M.F.Sc. (Aquaculture)

Course Structure – At a Glance

A	**MAJOR COURSES**			**26 Credits**
	A1	**CORE COURSES**		
1.	AQC 501	Fresh water aquaculture and seed production system	2+1	
2.	AQC 502	Costal aquaculture and seed production system	2+1	
3.	AQC 503	Aquaculture Environment Management	2+1	
4.	AQC 504	Aquaculture Engineering	2+1	
5.	AQC 505	Finfish and shellfish physiology	2+1	
	A2	**OPTIONAL COURSES**		
1.	AQC 506	Aquaculture of ornamental fishes	1+1	
2.	AQC 507	Larval nutrition and live feed	1+1	
3.	AQC 508	Integrated fish farming	1+1	
4.	AQC 509	Inland saline aquaculture	1+0	
5.	AQC 510	Aquaculture for sports and recreational fishing	1+0	
6.	AQC 511	Culture based capture fisheries	1+1	
7.	AQC 512	Hydrobiology and Limnology	1+1	
8.	AQC 513	Fish Biology	1+1	
B	**MINOR COURSES-** (Courses outside major discipline / from other relevant disciplines)			**6 Credits**
C	**SUPPORTING COURSES (COMPULSORY)**			**5 Credits**
1.	FST 501	Research Methodology	1+1	
2.	FST 502	Statistical Methods	2+1	
		Total Course Work Credits		**37 Credits**
D	**MASTER'S SEMINAR and Field Training**			**3 Credits**
1.	AQC 591	Master's Seminar	1+0	
2.	Field Training	Field Training / Internship	0+2	
E	**MASTER'S RESEARCH**			**20 Credits**
1.	AQC 599	Masters Research (Semester III)	0+10	
2.	AQC 599	Masters Research (Semester IV)	0+10	
	Total M.F.Sc. Program Credit Hours			**60Credits**

AQC 501 Freshwater Aquaculture And Seed Production System (2+1)

Objective To understand traditional methods and recent advancement in farming and seed production of cultivable fresh water aquaculture species**.**

Theory

Unit I

Status: Global and national, overview of production status of candidate species of aquaculture: carps, catfish, murrels, tilapia, freshwater prawns,natural seed production, constraints; environmental, disease and exotic fish introduction,contamination of gene pools *etc.*

Unit II

Different farming systems: Extensive, semi-intensive, intensive, composite/poly culture, integratedfish farming, raceway culture.

Unit III

Farming practices of cultivable species: Carps, catfish, murrels, tilapia, freshwater prawns and coldwater fishes. Grow out practices: pre-stocking and post-stocking management, harvesting,BMP,improved strain for culture.

Unit IV

Seed production of candidate species: Carps, air breathing fishes, murrels, tilapia, freshwater prawns and cold water fishes. Brood stock management and early maturation through hormonal and feed manipulation, induced breeding, hatchery and nursery management, cryo-banking andsurrogacy in aquaculture, biosecurity, transportation of brood fish and seed, quarantine.

Unit V

Advanced farming practices and value addition, eco labelling, aquaponics, biofloc techniques, RAS and organic farming.

Practical

Identification of cultivable finfishes, their gonadal development, induced breeding methods, identification of fertilized and unfertilized eggs, counting methods, operation of finfish hatchery.Identification of plankton, periphyton, benthos, aquatic insects and weeds.

Drawing and designing of different hatchery systems, visit to finfish and shellfish hatcheriesand fish farms.

Suggested Readings

1. Midlen& Redding TA. 1998. *Environmental Management for Aquaculture*. Chapman &Hall.
2. ICAR. 2006. *Hand Book of Fisheries and Aquaculture*. ICAR.
3. Jhingran VG &Pullin RSV. 1985. *Hatchery Manual for the Common, Chinese and Indian Major Carps*. ICLARM, Philippines.
4. Landau M. 1992. *Introduction to Aquaculture*. John Wiley & Sons.

