statistical Methods- C. B. Gupta.
5. Practical Biochemistry By Wilson and Walker
6. Cell : A molecular approach By Cooper
7. Molecular Biology of the Cell by Lodish et al.
9. Basic Biostatistics and its applications- Datta A. K
10. Biostatistics and Biometry- Parihar and Parihar.
11. An Introduction to statistical Methods- C. B. Gupta.

MZFT 203 –Aquaculture Biotechnology

Course Objectives: Students will able to

1. Study Reproductive biotechnology in aquaculture
2. Study application of biotechnological tools in fish breeding.
3. Understand nutrition, health, processing and other issues in fisheries.
4. Study cryopreservation of gametes, embryos and stemcells.IPR issues in

Biotechnology.

Credits=4	SEMESTER-II MFT 203 –AQUACULTURE BIOTECHNOLOGY	No. ofhours perunit/ credits
UNIT-I	Reproductive biotechnology: Induced breeding hormones and analogues. Manipulation of primordial germ cells and surrogacy.	**(15)**
UNIT-II	Chromosome manipulation: Ploidy manipulation, Sex manipulation, Androgenesis, Gynogenesis and applications. Transgenesis in fish; GMOs: Biosafety regulations and ethics.	**(15)**
UNIT-III	Nutritional & health biotechnology: Probiotics, Biofilms, Biofloc, Single cell protein, Bio-encapsulated feeds, Nutraceuticals, Nutrigenomics, Disease diagnostic techniques and therapeutics.	**(15)**
UNIT-IV	Gene Bank and conservation: Cryopreservation of gametes, embryos and stemcells.IPR issues in Biotechnology	**(15)**

CourseOutcomes: Students should be able to

1. Study Reproductive biotechnology in aquaculture.
2. Study application of biotechnological tools in fish breeding.
3. Understand nutrition, health, processing and other issues in fisheries.
4. Study cryopreservation of gametes, embryos and stem cells. IPR issues in Biotechnology.

References :

1. Dunham, R. A., (2004) Aquaculture and Fisheries Biotechnology: Genetic Approaches. CABI Publishing, Cambridge, USA. 385 pp.
2. Borowitzka, M.A. &
Borowitzka, L.J. (1988) Micro-algal Biotechnology. Cambridge University Press, London, UK, 488 pp.
3. Chen, F. &Jiang, Y. (2001) Algae and theirBiotechnological Potential. Springer Netherlands, 306 pp.
4. Gordon R. &Seckbach J. (2012) The Science of Algal Fuels. Springer Netherlands, 506

pp.
5.Lakra. W.S (2004) “Fisheries Biotechnology” Narendra Publishing House, New Delhi, 240 pp.

MZFT 204 : E_1Applied Genetics in Aquaculture

CourseObjective: Students will be able to

1. Study origin and advancement in genetics
2. Study application and methods of selection of molecular markers.
3. Understand Inbreeding and conservative genetics
4. Impart knowledge of fish breeding and genetic management strategies.

Credits=4	**SEMESTER-II** **MZFT 204 : E_1Applied Genetics In Aquaculture**	**No. ofhours perunit/ credits**
UNIT-I	Introduction: Origin and advancement in genetics; physical basis of heredity; genetic correlation, domestication and local adaptation. Chromosome manipulation: Ploidy induction methods - triplody and tetraploidy, advantages and disadvantages of polyploids, androgenesis and gynogenesis. Sex determination: Sex differentiation and sex reversal in fishes, sex control and its role in aquaculture.	**(15)**
UNIT-II	Selection: Scope, application and methods of selection, marker assisted selection-biochemical and molecular markers. Molecular tools for stock differentiation for selection. T V Hybridization: Heterosis, hybrid vigour, introgression.	**(15)**
UNIT-III	Inbreeding: Methods of estimation, inbreeding depression and consequences, measures to reduce inbreeding in hatcheries. Conservation genetics: Genetic resources of India and conservation, endangered species, cryopreservation of fish gametes.	**(15)**
UNIT-IV	Cytogenetics: Importance and karyotyping. Fish breeding: History and advancement of fish breeding, mode of reproduction, basic breeding methods and breeding programmes and goals. Genetic management strategies: Environmental impacts, Lessons from the green revolution, Bioprospecting, GMOs and their detection.	**(15)**

CourseOutcomes: Students should be able to

1. Study origin and advancement in genetics
2. Study application and methods of selection of molecular markers.
3. Understand Inbreeding and conservative genetics
4. Impart knowledge of fish breeding and genetic management strategies.

