



Rayat Shikshan Sanstha's

**YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA
(Autonomous)**

**Lead College
of
KARMAVEER BHAURAO PAIL UNIVERSITY, SATARA**

**Syllabus for
Master of Science
Part- II**

FISHERIES

**Syllabus to be implemented from Academic Year 2024-25
(As per NEP-2020 Guideline)**

. PREAMBLE:

M. Sc. Fisheries course under autonomy has been prepared keeping in view the unique requirements of M. Sc. Fisheries students. The prominence of the contents is to provide students the latest information along with due weightage to the concepts of traditional fisheries so that they are able to understand and appreciate the current interdisciplinary approaches in the study of animal sciences and its role in societal and environmental development. The course content also advanced practical exercises so the students gets a hands on experience of the newest techniques that are currently in use. Project curriculum covering over the two years of the course which is designed in a way that, to give the students first hand research experience as it consists of writing of synopsis, literature review along with actual laboratory work and handling laboratory instruments. The course will also encourage students to hunt higher studies and research in life sciences, for becoming an entrepreneur and enable students to get employed in research institutes.

Credit Framework for M.Sc. II

Structure of Course: M.Sc. – II

Semester – III

Level	Semester	Course Code	Course Title	No. of Lectures Per Week	Credits
		Discipline Specific Courses (Mandatory)			
6.5	III	MFT 531	Ornamental Fish Production and Its Management	4	4
		MFT 532	Breeding and Hatchery Management of Finfish and Shellfish	4	4
		MFT 533	Brackish Water Aquaculture and Mari Culture	4	4
		Discipline Specific Elective (Choose Any one among two)			
		MFT 534 E-I MFT 534 E-II	E-I) Fish Nutrition and Types of Feed E-II) Larval Nutrition and Live Feed	2	2
		MFP 535	Research Project	12	6
		MFP 536	LAB- III (based on MPT-531, 532 and 533)	4	2
Total					22

Structure of Course: M.Sc. – II

Semester –IV

Level	Semester	Course Code	Course Title	No. of Lectures Per Week	Credits
		Discipline Specific Courses (Mandatory)			
6.5	IV	MFT 541	Fish Diseases and Management	4	4
		MFT 542	Aquatic Ecology and Biodiversity	4	4
		MFT 543	Reservoir fisheries	4	4
		Discipline Specific Elective (Choose Any one among two)			
		MFT 544 E-I MFT 544 E-II	E-I) Fisheries Marketing, Finance and Extension Education in fisheries E-II) Marine Biology	4	4
		MFP 545	On Job Training (OJT)	8	4
		MFP 546	LAB- IV (based on MPT-541, 542 and 543)	4	2
Total					22

M.Sc. Part II

SEMESTER III

MZFT 531: ORNAMENTAL FISH PRODUCTION AND MANAGEMENT

Course Objectives: Students should be able to

1. Learn the benefits of ornamental fish keeping.
2. Understand materials required for construction of tanks.
3. know various physico-chemical parameters, live food & feeding.
4. gain the knowledge of breeding of live bearers and breeding of egg layer.

Credits=4	MFT 531: ORNAMENTAL FISH PRODUCTION AND ITS MANAGEMENT	No. of hours 60
UNIT I	Introduction-	15
	1. Benefits of ornamental fish keeping as a hobby 1.1 Origin of keeping ornamental fishes as pets 1.2 Constrains and current status of ornamental fish farming in India 1.3 Commercially important ornamental fishes 1.4 exotic ornamental species 1.5 Indigenous ornamental species 1.6 Marine Ornamental fishes	
UNIT II	Construction of an Aquarium	15
	2 Different types of fish tanks 2.1 Materials required for construction of fish tanks 2.2 Construction of all glass aquarium glass tank 2.3 Steps involved in setting up of aquarium 2.4 Equipments and accessories needed for small scale unit Equipment and accessories needed for large scale ornamental fish production unit- 2.5 Maintenance of aquarium 2.5.1Aerator, Filters-Types of Filter, Canister filter external or internal type) -Trickle filter Resource,-Submersible power filter (box filter/corner filter) 2.5.2 Types of Aquatic plants 2.5.3 Common aquarium plants and their propagation.	
UNIT III	Water quality management	15

	<p>3.1 Temperature, Dissolved oxygen (DO), Carbon dioxide (CO₂), pH, Hardness</p> <p>3.2 Live food organisms- live feeds of fry</p> <p>3.2.1 Infusoria, Daphnia Moina, Rotifers, Copepods, Tubifex, -Blood worms, Mosquito larvae, Artemia</p> <p>3.2.2 Importance of Live food</p> <p>3.2.3 Artificial feed</p> <p>3.2.4 Types of feeds</p> <p>3.3 Feed formulation and processing of Feed storage.</p>	
UNIT IV	Breeding of ornamental fishes	15
	<p>4 Breeding of live bearers</p> <p>4.1 Introduction</p> <p>4.2 Sex identification</p> <p>4.3 Conditioning of parent fish</p> <p>4.4 Breeding of egg layers</p> <p>4.4.1 Egg-scatterers</p> <p>4.4.2 Egg-depositors</p> <p>4.4.3 Egg-buriers</p> <p>4.4.4 Mouth-brooders</p> <p>4.4.5 Nest-builders</p> <p>4.5 Stimulating spawning</p> <p>4.6 Fry rearing.</p> <p>4.7 Different breeding substrate</p>	

Course Outcomes: Students will be able to

- a. describe the benefits of ornamental fish keeping.
- b. discuss the materials required for construction of tanks.
- c. justify various physico-chemical parameters, live food & feeding.
- d. design the aquarium for breeding of live bearers and breeding of egg layers.