5. Pillay TVR &Kutty MN. 2005. *Aquaculture- Principles and Practices*. Blackwell.
6. Rath R. K. 2000. *Freshwater Aquaculture*. Scientific Publ.
7. Thomas PC, Rath SC &Mohapatra KD. 2003. *Breeding and Seed Production of Finfish and Shellfish*. Daya Publ.
8. Selvamani BR &Mahadevan RK. 2008. *Aquaculture, Trends and Issues*. Campus Books International.
9. Agarwal SC. 2008. *A Handbook of Fish Farming*. 2nd Ed. Narendra Publ. House.
10. Beveridge MCM & Mc Andrew BJ. 2000. *Tilapias: Biology and Exploitations*. Kluwer.
11. FAO. 2007. *Manual on Freshwater Prawn Farming*. Midlen& Redding TA. 1998. *Environmental Management for Aquaculture*.
12. Kluwer. New MB. 2000. *Freshwater Prawn Farming*. CRC Publ.
13. Pillay TVR. 1990. *Aquaculture: Principles and Practices*. Fishing NewsBooks, Cambrige University Press, Cambridge.
14. Welcomme RL. 2001. Inland Fisheries: Ecology and Management. Fishing News Books.

AQC 502 Coastal Aquaculture and Seed Production System (2+1)

Objective Establishing and managing different fish/shellfish farming systems in coastal waters.

Theory

Unit I

Current status, problems and prospects of coastal aquaculture and seed resources.

Unit II

Broodstock management: availability, collection, transport, captive rearing, maturation. Nutritional requirements of fishes (cobia, grouper, pompano,seabass, milkfish, mullets, pearlspot) and shellfishes (shrimps, crabs, lobsters, mussels and oysters).

Unit III

Hatchery technology and management (cobia, grouper, pompano, seabass,milkfish, mullets, pearlspot, shrimps, crabs, lobsters, mussel & oysters).

Unit IV

Culture practices of selected finfishes and shellfishes: sea bass, cobia, pompano, milkfish, mullets, pearlspot, shrimps, crabs, lobsters, mussels and oysters.

Unit V

Seaweed culture:Major seaweed species, methods of culture, farming of agar, algin, carageenan yielding species, emerging trends in their farming.

Practical

Identification of cultivable marine and brackishwater finfishes and shellfishes.Identificationofcultivable seaweeds, layout and design of fish and shrimp hatcheries and farms, life cycleand larval stages of shrimps, crabs and mussels.

Suggested Readings

1. Bardach EJ, Rhyther JH & Mc Larney WO. 1972. *Aquaculture the Farming and Husbandry of freshwater and Marine Organisms*. John Wiley & Sons.
2. FAO. 2001. *Planning and Management for Sustainable Coastal AquacultureDevelopment*. FAO Publ.
3. Gilbert B. 1990. *Aquaculture*. Vol. II. Ellis Horwood.
4. ICAR. 2006. *Handbook of Fisheries and Aquaculture*. ICAR.
5. Pillay TVR. 1990. *Aquaculture, Principles and Practices*. Fishing News Books.
6. Pillay TVR &Kutty MN. 2005. *Aquaculture: Principles and Practices*. 2nd Ed. Blackwell.
7. Shepherd J &Bromage N. 1990. *Intensive Fish Farming*. B.S.P. Professional Books.

AQC 503 Aquaculture Environment Management (1+1)

Objectives Knowledge on effective soil and water quality management practices.

Theory

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 microorganismsand their role incarbon, nitrogen, phosphorus and sulphur cycles.

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 ofbioactive compounds by microorganisms.

Unit III

Soil and water quality management: Cat clay/pyrite soil, seepage and its control, zero waterexchange system, water filtration devices, aeration, chlorination, ozonization and uv radiation.

Unit IV

Eutrophication, algal bloom control, aquatic weed management, waste water treatmentpractices. Water quality management in culture and hatchery practices, waste dischargestandards. Role of micro-organisms in aquatic animal health and pond management.

