Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(An Autonomous College)

Reaccredited by NAAC with 'A+' Grade

New Syllabus for

Master of Science

Part- II Fisheries

Syllabus

To be Implemented from June, 2022 onward

M.Sc. Part I Semester I

Nature of the Course	Course code	Name of the Course
Theory	MZFT 101	Biosystematics and Biodiversity
	MZFT 102	Ecology and Environmental Pollution
	MZFT 103	Fish Cell and Molecular Biology
	MZFT 104	Sustainable Aquaculture
Practical	MZFP 105	Practical Course I:Lab-I
	MZFP 106	Practical Course I: Lab-II

SemesterII

Nature of The Course	Course code	Name of the Course
Theory	MZFT 201	Physiological chemistry
	MZFT 202	Quantitative Biology and Tools and Techniques in Biology
	MZFT 203	Aquaculture Biotechnology
	MZFT 204	Applied Genetics in Aquaculture
Practical	MZFP 205	Practical Course II: Lab I
	MZFP 206	Practical Course II: Lab II

M.Sc. Part II Semester III

Nature of the Course	Course code	Name of the Course
Theory	MZFT 301	Ornamental Fish Production and Its Management
	MZFT 302	Breeding and Hatchery Management of Finfish and Shellfish
	MZFT 303	Brackish Water Aquaculture and Mari Culture
	MZFT 304	Fish Nutrition and Feed Technology
Practical	MZFP305	Practical Course III: Lab I
	MZFP306	Practical Course III: Lab II

Semester IV

Nature of the Course	Course code	Name of the Course
Theory	MZFT 401	Fish Diseases and Management
	MZFT 402	Fish Processing Technology
	MZFT 403	Reservoir fisheries
	MZFT 404	Fisheries Marketing, Finance and Extension Education in fisheries
Practical	MZFP405	Practical Course IV: Lab I
	MZFP406	Practical Course IV: Lab II

SEMESTER III
MZFT 301: ORNAMENTAL FISH PRODUCTION AND MANAGEMENT

Course Objectives: Student will able to

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

Credits=4	**SEMESTER-III** **MZFT 301: ORNAMENTAL FISH PRODUCTION AND ITS MANAGEMENT**	**No. of hours per unit/ credits**
Credit–I **UNIT I**	**Introduction-**	**(15)**
	Benefits of ornamental fish keeping as a hobby -Origin of keeping ornamental fishes as pets -Constrains and current status of ornamental fish farming in India -Commercially important ornamental fishes -exotic ornamental species - Indigenous ornamental species -Marine Ornamental fishes	
Credit–1 **UNIT II**	**Construction of an Aquarium**	**(15)**
	Different types of fish tanks -Materials required for construction of fish tanks -Construction of all glass aquarium glass tank - Steps involved in setting up of aquarium -Equipments and accessories needed for small scale unit Equipment and accessories needed for large scale ornamental fish production unit- Maintenance of aquarium -Aerator - Filters-Types of Filter -Canister filter (externalorinternaltype) -Trickle filter Resource -Submersible power filter (box filter/corner filter) - Types of Aquatic plants - Common aquarium plants and their propagation.	

Credit–1 UNIT III	**Water quality management**	**(15)**
	-Temperature -Dissolved oxygen (DO) -Carbon dioxide (CO_2) - pH -Hardness - Live food organisms- live feeds of fry - Infusoria - Daphnia - Moina - Rotifers - Copepods - Tubifex -Blood worms -Mosquito larvae -Artemia - Importance of Live food –Artificial feed - Types of feeds - Feed formulation and processing of Feed storage.	
Credit–1 UNIT IV	**Breeding of ornamental fishes**	**(15)**
	- Breeding of live bearers - Introduction - Sex identification - Conditioning of parent fish - Breeding of egg layers - Egg-scatterers - Egg-depositors - Egg-buriers - Mouth-brooders - Nest-builders - Stimulating spawning - Fry rearing. - Different breeding substrate	