Reference Books:

1. APHA (American Public Health Association), AWWA (American Water Works Association), WEF (Water Environment Federation) (2017). Standard methods for examination of water and waste water, 23th edition, Port city press, Baltimore, Maryland, USA.
2. Boyd, C.E., (1981). Water quality in warm water fish ponds. Auburn University, Alabama, USA.
3. Hawlins, A.D.(Ed). Aquarium Systems. Academic Press.
4. Hunnam , P. Ward Lock , Living Aquarium.
5. Ratjak, K. and Zukal, R., Aquarium Fishes and Plants.
6. Spotte and John Wiley, S., Seawater Aquariums.
7. Straughan, R. P. L. and Thomas Yoseloff. Salt water Aquarium in the Home.

8. Dick Mills,(1987. Illustrated Guide to Aquarium Fishes. Published by Galley and Price, an imprint of W.H. Smith and Sons Limited, England.
9. Stephen Spotte. Marine Aquarium Keeping. A Wiley-Interscience Publication.
10. Dick Mills and Gwynne Vevere. Tropical Aquarium Fishes. Published by Salamander Books Limited. London.
11. Carcason, R. H. A field guide to the Coral Reef Fishes of the Indian and West Pacific Oceans.
12. Vincent B. Hargreaves. The Tropical Marine Aquarium .Mc-Graw-Hill Book Company. New York.
13. Guy N. Smith. Profitable Fish Keeping.
14. Maurice Melzak. Marine Aquarium Manual. B.T. Balford Ltd., London.
15. K. L. Tekrivaland A. A. Rao. Ornamental aquarium fishes of India-(1999)- TFH United Kingdom.
16. J. C. Cato and C.L. Brown Marine Ornamental species(collection, culture and conservation)—Blackwell Science
17. Dick Mills (1998). Aquarium fishes, Dorling Kindersly Ltd, London
18. Van Ramshort JD (1978). The complete aquarium encyclopaedia, Elsevier

MFT 532: BREEDING AND HATCHERY MANAGEMENT OF FINFISH AND SHELLFISH**Course Objectives: Students should be able to**

1. gain knowledge of types of breeding & fresh water fish seed resources of the world.
2. get information of breeding seasons, gonad & gametes development of cultivable fish
3. to learn induced breeding of warm & environmental factors affecting spawning and breeding fish.
4. study different types of hatcheries & breeding techniques for Indian Major Carps & Exotic carps.

Credits=4	MFT-532: BREEDING AND HATCHERY MANAGEMENT OF FINFISH AND SHELLFISH	No. of hours 60
UNIT I	Fresh water fish seed resources	15
	<ol style="list-style-type: none">1. Fresh water fish seed resources of the world<ol style="list-style-type: none">1.1 Fresh water fin fish seed resources of India1.2 Natural breeding of fin fish in fresh water ecosystems1.3 Monsoon and breeding of finfish1.4 Types of breeding in finfish & shellfish. Selection of riverine spawn collection sites1.5 Gears used for collection of finfish & shell fish spawn1.6 identification and segregation of finfish and shellfish seed, spawn quality and quantity indices1.7 Advantages and disadvantages of wild seed collection from rivers.	
UNIT II	Seed maturity and breeding	15
	<ol style="list-style-type: none">2. Seed maturity and breeding season of various cultivable fresh water finfish & shellfish species<ol style="list-style-type: none">2.1 Gonadal stages2.2 Gonad development and gamete development in male and female fish2.3 Gametes maturation and development(Spermatogenesis and Oogenesis)2.4 Type of fish eggs and embryonic development	

UNIT III	Induced breeding	15
	3. Induced breeding of cultivable fin fish & shell fish species 3.1 Environmental factors affecting spawning and breeding 3.2 Hypophysation of fishes Methods of natural and artificial fertilization- 3.3 Fish pituitary gland ,its structure, collection, preservation and preparing of pituitary extract and injecting 3.4 Dosage calculation of pituitary extract and administration 3.5 Brood stock management and transportation of brood fish 3.6 Use of different Synthetic hormones used for induced breeding of carps 3.7 Stripping and fertilization.	
UNIT IV	Hatcheries Design and Management	15
	4. Hatchery design and management- criteria for site selection of hatchery 4.1 Different types of freshwater fish hatcheries – traditional, Chinese, glass jar and modern controlled hatcheries 4.2 Causes of mortalities of eggs and spawn 4.3 Spawn rearing techniques 4.4 Use of anesthetics in fish breeding and transport 4.5 Breeding techniques for Indian Major Carps, Exotic carps, Mahseer, Trout, Tilapia, Catfishes 4.6 Seed production of commercially important prawns, shrimp, crabs, lobsters, mussels, clams, edible oysters etc 4.7 Cryopreservation of fresh water fish gametes 4.8 Hatchery standards and biosecurity-better management practices (BMP's).	