Practical

Equipments used in soil and water analysis, soil sampling, determination of particleand bulk density, permeability and hydraulic conductivity, pond filling, analysis of soil pH and texture; measurements of water temperature, pH, conductivity, salinity, transparency, turbidity and solids. Analysis of dissolved oxygen, free carbon dioxide, alkalinity, hardness, phosphorus and nitrogen.Estimation of chlorophyll and primary productivity.Application of inorganic fertilizers and organic manures. Bioassay tests,treatment plant; Design and fabrication of different filters.

SuggestedReadings

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.

AQC 504 Aquaculture Engineering (1+1)

Objectives

1. To acquaint the students with basic principles of aquaculture engineering: site selection criteria for aquaculture farms;topography and survey methods,excavation, types of ponds, shape, size and their orientation from meteorological point, design of embankments, etc.
2. To impart knowledge on aquaculture equipments: surveying and leveling, selection criteria and maintenance of water pumps, aeration machinery, automatic and demand feeders, soil and water samplers, permeametersetc.

Theory

UnitI

Site selection for aquaculture farms:Topography criteria and survey methods, earth work calculationsand estimation of cost of construction; water resources and their suitability (streams, open-water and sub-soil water), quantity and quality assessment, culture requirement, suitability of soil from stabilityand productivity point of view.

Unit II

Area and volume calculations for an aquafarm and water bodies, surveying and leveling (chain, compass and plain table survey, dumpy level and theodolite).

Unit III

Aquafarm design and construction: Types of ponds, shape, size and orientation, design of embankments,pond bottom, pond inlets, outlets, sluice gates, and monks; water supply channels and drainage systems, design considerations for integrated aqua farms.

Unit IV

Design and construction of enclosures, pens, cages, raceways, flow-through systems and re-circulatory aquaculture systems, biofilters, effluent treatment systems.

Unit V

Design and construction of hatchery shed and platform, water supply and drainage systems, aerationgrid, FRP tanks, cement tanks, water filters. Aquaculture equipments: Selection criteria and maintenance of water pumps, aeration machinery, automatic and demand feeders, soil and water samplers.

Unit VI

Methods of soil compaction and seepage control: aquifers, soil permeability, hydraulic conductivity,water budgeting, water harvesting, multiple use of water and aquaponics.

Practical

Visit to aqua farms, contour survey and mapping, chain and compass survey, dumpy leveling, evaluation of performance of seepage control measures, designing of freshwater and brackishwater fin and shellfish hatcheries and farms including their costing and evaluation,

estimation of pump capacity, estimation of construction cost of ponds, hatchery shed, evaluation of capacity for aeration devices.

Suggested Readings

1. Thomas L., 1995. Fundamentals of Aquacultural Engineering, Chapman & Hall.
2. Wheaton F.W., 1977. Aquacultural Engineering. John Wiley & Sons.
3. Ivar L.O., 2007. Aquaculture Engineering. DayaPubl.House.
4. Bimal Chandra Mal, 1995. Soil and Water Conservation Engineering, Kalyani.

AQC 505 Finfish and Shellfish Physiology (1+1)

Objectives

1. To acquaint the students with structure and function of neuroendocrine organs and hormonesassociated with reproduction in fin and shellfishes.
2. To impart knowledge on physiology of reproduction, respiration, nutrition, excretion and osmoregulation *etc.*

Theory

Unit I

Neuroendocrine organs and hormones associated with growth in fin and shellfishes: Physiology of moulting in crustaceans. Hormones concerned with migration in fishes, pheromones and behaviour.

UnitII

Reproduction in fish/shellfish. Hormones associated with reproduction, sex hormones, maturation inducing hormones,manipulation of maturation and spawning in fish. Sex reversal in fish and shellfish.Influence of environmental and biological factors on reproduction and embryogenesis. Effect of nutrition on reproduction.Parental care in fish and shellfish.Cryopreservation of gametes.

Unit III

Sensory organs and receptors, respiratory mechanism and metabolism in fin and shellfish,excretion and osmoregulation.

Unit IV

Environmental stress on culturable fish, crustaceans and molluscs: Adaptation to biotic and abiotic factors, stress ameliorative measures.

Unit V

Food and feeding behavior: Protein, carbohydrate, fat, vitamins and minerals in fish nutrition and their chemistry. Role of digestive enzymes in the digestion.Digestion and assimilation of nutrients,nutritional bio-energetics.