Course Outcomes: Student should be able to

1. understand the benefits of ornamental fish keeping.
2. Understand the materials required for construction of tanks.
3. understands various physico-chemical parameters, live food & feeding.
4. 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.WardLock, 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. StephenSpotte.MarineAquariumKeeping.AWiley-InterscicencePublication.
10. Dick Mills and Gwynne Vevere. Tropical Aquarium Fishes. Published by Salamander Books Limited. London.
11. Carcacson, R. H.A field guide to the Coral Reef Fishes of the Indian and West Pacific Oceans.
12. VincentB.Hargreaves.TheTropicalMarineAquarium.Mc-Graw-HillBookCompany.New York.
13. GuyN.Smith.ProfitableFishKeeping.
14. Maurice Melzak. Marine Aquarium Manual. B.T. Balsford Ltd., London.
15. OrnamentalaquariumfishesofIndia-1999-K.L.TekrivalandA.A.Rao. TFHUnitedKingdom.
16. MarineOrnamentalspecies(collection, culture and conservation)–J. C. Catoand C. L. Brown –Blackwell Science
17. Dick Mills1998.Aquarium fishes, DorlingKinderslyLtd,London
18. VanRamshortJD1978.Thecompleteaquariumencyclopaedia, Elseveir

MZFT 302: BREEDING AND HATCHERY MANAGEMENT OF FINFISH AND SHELLFISH

Course Objectives: Student will able to

1. Study of types of breeding & fresh water fish seed resources of the world.
2. Study of breeding seasons, gonad & gametes development of cultivable fish
3. Understand 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	**SEMESTER-III** **MZFT302: BREEDING AND HATCHERY MANAGEMENT OF FINFISH AND SHELLFISH**	**No. of hours per unit/ credits**
Credit–I UNIT I	**Fresh water fish seed resources**	**(15)**
	Fresh water fish seed resources of the world – Fresh water fin fish seed resources of India – Fresh water fish seed resources potential and present production in India – Natural breeding of fin fish in fresh water ecosystems – Monsoon and breeding of finfish – Types of breeding in finfish & shellfish. Selection of riverine spawn collection sites – Gears used for collection of finfish &shell fish spawn – identification and segregation of finfish and shellfish seed – spawn quality and quantity indices – Advantages and disadvantages of wild seed collection from rivers.	
Credit–1 UNITII	**Seed maturity and breeding**	**(15)**
	Seed maturity and breeding season of various cultivable fresh water finfish & shellfish species – Gonadal stages – Gonad development and gamete development in male and female fish – Gametes maturation and development(Spermatogenesis and Oogenesis) – Type of fish eggs and embryonic development	

Credit–1 UNITIII	**Induced breeding**	**(15)**
	Induced breeding of cultivable fin fish & shell fish species – Environmental factors affecting spawning and breeding – Hypophysation of fishes Methods of natural and artificial fertilization- – Fish pituitary gland ,its structure, collection, preservation and preparing of pituitary extract and injecting – Dosage calculation of pituitary extract and administration – Brood stock management and transportation of brood fish – Use of different Synthetic hormones used for induced breeding of carps – Stripping and fertilization.	
Credit–1 UNITIV	**Hatcheries Design and Management**	**(15)**
	Hatchery design and management- criteria for site selection of hatchery- Different types of freshwater fish hatcheries – traditional, Chinese, glass jar and modern controlled hatcheries – Causes of mortalities of eggs and spawn – Spawn rearing techniques – Use of anesthetics in fish breeding and transport – Breeding techniques for Indian Major Carps, Exotic carps, Mahseer, Trout, Tilapia, Catfishes – Seed production of commercially important prawns, shrimp, crabs, lobsters, mussels, clams, edible oysters etc – Cryopreservation of fresh water fish gametes – Hatchery standards and biosecurity-better management practices (BMP's).	

Course Outcome: Student should be able to

1. Understand the types of breeding & freshwater fish seed resources of the world.
2. Understand breeding seasons, gonad & gametes development of cultivable fish.
3. Understand induced breeding of warm & environmental factors affecting spawning and breeding fish.
4. Understand different types of hatcheries & breeding techniques.

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

MZFT303: Brackish Water Aquaculture and Mariculture

Course Objectives: Student will able to

1. Study of brackish water aquaculture.
2. Study shrimp and crab culture.
3. Study of lobster and mussel culture.
4. Study of identification of species used in mariculture.