Course Outcome: Students will be able to

1. to explain the types of breeding & freshwater fish seed resources of the world.
2. relate the breeding seasons, gonad & gametes development of cultivable fish.
3. to justify induced breeding of warm & environmental factors affecting spawning and breeding fish.
4. get information to develop different types of hatcheries & breeding techniques for Indian Major Carps & Exotic carps.

REFERENCEBOOKS:

1. Purdom. C.E.(1993)Genetics and Fish Breeding
2. Chattopadhyay. N.(2016) Induced Fish Breeding
3. Shukla, A.N.(2014) Fish Breeding
4. Andrews,C. (2010) Guide to fish breeding
5. Wedemeyer, G. A(2002) Fish Hatchery Management

MFT 533: Brackish Water Aquaculture and Mariculture

Course Objectives: Students should be able to

1. get knowledge of brackish water aquaculture.
2. learn about shrimp and crab culture.
3. Student should be aware of lobster and mussel culture.
4. identify species used in mariculture

Credits=4	MFT533: Brackish Water Aquaculture and Mariculture	No. of hours 60
UNIT I	Brackish water aquaculture:	15
	<p>1. Present status of brackish water aquaculture,</p> <p>1.1 Different farming systems- Raft and rack culture, cage culture, pen culture</p> <p>1.2 Principles of pond design– Inland and Coastal Pond forms, Tank and raceway farms, cage farms, pens</p> <p>1.3 Types of culture systems: Traditional, extensive, modified extensive, semi-extensive, intensive and super-intensive culture of shrimps and their management and economics</p> <p>1.4 Water quality management in Aquaculture, Physico-chemical variables: Salinity, temperature, pH, turbidity, BOD, COD, dissolved oxygen, nitrates, phosphates, ammonia, sulphates and silicates</p>	
UNIT II	Design and construction of shrimp culture ponds	15
	<p>2. Site selection, Infrastructure requirement, Pond preparation, stocking, feed and water quality management,</p> <p>2.1 Liming and fertilization</p> <p>2.2 Seed procurement of shrimps: Natural seed collection, hatchery reared seed, production and transportation stocking in nursery ponds, rearing and grow out ponds, pond harvesting, disease prevention and treatment.</p> <p>2.3 Principles of crab hatchery, brood stock, larval and post-larval management.</p> <p>2.4 Packing and transportation of seed - Crab culture: Pond design, management of crab farm.</p> <p>2.5 Brood stock management, physiology and techniques of eyestalk ablation.</p> <p>2.6 Crab culture and crab fattening process– production of soft-shell crabs, economics, cage culture and pen culture.</p>	

UNIT III	Seed Production	15
	<p>3.1 Principles involved in seed production of lobsters and mussels.</p> <p>3.2 Natural resources of shrimp, crab, brackish water fish, oyster and mussel seed, Seed collection practices, farming methods.</p> <p>3.3 Brackish water fish species for culture, management, traditional culture of brackish water fish.</p> <p>3.4 Culture of finfish– Sea-bass, milk fish and mullet pearl spot, grouper, cobia, sea breams, rabbit fish etc.</p> <p>3.5 culture of shellfish- shrimps, crabs, lobster, clams, oysters, pearl oysters.</p>	
UNIT IV	Mariculture	15
	<p>4.1 Present status and scope in India</p> <p>4.2 Species identification,</p> <p>4.3 Lobster culture</p> <p>4.4 Mussel culture</p> <p>4.5 Pearl culture</p> <p>4.6 Oyster culture</p> <p>4.7 Sea-weed culture- major seaweed species of commercial importance, methods of culture</p>	

Course Outcomes: Students will be able to

1. define brackish water aquaculture.
2. relate the shrimp and crab culture.
3. categories lobster and mussel culture.
4. identify and choose the species used in mariculture.

References

1. Huet,M.(1972)TextbookofFishCulture– BreedingandCultivationofFish.FishingNews (Books)Ltd., England.
2. Bardach, et.al.(1972) Aquaculture–The Farming and Husbandry of Fresh water and Marine Organisms. John Wiley & Sons, NY.
3. Chen,T.P.(1976)Aquaculture Practices in Taiwan. Fishing News (Books) Ltd., England,.
4. TakeoImai.(1977)Aquaculture in Shallow Seas–Progress in Shallow Sea Culture. Oxford & IBH Publ. Co., India.
5. Stickney, R. R.(1979) Principles of Water Aquaculture. John Wiley & Sons, NY.
6. Jhingran, V.G. (1982)Fish and fisheries of India. Hindustan Publ. Corporation (India).