References :

1. Carvalho GR & Pitcher TJ. (Eds.). 1995. Molecular Genetics in Fisheries. Chapman & Hall. Falconer DS & Mackay. 1996.
2. Introduction to Quantitative Genetics. 4th Ed. Longman. Kanakaraj P. 2001.
3. A Text Book on Animal Genetics. International Book Distributing Co. Nair PR. 2008.
4. Biotechnology and Genetics in Fisheries and Aquaculture. Dominant Publ. Padhi BK & Mandal RK. 2000.
5. Applied Fish Genetics. Fishing Chimes. Pandian TJ, Strüssmann CA & Marian MP. 2005.
6. Fish Genetics and Aquaculture Biotechnology. Science Publ. Purdom CE. 1993.
7. Genetics and Fish Breeding. Chapman & Hall. Reddy PVGK. 2005.
8. Genetic Resources of Indian Major Carps. FAO Publ. Reddy PVGK, Ayyappan S, Thampy DM & Krishna G. 2005.
9. Text book of Fish Genetics and Biotechnology. ICAR. Ryman N & Utter F. (Eds.). 1988.
10. Population Genetics and Fishery Management. Washington Sea Grant Programmes, USA. Tave D. 1996.
11. Genetics for Fish Hatchery Managers. 2nd Ed. AVI Publ. Thorpe JE, Gall GAE, Lannan JE & Nash CE. (Eds.). 1995.
12. Conservation of Fish and Shellfish Resources, Managing Diversity.

MZFT 204: E_2 Fishery Technology

CourseObjectives: Students will be able to

1. Study different crafts and gears used in fishing
2. Get knowledge of packing of fish and fishery products
3. Understand prospects of aquaculture biotechnology
4. Know about post harvest fishery technology

Credits=4	SEMESTER-II MZFT 204 : E_2 Fishery Technology	No. ofhours perunit/ credits
UNIT-I	Fishing craft and gear technology: Conventional fishing methods: types of crafts and gears, Unconventional fishing methods, Modern methods of fishing, Rules and regulations for fishing operations and safety at sea.	**(15)**
UNIT-II	Packing of fish and fishery products: Food packing, its purpose and procedures, technological aspects of packing fishery products, packing of fresh and frozen fish, packaging for transport, shipping and institutional supplies, packing standards for domestic and international trade	**(15)**
UNIT-III	Biotechnology in Aquaculture: Prospects of aquaculture biotechnology, Biotechnological tools in diagnosis of diseases in aquaculture, Application of hybridism technology in aquaculture, Cryopreservation technology in fishes, Application of biotechnology in health management in aquaculture	**(15)**
UNIT-IV	PostHarvest Technology: Reasons for spoilage of fishes, methods for fish preservation, refrigeration, deep freezing, freeze drying, salting, smoking, drying, canning, demerits of fish preservation, fish by products, HACCP for fish processing industry.	**(15)**

CourseOutcomes: Students should be able to

1. Study different crafts and gears used in fishing
2. Get knowledge of packing of fish and fishery products
3. Understand prospects of aquaculture biotechnology
4. Know about post harvest fishery technology

References:

1 Fishery Science: W.C. Royce.
2. Ecology, Utilization and Management of marine fisheries; G.A.Rounsefell.
3. Fisheries development of India: U.K. Shrivastava and M. Dharma Reddy.
4. Aquaculture research needs for 2000 AD: Jaw. Kai. Wang and P. V. Dehadari.
5. Fish farming hand book: E.E. Brown and J.B. Gratzek.
6. Fresh water biology: K.F. Lagler.
7. Fish and Fisheries of India: V.G. Jhingran.
8. Advances in aquaculture: T.V.R. pillay.
9. Fishes an introduction to ichthyology: P.B. Moyle and J.J. Cech.