Credits=4	SEMESTER-III **MZFT303: Brackish Water Aquaculture and Mariculture**	No. of hours per unit/ credits
Credit–1 UNIT I	**Brackish water aquaculture:**	**(15)**
	Present status of brackish water aquaculture, Different farming systems- Raft and rack culture, cage culture, pen culture Principles of pond design– Inland and Coastal Pond forms, Tank and raceway farms, cage farms, pens Types of culture systems: Traditional, extensive, modified extensive, semi-extensive, intensive and super-intensive culture of shrimps and their management and economics Water quality management in Aquaculture, Physico-chemical variables:Salinity,temperature,pH,turbidity,BOD,COD,dissolvedoxygen, nitrates, phosphates, ammonia, sulphates and silicates	
Credit–1 UNIT II	**Design and construction of shrimp culture ponds**	**(15)**
	–Site selection, Infrastructure requirement, Pond preparation, stocking, feed and water quality management, Liming and fertilization, 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. Principles of crab hatchery, brood stock, larval and post-larval management. Packing and transportation of seed - Crab culture: Pond design, management of crab farm. Brood stock management, physiology and techniques of eyestalk ablation. Crab culture and crab fattening process– production of soft-shell crabs, economics, cage culture and pen culture.	

Credit–1 UNIT III	**Seed Production**	**(15)**
	-Principles involved in seed production of lobsters and mussels. Natural resources of shrimp, crab, brackish water fish, oyster and mussel seed, Seed collection practices, farming methods. -Brackish water fish species for culture, management, traditional culture of brackish water fish. Culture of finfish– Sea-bass, milk fish and mullet pearl spot, grouper, cobia, sea breams, rabbit fish etc. culture of shellfish- shrimps, crabs, lobster, clams, oysters, pearl oysters.	
Credit–1 UNIT IV	**Mariculture**	**(15)**
	Present status and scope in India Species identification, -Lobster culture -Mussel culture -Pearl culture -Oyster culture -Sea-weed culture- major seaweed species of commercial importance, methods of culture	

Course Outcomes: Student should able to

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

BOOKS RECOMMENDED

1. Huet, M. (1972)Text book of Fish Culture– Breeding and Cultivation of Fish. Fishing News (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.

MZFT 304 FISH NUTRITION AND FEED TECHNOLOGY

Course Objectives: Student will be able to

1. Study about fish Nutrition.
2. Study the methods of Feed Formulation.
3. Study of different forms of feeds.
4. Study about Storage of feed, Methods of Feeding, Feeding devices etc.

Credits=4	**SEMESTER-III** **MZFT 304 FISH NUTRITION AND FEED TECHNOLOGY**	**No. of hours per unit/ credits**
Credit–I **UNIT I**	**Introduction to Fish Nutrition**	**(15)**
	- Principles of Fish Nutrition and terminologies Nutrients and growth-Proteins and Amino acids-Structure and Composition - Chemical Properties - - Role of nutrients: amino acids, fatty acids, protein, lipid, carbohydrates, Vitamins and minerals. - -Classification - Protein Digestion and Metabolism - Lipids Classification -Structure and composition- Fatty acid structure and classification-Phospholipids-Glycolipids-Waxes–Steroids–Cholesterol-Bileacids -Carbohydrates- Classification- Non Sugars- Sugars-Vitamins, Minerals & Energy-Classification -Laws of thermodynamics -Energy units- Forms of energy-partitioning –Energy metabolism - Nutritional requirements of cultivable fish and shellfish.	