7. Kurian, C. V. & V. O. Sabastian.(1982)Prawn and Prawn Fisheries of India. Hindustan Publ. Corp. India.
8. Brown, E. E.(1993)WorldFishFarming–Cultivation and Economics. AVI Publishing Co. Connecticut.
9. Huner Jay V. et. al.(1985) Crustacean and Mollusc Aquaculture in United States. AVI PublishingCo. Connecticut.
10. Pilley, T. V.R.(1990)Aquaculture–Principles and Practices. Fishing News (Books) Ltd., London.
11. Bose, A. N. (1991) Coastal Aquaculture Engineering. Oxford & IBH Publishing Company Pvt. Ltd.
12. Turcker, C. S.(ed.).(1985) Channel Cat fish Culture.Elsevier,1985.
13. Boyd, C. E. (1982) Water Quality Management for pond Fish Culture. Elsevier Scientific Publishing Company.

Elective – 1

MFT 534 FISH NUTRITION AND TYPES OF FEED

Course Objectives: Students should be able to

1. understand fish Nutrition.
2. get knowledge of different forms of feeds.
3. learn about Storage of feed–Methods of Feeding-Feeding devices etc.

Credits=2	E-1 MFT 534 FISH NUTRITION	No. of hours 30
UNIT I	Introduction to Fish Nutrition	15
	1.1 Principles of Fish Nutrition and terminologies 1.2 Nutrients and growth-Proteins and Amino acids-Structure and Composition 1.3 Chemical Properties 1.4 Role of nutrients: amino acids, fatty acids, protein, lipid, carbohydrates, Vitamins and minerals. 1.5 Classification 1.6 Protein Digestion and Metabolism 1.7 Lipids Classification -Structure and composition- Fatty acid structure and classification-Phospholipids-Glycolipids-Waxes–Steroids–Cholesterol-Bileacids 1.8 Carbohydrates- Classification- Non Sugars- Sugars- 1.9 Vitamins, Minerals & Energy-Classification -Laws of thermodynamics -Energy units- Forms of energy-partitioning –Energy metabolism 1.10 Nutritional requirements of cultivable fish and shellfish.	

UNIT II	Different types of Feeds	15
	<p>2.1 Nutritional value of feed ingredients and live feed</p> <p>2.3 Feeds based on life-cycle of fish</p> <p>2.3 Larval feeds</p> <p>2.4 Flakes-Farm-made feeds</p> <p>2.5 Feed additives-Binders, Antioxidants-Enzymes, Pigments Growth promoters</p> <p>2.6 Feed stimulants- Immuno stimulants- Non-conventional feed ingredients and anti-nutritional factors</p> <p>2.7 Digestive enzyme, digestibility and factors affecting digestibility- Protein digestion, Fat digestion, Carbohydrate Digestion, Factors affecting digestibility.</p> <p>2.8 Feed management – Feeding schedules, protein requirements at different ages of finfish and shellfish, feed formulations, wet feeds and dry feed</p>	

Course Outcomes: Students will be able to

1. summarize fish Nutrition.
2. categories different forms of feeds.
3. justify storage of feed, Methods of Feeding, Feeding devices etc.

References:-

BOOKS RECOMMENDED

1. Vidya and Rao, D.B., A Text Book of Nutrition
2. Chandrasekhar, Y. S., Fish Nutrition in Aquaculture book
3. Sena S., De Silva and Anderson Trevor A. (1995) Fish Nutrition in Aquaculture,
4. Halver, John E. and Ronald, W. Hardy(2002) Fish Nutrition
5. Athithan,S., Felix, N. and Venkatasamy, M.(2016)Fish Nutrition and Feed
6. Technology: A Teaching Manual

Elective – 2

MFT 534 Larval Nutrition and Live Feed

Course Objectives: Students should be able to

1. Understand larval Nutrition.
2. get knowledge of biology of live feeds.

Credits=2	E-2 MFT 534 Larval Nutrition and Live Feed	No. of hours 30
UNIT I	Larval nutrition:	15
	1.1 Nutritional requirements of finfish and shellfish larvae, 1.2 Nutritional quality of commonly used live feed, 1.3 Comparison of live feeds against the prepared feeds, 1.4 Nutritional disorders in larvae, 1.5 Larval feeds utilization and advantages	
UNIT II	Biology of live feeds:	15
	2.1 Important live feeds and their biological features, 2.2 Identification of new live feeds, 2.3 Live feed use in different forms, Advantages and disadvantages. 2.4 Important microalgae, rotifers, artemia, infusoria, cladocerans, copepods, oligochaetes, nematode and insect larvae. 2.4 Bio-enrichment of live feed, Biofilm/periphyton and its use, 2.6 Culture of single cell proteins and their nutritional quality	

Course Outcomes: Students will be able to

1. get knowledge of larval Nutrition.
2. explains biology of live feeds.

Credits - 6	MPP 535: Research Project	No. of hours 180
	Students will undertake research in specific area of his Major/Core with an advisory supported by a teacher/Faculty member. Students are required to take 6 credit Research Project for semester III under the guidance of faculty members.	

Level 6.5
SEMESTER III
Lab III
MZP 535 -Based on MZT 531, 532 & 533

Course Objectives: Students should be able to

1. identify ornamental fish & learn construction of tanks.
2. administer pituitary gland extract.
3. learn estimations of DO, turbidity, alkalinity, primary productivity etc.
4. study analysis of feed ingredients and feeds.