Practical

Dissection and identification of male and female reproductive systems of cultivable fin and shellfish.Maturity staging based on morphology and histology.Determination of gonado somatic index (GSI).Measurement of ova diameter of finfish/shellfish.Estimation of fecundity offinfish and shellfish.Study of sperm structure in fish, crustacean and molluscs.Study of embryonic development.Milt collection, evaluation, cryopreservation and *in vitro* fertilization. Estimation of metabolic rate in relation to environmental factors (Temp., light, salinity). Analysis of enzyme activity (carbohydrase, proteases and lipases).Dissection of endocrine glands in fish and shell fish.Determination of excretion rate.

Suggested Readings

1. Adiyodi KG &Adiyodi RG. 1971. *Endocrine Control of Reproduction in Decapod Crustacea*. Biology Reviews.
2. Agarwal NK. 2008. *Fish Reproduction*. APH Publ.
3. Bell TA & Lightner TA. 1988. *A Handbook of Normal Penaeid Shrimp Histology*. World Aquaculture Society.
4. Ghosh R. 2007. *Fish Genetics and Endocrinology*. Swastik Publ. & Distr.
5. Hoar WS, Randall DJ & Donaldson EM. 1983. *Fish Physiology*. Vol. IX. Academic Press.
6. Maria RJ, Augustine A & Kapoor BG. 2008. *Fish Reproduction*. Science Publ.
7. Matty AJ. 1985. *Fish Endocrinology*. Croom Helm.
8. Mente E. 2003. *Nutrition, Physiology and Metabolism in Crustaceans*. Science Publ.
9. Nikolsky GV. 2008. *The Ecology of Fishes*. Academic Press.
10. Thomas PC, Rath SC &Mohapatra KD. 2003. *Breeding and SeedProduction of Finfish and Shellfish. Daya Publ. House.*

AQC 506 Aquaculture of Ornamental Fishes (1+1)

Objective

To impart knowledge on ornamental fish and aquatic ornamental plants propagation.

Theory

Unit I

Global status of ornamental fish trade, present status and prospects of ornamental fish farming and trade in India, Indian ornamental fish diversity and its status. Marketing strategies,anesthetics, packing and transportation.

Unit II

Aquarium keeping (freshwater & marine): Design & construction of aquariumgarden pool, species compatibility, aquarium maintenance and care.

Unit III

Captive Breeding techniques of commercially important indigenous and marine ornamental fishes.

Unit IV

Common aquarium plants and invertebrates. Gadgets used in freshwater and marine aquarium, role of aerators, filters (UV, trickling and biofiltration), protein skimmers, ozonizer, thermostatic heater, chiller, lighting. Medicines and chemicals used in the ornamental fish industry.

Unit V

Value addition: Colour enhancement through pigmented feed. Prospects of production of new strains / varieties.

Unit VI

Prerequisite for establishment of ornamental fish breeding, culture unit for entrepreneurship development.Socio-economic upliftment of women through backyard ornamental fish farming.

Practical

Identification of common aquarium fishes.Aquarium fabrication, setting and maintenance.

Suggested Readings

1. Axelrod HR &Vorderwinkler W. 1978. *Encyclopaedia of Tropical Fishes*. TFH Publ.
2. Axelrod HR &Sweenen ME. 1992. *The Fascination of Breeding Aquarium Fishes*. TFH.
3. *Handbook of Fisheries and Aquaculture*. 2006. ICAR.
4. Mills D. 1981. *Aquarium Fishes*. Kingfisher Books.
5. Sanford G & Crow R. 1991. *The Manual of Tank Busters*. Salamander Books.
6. Spotte S. 1979. *Fish and Invertebrate Culture*. John Wiley & Sons.

7. Thabrow De WV. 1981. *Popular Aquarium Plants*. Thornbill Press.

AQC 507 Larval Nutrition and Live Feed (1+1)

Objective

To understand the nutritional requirements of finfish and shellfish larvae, mass culture and enrichment of live food organisms.