Credit–1 UNIT II	**Methods of Feed Formulation**	**(15)**
	Methods of Feed Formulation-Steps in feed formulation - Linear Programming-Quadratic programming - Feed Manufacturing-Receiving-Processing-Packaging Storage and Distribution -Grinding-Hammer mills-Attrition Mills-Horizontal Mixers-Vertical Mixer-Pelleting-Cooling and Drying- Crumbles-Extruder.	
Credit–1 UNIT III	**Different types of Feeds**	**(15)**
	- Nutritional value of feed ingredients and live feed - - Feeds based on life-cycle offish - Larval feeds - Flakes-Farm-made feeds -Feed additives-Binders - Antioxidants-Enzymes -Pigments Growth promoters -Feed stimulants- Immunostimulants- Non-conventional feed ingredients and anti-nutritional factors - Digestive enzyme, digestibility and factors affecting digestibility- Protein digestion - Fat digestion - Carbohydrate Digestion Factors affecting digestibility. Feed management – Feeding schedules, protein requirements at different ages of finfish and shellfish, feed formulations, wet feeds and dry feed	
Credit–1 UNITIV	**Evaluation of feed**	**(15)**
	-Storage of feed - Methods of Feeding and scheduling- ration size Feeding devices -Demand feeder - Electrically operated automatic feeders - Pneumatic-type automatic feeders- Hydraulic - type automatic feeders-Feeding charts - Feeding devices for wet or moist feeds - feed performance and economics.	

Course Outcomes: Student should be able to

1. Understand fish Nutrition.
2. Understand methods of Feed Formulation.
3. Understand different forms of feeds.
4. Understand 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 Silvaand 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.

MZFP 305
PRACTICAL COURSE–III: LAB–I

Course Objectives: Student will be able to

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

Credits=4	**SEMESTER-III** **MZFP 305: PRACTICAL COURSE– III:LAB -I**	**No. of hours per unit/ Credits (60)**
Credit–I	**Practical based on course–MZFT-301**	
	•Identification of common ornamental fishes •Identification of common ornamental plants •Fabrication of all glass aquariums •Setting up of aquariums •Aquarium accessories and equipment's •Conditioning and packing of ornamental fishes • Feed preparation •Culture of live food organisms	

	•Breeding of livebearers •Breeding of egg layers •Identification of ornamental fish diseases	
Credit–1	**Practical based on course– MZFT 302**	
	• Selection of brooders of carps and catfishes. • Collection and preservation of pituitary glands of freshwater fin fish •Preparation and administration of pituitary gland extract. • Use of synthetic hormone for induced breeding of freshwater finfish. • Care of eggs, spawn and fry. • Detailed study of design and operation of Chinese circular hatchery. Study of seed production technology of Indian carps/catfishes, tilapia.	

Credits=2	**SEMESTER-III** **MZFP 306: PRACTICAL COURSE– III:LAB -II**	**No. of hours per unit/ credits**
Credit–I	**Practical based on course–MZFT-303**	
	• Analysis of water quality parameters::Turbidity, pH, Alkalinity, hardness, Dissolved oxygen (DO), Carbon dioxide (CO_2) etc. • Primary productivity, Estimation by Light and Dark Bottle method • Spotters: Cultivable species of fin fish and shell fish based on the theory • Dissecting out the pituitary gland and preparing the extract • Fitting of surplus production model: Schaeffer model, Fox model.	
Credit–1	**Practical based on paper–MZFT 304**	
	• Proximate composition analysis of feed ingredients and feeds. • Preparation of artificial feeds using locally available feed ingredients. • Determination of sinking rate and stability of feeds. • Effect of storage on feed quality.	

	• Assessment of sanitation in fish processing plants, Indices of freshness and quality of fresh and processed fish. • Sensory evaluation, hedonic scale, physical and chemical methods of assessment of quality of fish and fishery products. • Visit to factory & Study of Hazard analysis Critical Control Point (HACCP)system and its implementation. • Visit to aquaculture farms, fin fish and shell fish hatcheries	

Course Outcome: Student should be able to

1. identify ornamental fish & understand construction of tanks.
2. Understand administration of pituitary gland extract.
3. estimate DO, turbidity, alkalinity primary productivity etc.
4. compose feed ingredients and feeds.

Semester IV

MZFT401– Fish Diseases and Management

Course Objectives: Student will be able to

1. Study significance of fish disease.
2. Study bacterial, cultured finfish and shellfish.
3. Study parasitic diseases.
4. Study principles and methods of vaccine production and fish immunization.