Credit- 2	MZP 535 -Based on MZT 531, 532 & 533	No. of hours
	<ol style="list-style-type: none"> 1. Identification of common ornamental fishes 2. Identification of common ornamental plants 3. Fabrication of all glass aquariums 4. Setting up of aquariums 5. Aquarium accessories and equipment's 6. Conditioning and packing of ornamental fishes 7. Feed preparation 8. Culture of live food organisms 9. Breeding of livebearers 10. Breeding of egg layers 11. Identification of ornamental fish diseases 12. Selection of brooders of carps and catfishes. 13. Dissecting out the pituitary gland and preservation of pituitary glands of freshwater fin fish 	

	14. Preparation and administration of pituitary gland extract. 15. Use of synthetic hormone for induced breeding of freshwater finfish. 16. Care of eggs, spawn and fry. 17. Detailed study of design and operation of Chinese circular hatchery 18. . Study of seed production technology of Indian carps/catfishes, tilapia. 19. Analysis of water quality parameters::Turbidity, pH, Alkalinity, hardness, Dissolved oxygen (DO), Carbon dioxide (CO2) etc. 20. Primary productivity, Estimation by Light and Dark Bottle method	
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Course Outcome: Students will be able to

1. Students will be able identify ornamental fish & learn construction of tanks.
2. Student demonstrates administration of pituitary gland extract.
3. Student able to estimate DO, turbidity, alkalinity primary productivity etc.
4. Student will be able to compose feed ingredients and feeds.

Level 6.5

Semester IV

MFT541– Fish Diseases and Management

Course Objectives: Students should be able to

1. get knowledge of significance of fish disease.
2. Study bacterial diseases in cultured finfish and shellfish.
3. Understand the parasitic diseases.
4. learn about the principles and methods of vaccine production and fish immunization.

Credits=4	MFT541– FISH DISEASES AND MANAGEMENT	No. of hours 60
UNIT I	Fish Diseases and Aquaculture	15

	<p>1.1 Basics of fish and shellfish health management</p> <p>1.2 Significance of fish diseases in relation to aquaculture.</p> <p>1.3 Disease development Process in fish and shellfish.</p> <p>1.4 Environmental stress</p> <p>1.5 Host, pathogen and environment interaction. Pathophysiology of fish diseases.</p> <p>1.6 Systematic pathology of fish and shellfish (Integumentary system, respiratory system, circulatory system, digestive system, excretory system, nervous system, musculoskeletal system, Reproductive system, endocrine system).</p>	
UNIT II	Infectious diseases	15
	<p>2.1 Bacterial, viral and fungal diseases of cultured finfish and shellfish.</p> <p>2.2 OIE listed and notifiable diseases. Principles of disease diagnosis.</p> <p>2.3 Case history and clinical signs in diagnosis.</p> <p>2.4 Conventional and rapid diagnostic techniques.</p> <p>2.5 Microscopical, microbiological, histopathological and biochemical methods.</p> <p>2.6 Antibody and nucleic acid based rapid diagnostics</p>	
UNIT III	Parasitic diseases	15
	<p>3.1 Parasitic diseases of fish and shellfish.</p> <p>3.2 Protozoan and metazoan parasites-Morphology, biology and lifecycle of parasites.</p> <p>3.3 Diagnosis, prevention and treatment</p> <p>3.4 Infectious bacterial and viral diseases: Morphology, biology and life cycle of parasites, Diagnosis, prevention and treatment</p> <p>3.5 Zoonotic diseases, non-infectious diseases (nutritional, genetic, and environmental diseases)</p>	
UNIT IV	Defense mechanism	15
	<p>4.1 Defense mechanism in finfish and shellfish</p> <p>4.2 Specific and non-specific immune system.</p> <p>4.3 Role of stress and host defense mechanism in disease development.</p> <p>4.4 Disease control: Environment management, host management, use of antibiotics and chemicals in health management, Inflammation response to diseases, innate and acquired immunity,</p> <p>4.5 Principles and methods of vaccine production and fish immunization.</p> <p>4.6 Fish vaccines & delivery mechanisms</p> <p>4.7 SPF and SPR stocks-development and its applications, fish health and quarantine system.</p>	

Course Outcomes: Students will be able to

1. enlist the significance of fish disease.
2. to differentiate bacterial, viral and fungal diseases of cultured finfish and shell fish.
3. categorize parasitic diseases.
4. get acquainted to principles and methods of vaccine production and fish immunization.