MZFP 205
(Practical based on paper – MZFT 201& MZFT 202)

CourseObjectives: Students will be able to

1. Understand human system physiology, building on knowledge of basic physiological principles.
2. Understand how to apply testing hypothesis, Probability distribution, student t-test, ANOVA and Chi-square test with examples
3. Acquire skills in Chromosome manipulation in fish.
4. Study different crafts and gears and fish preservation techniques.

Credits=4	MZFP 205 (Practical based on paper – MZFT 201& MZFT 202)	No. ofhours perunit/ credits
	1. Estimation of glycogen. 2. Estimation of lipids & phospholipids. 3. Estimation of Vitamin C. 4. Estimation of Cholesterol. 5. Estimation of alpha-amino nitrogen by formoltitration. 6. To find saponification value for a given fat. 7. To prepare solution of given concentration change in normality/Molarity Prepare phosphate buffer of known pH and molarity- pH measurement, measurement of pH of lemon juice, urine and serum. 8. To find absorption spectrum of hemoglobin, bovine	

	serum albumin, tyrosine and (UV- visible). 9. To estimate free amino acids by Ninhydrin method. 10. To estimate protein content by Biuret method/ Lowry et.al./ Bradford method. 11. To estimate the sugar by Nelson-Somogyi method and glucose. 12. Separation of sugars by TLC. 13. Spot test of amino acids. 14. Serum cholesterol, Calcium estimation 15. Examples based on different population genetical principles (Based on theory). 16. To isolate proteins by salting out or by adjusting isoelectric point. 17. To estimate tyrosine content by Folin-phenol method. 18. To estimate the purity of ATP. 19. Examples based on Chi-square test & student t-test. 20. Examples based on regression. 21. Examples based on Correlation coefficient. 22. Examples based on Coefficient of variance 23. Examples based on ANOVA. 24. 24. Examples based on Probability. 25. Any other practical set by the concerned teacher.	

MZFP 206
(Practical based on paper – MFT 203 & MFT 204)

Credits=4	**MFP 206** **(Practical based on paper – MZFT 204 E_1)**	**No. ofhours perunit/ credits**
	1. Chromosomal manipulation- Gynogenesis, Triploidy, 2. Disease diagnosis using 3. PCR and ELISA, Spirulina culture, Cryopreservation of milt, Patent search.	
	MFP 206 **(Practical based on paper – MZFT 204 E_2)**	
	1.Identification of fishing crafts, gears and fishing accessories- floats, sinkers, hook, synthetic and natural fibers, twines, ropes, iron wares 2. Identification of different types of gear materials.	

	3. Different methods in fish preservation techniques 4. Preparation of salted and dries fish 5. Cryopreservation of fish gametes 6. Visit to fish processing industry 7. Any other practical set by the concerned teacher.	

CourseOutcomes: Students should be able to

1. Understand human system physiology, building on knowledge of basic physiological principles.
2. Understand how to apply testing hypothesis, Probability distribution, student t-test, ANOVA and Chi-square test with examples
3. Acquire skills in Chromosome manipulation in fish.
4. Study different crafts and gears and fish preservation techniques.

References:-

1 Fishery Science: W.C. Royce.
2. Ecology, Utilization and Management of marine fisheries; G.A.Rounsefell.
3. Fisheries development of India: U.K. Shrivastava and M. Dharma Reddy.
4. Aquaculture research needs for 2000 AD: Jaw. Kai. Wang and P. V. Dehadari.
5. Fish farming hand book: E.E. Brown and J.B. Gratzek.
6. Fresh water biology: K.F. Lagler.
7. Fish and Fisheries of India: V.G. Jhingran.
8. Advances in aquaculture: T.V.R. pillay.
9. Fishes an introduction to ichthyology: P.B. Moyle and J.J. Cech.