Credits=4	**SEMESTER-IV** **MZFT401– FISH DISEASES AND MANAGEMENT**	**No. of hours per unit/ Credits (60)**
Credit–I UNITI	**Fish Diseases and Aquaculture**	**(15)**
	• Basics of fish and shellfish health management • Significance of fish diseases in relation to aquaculture. • Disease development Process in fish and shellfish. • Environmental stress • Host, pathogen and environment interaction. Pathophysiology of fish diseases. • Systematic pathology of fish and shellfish (Integumentary system, respiratory system, circulatory system, digestive system, excretory system, nervous system, musculoskeletal system, Reproductive system, endocrine system).	
Credit–1 UNIT II	**Infectious diseases**	**(15)**
	• Bacterial, viral and fungal diseases of cultured finfish and shellfish. • OIE listed and notifiable diseases. Principles of disease diagnosis. • Case history and clinical signs in diagnosis. • Conventional and rapid diagnostic techniques. • Microscopical, microbiological, histopathological and biochemical methods. • Antibody and nucleic acid based rapid diagnostics	

Credit–1 UNIT III	**Parasitic diseases**	**(15)**
	• Parasitic diseases of fish and shellfish. • Protozoan and metazoan parasites-Morphology, biology and lifecycle of parasites. • Diagnosis, prevention and treatment • Infectious bacterial and viral diseases: Morphology, biology and life cycle of parasites, Diagnosis, prevention and treatment • Zoonotic diseases, non-infectious diseases (nutritional, genetic, and environmental diseases)	
Credit–1 UNIT IV	**Defense mechanism**	**(15)**
	• Defense mechanism in finfish and shellfish • Specific and non-specific immune system. • Role of stress and host defense mechanism in disease development. • Disease control: Environment management, host management, use of antibiotics and chemicals in health management, Inflammation response to diseases, innate and acquired immunity, • Principles and methods of vaccine production and fish immunization. • Fish vaccines & delivery mechanisms • SPF and SPR stocks-development and its applications, fish health and quarantine system.	

Course Outcomes: Student should be able to

1. Understand the significance of fish disease.
2. Understand bacterial, viral and fungal diseases of cultured finfish and shell fish.
3. categorize parasitic diseases.
4. Understand the methods of vaccine production and fish immunization**.**

Books and References:

1. Austin,B.andD.A.Austin.1987.Bacterialfishpathogens:diseaseoffarmedandwildfish.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. Leatherl and,J.F.,and P. T. K. Woo(editors)1998.Fish diseases and disorders.Volume2:Non-infectiousdisorders.CABIPublishing. NewYork.400 pp.
4. Noga,EdwardJ.2000.Fishdisease:diagnosisandtreatment.IowaStatePress.Ames,Iowa.

5.367 pp.

6. Plumb, JohnA.1999.Health maintenance and principal microbial diseases of cultured fishes. Iowa State Press. Ames, Iowa. 328pp.
7. Roberts,R.J.andC.J.Shepherd1997.Handbookoftroutandsalmondiseases.FishingNewsPres

s. Oxford. 179pp.
8. Roberts,R.J.2001.Fishpathology.London:W.B.Saunders.472pp.
9. Stoskopf,MichaelK.1993.Fishmedicine. SaundersPublishing.902pp.
10. 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.
11. Woo, P. T. K. (editor) 1995. Fish diseases and disorders. Volume 1: Protozoan and Metazoan Infections. CABI Publishing. New York. 768 pp.
12. 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.
13. 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.

MZFT 402– Fish Processing Technology

Course Objectives: Student will be able to

1. Study of fish processing.
2. Study of principles and methods of fish Preservation.
3. Study quality control objectives.
4. Study fish microbes.

Credits=4	**SEMESTER-IV** **MZFT402– Fish Processing Technology**	**No. of hours per unit/ Credits**
Credit–I UNITI	**Fish Processing**	**(15)**
	• Introduction to processing-principle of thermal processing, Mechanism of heat transfer: conduction, Convection, Radiation, • Definition and necessity of processing, causes of fish spoilage. • Handling & transport of fresh fish. • different types of ice, their manufacturing and advantages.	
Credit–1 UNIT II	**Fish preservation-**	**(15)**
	• Fish preservation- • Principles of fish Preservation, • Traditional methods, Artificial dehydration of fish • Vapour compression system, • Refrigerants, Method of freezing, different types of freezers Fish canning. Canning process, additives, canning machinery and equipment, pasteurization, sterilization. Packaging-Types of packaging techniques	