Books and References:

1. Austin, B. and D. A. Austin. (1987). Bacterial fish pathogens: disease of farmed and wild fish. Ellis Horwood Ltd. New York. 364pp.
2. Kent, Michael and T. Poppe. (1998). Diseases of seawater netpen-reared salmonid fishes in the Pacific Northwest. Quadra Printers Ltd. Nanaimo, BC. 137 pp.
3. Leatherly and, J. F., and P. T. K. Woo (editors) (1998). Fish diseases and disorders. Volume 2: Non-infectious disorders. CABI Publishing. New York. 400 pp.
4. Noga, Edward J. (2000). Fish disease: diagnosis and treatment. Iowa State Press. Ames, Iowa. 536 pp.
5. Plumb, John A. (1999). Health maintenance and principal microbial diseases of cultured fishes. Iowa State Press. Ames, Iowa. 328pp.
6. Roberts, R.J. and C.J. Shepherd (1997). Handbook of trout and salmon diseases. Fishing News Press. Oxford. 179pp.
7. Roberts, R.J. (2001). Fish pathology. London: W.B. Saunders. 472pp.
8. Stoskopf, Michael K. (1993). Fish medicine. Saunders Publishing. 902pp.
9. Thoesen, J.C. 1994. Suggested procedures for the detection and identification of certain finfish and shellfish pathogens. Fish Health Blue Book. American Fisheries Society, Fish Health Section. Bethesda MD.
10. Woo, P. T. K. (editor) (1995). Fish diseases and disorders. Volume 1: Protozoan and Metazoan Infections. CABI Publishing. New York. 768 pp.
11. Woo, P. T. K. and D.W. Bruno (editors) (1999). Fish diseases and disorders. Volume 3: Viral, bacterial and fungal infections. CABI Publishing. New York. 896 pp.
12. Woo, P.T.K., D.W. Bruno and L.H.S. Lim. (2002). Diseases and disorders of finfish in cage culture. CABI Publishing. New York. 354 pp.

MFT 542– Aquatic Ecology and Biodiversity**Course Objectives:** Students should be able to

1. Understand about aquatic biota.
2. learn importance of biodiversity.
3. Understand habitat conservation.
4. get knowledge conservation management .

Credits=4	MFT 542– .Aquatic Ecology and Biodiversity	No. of hours 60
UNIT I	Aquatic Biota:	15
	1.1 Components of aquatic ecosystem. 1.2 Nutrient cycles 1.3 Energy flow 1.4 Food chains. 1.5 Animal associations: Symbiosis, commensalisms, parasitism, prey-predator relationship, host parasite relationship.	
UNIT II	Biodiversity and Importance:	15
	2.1 Definition, species diversity 2.2 Genetic diversity 2.3 Habitat diversity 2.4 Diversity indices. 2.5 Ecological and evolutionary processes. 2.6 Ecological niches lagoons, estuaries, mangroves, coral reefs, flood plains, wetlands. 2.7 Threats to biodiversity- habitat destruction, introduction of exotic species.	
UNIT III	Habitat Conservation:	15
	3.1 Marine parks and sanctuaries. 3.2 Conservation programmes for endangered species. 3.3 Ex situ and in situ conservation, captive breeding and management of endangered species. 3.4 Various national and international conventions and regulations concerning biodiversity, including use of selective gears and exclusion devices.	
UNIT-IV	Conservation and Management:	15
	4.1 Cetaceans (whales, dolphins, porpoises and narwhal), 4.2 Sirenia (manatees and dugongs) 4.3 Carnivore (seals, sea lions walruses, polar bear and otter), Sea turtles, tortoise, crocodiles, sea/freshwater snakes and amphibians. 4.4 IUCN criteria Red list,	

	4.5 Wild Life (Protection) Act. Role in Conservation and Management.	
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Course Outcomes: Students will be able to

1. Explain about aquatic biota.
2. Discuss about importance of biodiversity.
3. explain habitat conservation.
4. Acquire the knowledge of conservation management.

Reference and Test Books

1. Hutchinson, G. E. (2015). A Treatise on Limnology, John Willey and Sons, Inc., London. 6th Edition.
2. Robert, G. W. (1983). Limnology. Sounders College Publishing, New York.
3. Templeton, R. G. K. (1995). Freshwater Fisheries Management. Fishing News Books.
4. Joseph. S. Nelson, Terry C. Grande Mark and V.H. Wilson. (2016). Fishes of the World. 5th Edition.
5. Sakhare, V. B., .S. G. Jetithor, and S. S. Jadhav. (2018). Biodiversity and Fisheries.
6. Ahluwalia, V. K. (2016). Manual of Environmental Pollutants Estimations Air, Water and Soil. 1st Edition.
7. Sujandu Dey and Banu Nasrin. (2014). Ecology of Aquatic Systems. 1st Edition.
8. Gabriella Bianchi and Hein R. Skjoldal. (2008). The Ecosystem Approach to Fisheries. 1st Edition.

MFT - 543: Reservoir fisheries

Course Objectives: Students should be able to

1. get knowledge of Leasing policies for fish culture in reservoir.
2. learn Reservoirs fish production and their management.
3. understand cage culture and pen culture
4. to explain water quality parameters for reservoirs.