	• Packing materials for frozen & canned fish, Labeling and printing aspect, retort pouch processing of fish and fishery products principle and techniques.	
Credit–1 UNIT III	**Quality Control**	**(15)**
	• Quality Control-Objectives • factors affecting quality of fresh fish: intrinsic and extrinsic factors. • Steps in quality control • HACCP principles and good manufacturing practices (BMP), • Common quality defects, • Microbiological Standard, • ISI standards. • quality assessment of fish and fishery products-physical, chemical, organoleptic and microbiological standards. • Fish Marketing-Concepts of fish marketing, • Types & functions, • Co-operative marketing	
Credit–1 UNIT IV	**Fish Microbiology**	**(15)**
	• Fish Microbiology- • Bacterial cell, Classification of bacteria on the basis of O_2 requirement, temperature tolerance, nutritional requirement & Gram's staining, • Introduction to Salmonella, Shigella, Clostridium, Staphylococcus • Methods of detection: rapid detection and indirect detection methods of pathogens and parasites, water-borne, air-borne and food- borne diseases.	

Course Outcomes: Student should be able to

1. Understand about fish processing.
2. Understand principles and methods of fish preservation.
3. Understands quality control objectives.
4. Understand about fish microbes.

Books and References:

1. S. S. Khanna (2008) Fish and fisheries, Himalaya publication.
2. Holdsworth , D.S. (1987). Physical and engineering aspects of food freezing . In Developments in Food Preservation–4 (Thorne, S., ed.). Elsevier Applied Science, London.
3. Tressler, D. K., VanArsdel, W. B., M. J. and Woolrich, W. R. (1968). The Freezing Preservation of Foods. The Avi Publishing Co. , Westport.

MZFT403: Reservoir fisheries

Course Objectives: Student will be able to

1. Study Leasing policies for fish culture in reservoir.
2. Study reservoirs fish production and their management.
3. Study cage culture and pen culture.
4. Study water quality parameters for reservoirs.

Credits=4	**SEMESTER-IV** **MZFT 403– Reservoir fisheries**	**No. of hours per unit/ Credits**
Credit–I UNITI	**Introduction of Reservoir fisheries**	**(15)**
	Definition of reservoirs in India; Scope, present status and future prospectus of reservoir fisheries. Nature and extent of reservoirs, topography and species diversity; importance of morpho-edaphic index in reservoir productivity and classification; factors influencing fish production; trophic phases in reservoir; pre-impoundment and post impoundment stages and their significance in establishment of reservoirs fisheries. Leasing policies for fish culture in reservoir.	
Credit–1 UNIT II		**(15)**
	Salient features of reservoir limnology and their significance to fisheries development; management of small, medium and large reservoirs; present status and future prospects in Reservoirs fish production. Fisheries of some important reservoirs; recent advances in reservoirs fisheries management; conservation measures in reservoir fisheries. Fish stocking in Reservoirs. Culture based capture fisheries in reservoir.	

Credit–1 UNIT III	Cage culture:	**(15)**
	Cage culture: History of cage culture, advantages of cage culture. Role of cage culture in enhancement of fish production from reservoirs. Selection of suitable site of cage culture. Cage materials, designs, shape, size and fabrication. Cage frames and supporting system. Suitable species for culture in cages. Nursery rearing of fish fry in cages. Grow-out of fishes in Cages. Integration of cage culture with other farming systems. Constraints in cage culture. Economics of cage culture. Field visit to Cage culture unit. Pen Culture: History of pen culture, pen materials, fabrication pen system; Role of pen culture in enhancement of fish production from reservoirs. Suitable species for culture in pens. Rearing of spawn in pen. Grow-out of fishes in pens. Constraints in pen culture. Economics of pen culture. Field visit to Pen fish culture unit.	
Credit–1 UNIT IV	**Primary Productivity of Reservoir**	**(15)**
	Estimation of primary productivity of reservoir. Estimation of Water quality parameters of reservoir: Physio-chemical variables: Temperature, pH, turbidity, dissolved oxygen (DO), Carbon dioxide (CO_2) nitrates, ammonia. Estimation of chlorophyll. Types of nets, boats used in capture operation and number of fishers involved in trade. Field visit to cage culture site to acquaint construction details and operation. Field visit to pen culture site to study construction details and operation. Economics of cage culture. Economics of pen culture.	