	MFT 543– Reservoir fisheries	No. of hours 60
Credits=4		
UNIT I	Introduction of Reservoir fisheries	15
	1.1 Definition of reservoirs in India; Scope, present status and future prospectus of reservoir fisheries. 1.2 Nature and extent of reservoirs, topography and species diversity; importance of morphi-edaphic index in reservoir productivity and classification. 1.3 Factors influencing fish production; trophic phases in reservoir; pre-impoundment and post impoundment stages and their significance in establishment of reservoir fisheries. 1.4 Leasing policies for fish culture in reservoir.	
UNIT II	Reservoir management	15

	<p>2.1 Salient features of reservoir limnology and their significance to fisheries development.</p> <p>2.2 Management of small, medium and large reservoirs;</p> <p>2.3 Present status and future prospects in Reservoirs fish production.</p> <p>2.4 Fisheries of some important reservoirs;</p> <p>2.5 Recent advances in reservoirs fisheries management; conservation measures in reservoir fisheries.</p> <p>2.6 Culture based capture fisheries in reservoir.</p>	
UNIT III	Cage culture:	15
	<p>3.1 Cage culture:</p> <p>3.1.1 History of cage culture, advantages of cage culture.</p> <p>3.1.2 Role of cage culture in enhancement of fish production from reservoirs.</p> <p>3.1.3 Selection of suitable site of cage culture.</p> <p>3.1.4 Cage materials, designs, shape, size and fabrication. Cage frames and supporting system. Suitable species for culture in cages.</p> <p>3.1.5 Nursery rearing of fish fry in cages.</p> <p>3.1.6 Grow-out of fishes in Cages. Constraints in cage culture. Economics of cage culture.</p> <p>3.2 Pen Culture:</p> <p>3.2.1 History of pen culture, pen materials, fabrication pen system;</p> <p>3.2.2 Role of pen culture in enhancement of fish production from reservoirs.</p> <p>3.2.3 Suitable species for culture in pens.</p> <p>3.2.4 Rearing of spawn in pen.</p> <p>3.2.5 Grow-out of fishes in pens.</p> <p>3.2.6 Constraints in pen culture. Economics of pen culture.</p>	
UNIT IV	Primary Productivity of Reservoir	15
	<p>4.1 Primary productivity of reservoir.</p> <p>4.2 Estimation of Water quality parameters of reservoir:</p> <p>4.3 Physio-chemical variables: Temperature, pH, turbidity, dissolved oxygen (DO), Carbon dioxide (CO₂) nitrates, ammonia.</p> <p>4.4 Estimation of chlorophyll.</p> <p>4.5 Types of nets, boats used in capture operation and number of fishers involved in trade.</p>	

Course Outcomes: Students will be able to

1. get knowledge about Leasing policies for fish culture in reservoir.
2. differentiate the small, medium and large Reservoirs and their management.
1. to justify quality control objectives.
2. to design cage material, pen material and fabrication.

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 2. Sugunan VV. (1997). Reservoir Fisheries of India. Daya Publ. House.
 3. Blaber JM. (1997). Fish and Fisheries in Tropical Estuaries. Chapman & Hall.
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 6. Jhingran VG & Sehgal KL. (1978). Cold Water Fisheries of India. J. Inland. Fish. Soc. India. Sp. Publ.
- <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=41346>
<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=35103>

Elective – 1

MFT 544 - FISHERIES MARKETING, FINANCE AND EXTENSION EDUCATION IN FISHERIES

Course Objectives: Students should be able to

1. get knowledge of marketing strategies in fisheries.
2. learn export and import procedures in fisheries.
3. explain role of fisheries extension in fisheries development.
4. Understand the importance of fisheries education in fisheries development.

Credits=4	E-1 MFT 544– FISHERIES MARKETING, FINANCE AND EXTENSION EDUCATION IN FISHERIES	No. of hours 60
UNIT I	FISHERIES MARKETING	15
	1.1 Definition–Approaches to the study of marketing: product, functional, participant and decision making– 1.2 Classification of markets: based on location, time, position of sellers, volume of business transactions and competition– 1.3 Market structure: product market, factor market 1.4 Marketing functions: exchange, physical supply and facilitating. Objectives and importance of fish marketing – 1.5 Marketing channel: Definition–Types of marketing channel for fish and fishery products, 1.6 Marketing efficiency– Price spread: Marketing costs.	

UNIT II	EXPORT MARKET	15
	2.1 Export markets: meaning and definition – 2.2 Export and import procedures – 2.3 Pattern and performance of fishery product export from India 2.4 Trade liberalization and fisheries exports 2.5 Role of MPEDA (Marine Product Export Development Authority) and EIC in fish and fishery product export development.	
UNIT III	FISHERIES EXTENSION	15
	3.1 Introduction to fisheries extension – concepts, objectives and principles extension education-formal and informal education. 3.2 History and role of fisheries extension in fisheries development. 3.3 Fisheries extension methods-individual, group and mass contact methods and their effectiveness 3.4 Audiovisual aids-definitions, advantages and disadvantages 3.5 Classification and choice of audiovisual aids Cone of experiences of experiences and criteria for selection and evaluation of audio visual aids 3.6 Videoconferencing-factor influencing their selection and use	
UNIT IV	FISHERIES EDUCATION	15
	4.1 Extension programme planning and evaluation-steps and importance-participatory planning process. 4.2 Basic concepts in rural sociology and psychology and the irrelevance in fisheries extension– 4.3 Social change-social control– 4.4 Social problems and conflicts in fisheries 4.5 Gender issues in fisheries 4.6 Theories of learning–learning experience–learning situation.	