Course Outcomes: Student should be able to

1. Understand Leasing policies for fish culture in reservoir.
2. Differentiate the small, medium and large reservoirs and their management.
5. Understand quality control objectives.
6. Design cage material, pen material and fabrication.

Books and References:

1. Jhingran VG. 1991. Fish and Fisheries of India. 3rd Ed. Hindustan Publ.
2. Sugunan VV. 1997. Reservoir Fisheries of India. Daya Publ. House.
3. Blaber JM. 1997. Fish and Fisheries in Tropical Estuaries. Chapman & Hall.
4. De Silva SS. (Ed.). 2001. Reservoir and Culture Based Fisheries: Biology and Management. ACAIR Proceedings

Reference Books:-

5. Jhingran VG & Pathak V. 1987. Ecology and Management of Bheels in Assam: A case study of Dhir Bheel. In: Workshop on Development of Bheel Fisheries in Assam, held at Assam Agricultural University, Guwahati from 21st to 22nd April.
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

MZFT 404 - FISHERIES MARKETING, FINANCE AND EXTENSION EDUCATION IN FISHERIES

Course Objectives: Student will be able to

1. Study marketing strategies in fisheries.
2. Study export and import procedures in fisheries.
3. Study the role of fisheries extension in fisheries development.
4. Study importance of fisheries education in fisheries development.

Credits=4	**SEMESTER-IV** **MZFT 404– FISHERIES MARKETING, FINANCE AND EXTENSION EDUCATION IN FISHERIES**	**No. of hours per unit/ Credits**
Credit–I UNITI	**FISHERIES MARKETING**	**(15)**
	• Definition–Approaches to the study of marketing: product, functional, participant and decision making– • Classification of markets: based on location, time, position of sellers, volume of business transactions and competition– • Market structure: product market, factor market • Marketing functions: exchange, physical supply and facilitating. Objectives and importance of fish marketing – • Marketing channel: Definition–Types of marketing channel for fish and fishery products, • Marketing efficiency– Price spread: Marketing costs.	

Credit–1 UNIT II	**EXPORT MARKET**	**(15)**
	• Export markets: meaning and definition – • Export and import procedures – • Pattern and performance of fishery product export from India • Trade liberalization and fisheries exports • Role of MPEDA (Marine Product Export Development Authority) and EIC in fish and fishery product export development.	
Credit–1 UNIT III	**FISHERIES EXTENSION**	**(15)**
	• Introduction to fisheries extension – concepts, objectives and principles extension education-formal and informal education. • History and role of fisheries extension in fisheries development. • Fisheries extension methods-individual, group and mass contact methods and their effectiveness • Audiovisual aids-definitions, advantages and disadvantages • Classification and choice of audiovisual aids Cone of experiences of experiences and criteria for selection and	

	evaluation of audio visual aids • Videoconferencing-factor influencing their selection and use	
Credit–1 UNIT IV	**FISHERIES EDUCATION**	**(15)**
	• Extension programme planning and evaluation-steps and importance-participatory planning process. • Basic concepts in rural sociology and psychology and the irrelevance in fisheries extension– • Social change-social control– • Social problems and conflicts in fisheries • Gender issues in fisheries • Theories of learning–learning experience–learning situation.	

Course Outcomes: Student should be able to

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

Books and References :

1.Curtis, M J. and Howard, A.C. (1997) Economics of Aquaculture. Food products press, NewYork.
2. Rao,P.S(1983)FisheryeconomicsandmanagementinIndia.Pioneerpublishersanddistributors D/9, Vanshree opposite Diamond Talkies LT road, Borivili (West), Bombay-400092.
3. Mahesh V. Joshi (1996) Economics of fisheries. A.P. II. Publishing corporation, 5-Ansari Road, Darya Ganj, New Delhi.
4. P.N.AroraandP.K.Malhan(2002)Biostatistics,HimalayapublishingHouse.
5. Rama Krishnan, P. (1995) Biostatics, Saras publication A.R.P. camp Road, Periavilai, Kottar,po.Nagercoil, Kanyakumari-Dist. Pin-629 002.