Course Outcomes: Students will be able to

1. to recognize marketing strategies in fisheries.
2. to explain export and import procedures in fisheries.
3. to apply the role of fisheries extension in fisheries development.
4. convinced to the importance of fisheries education in fisheries development.

Elective – 2**MFT 544 – Marine Biology****Course Objectives: Students should be able to**

1. get knowledge of marine environment.
2. learn different zonation and characteristics of marine habitat.
3. explain environmental factors affecting life in the oceans.
4. Understand the importance of. biodiversity and conservation

Credits=4	E-2 MFT 544–. Marine Biology	No. of hours 60
UNIT I	Introduction to Marine Biology:	15
	1.1 Divisions of marine environment- pelagic, benthic, euphotic, aphotic divisions and their subdivisions. 1.2 Life in oceans - 1.3 General account of major groups of phytoplankton, sea weeds and major zooplankton groups.	
UNIT II	Marine Ecosystem:	15
	2.1 Definition, zonation, characteristics, 2.2 Estuaries: Classification, Physico-chemical factors, Biota and productivity, 2.3 Examples of some Indian Estuaries. 2.4 Boring and fouling organisms 2.5 Rocky shore, sandy shore and mud flats, zonation, communities, and the adaptation	
UNIT III	Biological Ecosystem and Environment:	15
	3.1 Environmental factors affecting life in the oceans-salinity, temperature, light, currents, waves, tides, oxygen, and carbon dioxide. 3.2 Vertical migration of zooplankton, Phytoplankton- 3.3 Zooplankton relationship, geographical and seasonal variation in plankton production, 3.4 plankton and fisheries	
UNIT- IV	Biodiversity and Conservation:	15
	4.1 Nekton outline, composition of nekton, habitats of nekton. 4.2 Bioluminescence and indicator species,	

	<p>4.3 Blooms, Red tides: cause and effects.</p> <p>4.4 Various national and international conventions and regulations concerning biodiversity, including use of selective gears and exclusion devices..</p>	
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Course Outcomes: Students will be able to

1. get knowledge of marine environment.
2. explain different zonation and characteristics of marine habitat.
3. explain environmental factors affecting life in the oceans.
4. acquire the importance of. biodiversity and conservation.

Reference

1. Anne Grovea Salvanes, Jennifer Devine, Knut.Helge Jensen and Jonthomassen Hestestun.
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3. Bardach, J. E., Ryther, J. H. and Larney, Mc W. O. (2005). Aquaculture - The farming and husbandry of freshwater and marine organisms. John Wiley & Sons, New York.
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11. Curtis, M J. and Howard, A.C. (1997) Economics of Aquaculture. Food products press, NewYork.
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14. P. N. Aroraand P. K. Malhan (2002) Biostatistics, Himalaya publishing House.
15. Rama Krishnan, P. (1995) Biostatics, Saras publication A.R.P. camp Road, Periavilai, Kottar,po.Nagercoil, Kanyakumari-Dist. Pin-629 002.

Credits - 4	MPP 545: On Job Training (OJT)	No. of hours - 120
	OJT will provide the opportunities for internship with local/regional industries, business organization, health and allied areas, local government, etc. so that students may actively engaged with the employability opportunities. Students will undergo 4 credit work based learning/OJT/internship.	

Level 6.5
SEMESTER IV
Lab IV
MFP 545 PRACTICAL COURSE– IV:

**Course Objectives: Students
should be able to**

1. get knowledge of live and postmortem examination of diseased fish.
2. learn principles and methods of fish Preservation.
3. plan management strategies of pre-disaster, during disaster and post-disaster.
4. Learn importance of fisheries education in fisheries development.

Credits=2	MFP 545: Based on MFT - 541,542, and 543	No. of hours
	<ol style="list-style-type: none"> 1. Methods of sampling fish and shellfish for disease diagnosis. 2. Live and postmortem examination of diseased fish. 3. Collection and identification of parasites. Morphological, biochemical and biological tests of bacteria, virus and fungi. 4. Methods of treatment. 5. Analysis of soil – determination of soil texture, soil pH, conductivity, available nitrogen, available phosphorus and organic carbon. 6. Estimation of water salinity and pH. 7. Estimation of primary productivity (light and dark bottle method). 8. Estimation of COD and BOD. 9. Estimation of oxygen consumption. 10. Study of energy flow in aquatic ecosystem 	

	11. .Study of different types of food chains 12. Fish species composition and production details. 13. Estimation of the Primary productivity of the reservoir 14. Types of nets, boats used in capture operation and number of fishers 15. Involved in trade. 16. Estimation of Water quality parameters of reservoir water 17. Estimation of Biodiversity of reservoir. 18. Case studies on cage culture. 19. Field visit to cage culture site to acquaint construction details and operation. 20. Field visit to pen culture site to study construction details and operation.	
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Course Outcomes: Student will be able to

1. get knowledge of live and postmortem examination of diseased fish.
2. learn principles and methods of fish Preservation.
3. Acquires knowledge of management strategies of pre-disaster, during disaster and post-disaster.
4. Propagate importance of fisheries education in fisheries development.

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10. Jhingran VG & Sehgal KL. (1978). Cold Water Fisheries of India. J. Inland. Fish. Soc. India. Sp. Publ.