MZFP 405 PRACTICAL COURSE– IV: LAB I

Course Objectives: Student should be able to

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

Credits=4	**SEMESTER-IV** **MZFP 405: PRACTICAL COURSE–IV: LAB I**	No. ofhours perunit/ Credits (60)
Credit–I UNITI	**Practical based on paper–MZFT-401**	
	• Methods of sampling fish and shellfish for disease diagnosis. • Live and postmortem examination of diseased fish. • Collection and identification of parasites. Morphological, biochemical and biological tests of bacteria, virus and fungi. • Immunological and molecular disease diagnostic techniques. • Antibiotic sensitivity assays. Techniques in histology. • Pathological changes in different organ systems associated with different pathogens. • Methods of treatment.	

Credit–1 UNIT II	**Practical based on paper–MZFT-402**	
	• Determination of freshness of fish by organoleptic method. • Handling of fresh fish. • Sanitation of containers. • Method of Icing. • Preservation methods- drying & salting. • Study of refrigeration cycle. • Projects: 1. Visit to landing center. 2. Visit to canning unit. 3. Fish salting.	

Credits=4	**SEMESTER-IV** **MZFP406: PRACTICAL COURSE– IV: LAB -II**	
Credit–I UNITI	**Practical based on paper–MZFT-403**	
	• Preparation of charts on the present situation of reservoirs fisheries Productivity in India and Maharashtra state. Preparedness inpre, during and post disasters. • Detailed case studies of selected reservoirs on the changing trends in capture fisheries profile. • Fish species composition and production details. • Estimation of the Chlorophyll of the reservoir water. • Estimation of the Primary productivity of the reservoir • Types of nets, boats used in capture operation and number of fishers Involved in trade. • Estimation of Water quality parameters of reservoir water • Estimation of Biodiversity of reservoir. • Case studies on cage culture. • Case studies on pen culture. • Field visit to cage culture site to acquaint construction details and operation. • Field visit to pen culture site to study construction details and operation. • Suggestions for the sustainable development of reservoirs fisheries. • Practical Assignment.	

Credit–1 **UNIT II**	**Practical based on paper–MZFT-404**	
	❖ Collection of socio-economic data from fishing villages; study of social Issues/problems through participatory and rapid rural appraisal techniques, stakeholders ❖ Analysis and needs assessment; assessment of development needs of community and role of formal and non – governmental organizations through stakeholder analysis; ❖ Case studies on social/gender issues and social conflicts in fisheries. ❖ Case studies on extension programs and Success stories Practical exercises on conducting fish farmers meet.	

Course Outcomes: Student should be able to

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

References: -

1. Peppler H.J., Pearlman D. (1979) Microbial Technology (2nd Edition), Academic Press
2. Pharmaceutical Microbiology Manual (PMM), (2014) United States Food and Drug Administration (USFDA), ORA.007, Version 1.2,.
3. Manual of Methods of Analysis of Foods–Microbiological Testing–Food, Safety and Standards Authority of India, (2012) Ministry of Health and Family Welfare, Government of India, New Delhi
4. Friesner Richard A. Computational Methods for Protein Folding: advances in Chemical Physics Volume 120 Kindle Edition. Publisher: New York, John Wiley & Sons. 2002. ISBN:0471209554
5. Jhingran VG. 1991. Fish and Fisheries of India. 3rd Ed. Hindustan Publ.
6. Sugunan VV. 1997. Reservoir Fisheries of India. Daya Publ. House.
7. Blaber JM. 1997. Fish and Fisheries in Tropical Estuaries. Chapman & Hall.
8. De Silva SS. (Ed.). 2001. Reservoir and Culture Based Fisheries: Biology and Management. ACAIR Proceedings.
9. Jhingran VG & Pathak V. 1987. Ecology and Management of Bheels in Assam: A case study of Dhir Bheel. In: Workshop on Development of Bheel Fisheries in Assam, held at Assam Agricultural University, Guwahati from 21st to 22nd April.
10. Jhingran VG & Sehgal KL. 1978. Cold Water Fisheries of India. J. Inland. Fish. Soc. India. Sp. Publ.