Theory

Unit I

Nutritional requirements of finfish and shellfish larvae, larval feeds.

Unit II

Nutritional quality of commonly used fish food organisms, bio-enrichment of fish food organisms.Biofilm/periphyton and its use, culture of single cell proteins and their nutritional quality.

Unit III

Formulation and preparation of artificial feeds for larval rearing, microparticulate diets, particulate and microencapsulated diets.

Unit IV

Role of fish food organisms in larval nutrition.Pure culture and mass culture techniquesof important microalgae, rotifers, artemia,infusoria, cladocerans, copepods, oligochaetes, nematode and insects larvae.

Practical

Collection, identification and isolation of live food organisms using various techniques,preparation of various culture media, preparation and maintenance of stock microalgal culture, preparation of artificial feed for rearing finfish and shellfish larvae, mass culture of microalgae, cladocerans, copepods and rotifers, hatching of artemia and enrichment, culture of infusoria, earthworms and chironomid larvae.

SuggestedReadings

1. CIFE. 1993. *Training Manual on Culture of Live Food Organisms for AQUA Hatcheries*. Central Institute of Fisheries Education, Versova, Mumbai.
2. Finn RN & Kapoor BG. 2008. *Fish Larval Physiology*. Science Publ.
3. Hagiwara A, Snell TW, Lubzens E & Tamaru CS. 1997. *Live Food in Aquaculture*. Proceedings of the Live Food and Marine Larviculture Symposium. Kluwer.
4. MPEDA. 1993. *Handbook on Aqua Farming - Live Feed. Micro Algal Culture.* MPEDA Publication.
5. Muthu MS. 1983. *Culture of Live Feed Organisms*. Tech. Paper 14.Summer Institute in Hatchery Production of Prawns Seeds. CMFRI,Cochin.
6. Ojha JS. 2005. *Aquaculture Nutrition and Biochemistry*. Daya Publ.

7. Santhanam R, Ramnathan M &Venkataramanujum. 1997. *A Manual of Methods in Plankton*. Fisheries College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Tuticorin.
8. Sorgeloos P &Pandian KS. 1984. *Culture of Live Food Organisms with Special Reference to Artemia Culture*. CMFRI Spl. Publ. No. 15.
9. Tonapi GT. 1980. *Freshwater Animals of India*. Oxford & IBH.

AQC 508 Integrated Fish Farming (1+1)

Objective

To understand the concept and principles of integrated fish farming with agriculture and livestock.

Theory

Unit I

Integrated fish farming: Basic principles, history and global status, integration with agricultural (paddy), horticultural crops (vegetable & fruits) and livestock (cattle, poultry, ducks, pigs and other terrestrial animals).

Unit II

Effective recycling of wastes.

Unit III

Bioprocessed manures in integration – Vermi-compost, farmyard manure/ compost, biogas slurry *etc.*

Practical

Nutrient value of different manures, working out economics of differentintegrated systems with case studies. Design of various integrated farming models. Visit to integrated farms. Workout inputs of organic load and optimization.

SuggestedReadings

1. Handbook of Fisheries and Aquaculture, ICAR publication. 2011.
2. T. V. R. Pillay, M. N. Kutty, Aquaculture: principles and practices, 2nd ed.

AQC 509 Inland Saline Aquaculture (1+0)

Objective

1. To acquaint the students with hatchery, rearing and culture practices of fish and shellfish in inland saline waters.
2. To impart knowledge on water and soil quality control techniques.

Theory

Unit I

Introduction to inland saline water, surface and ground water.Causes and process of salinization, geo-morphological changes.Problems of salinization, extent and impact on agriculture, potential for aquaculture.

Unit II

Soil and water characteristics.Assessment of inland saline water using GIS, RS, its comparison with coastal waters, ionic amendment, technological and engineering interventions for water quality improvement.

Unit III

Suitable species and areas for culture, production status, possibilities of seed production, constraints and solutions, alternate species with breeding possibilities.

Unit IV

Development of cost effective farming systems: Use of poly houses, aqua lining and recirculatory systems.

Suggested Readings

1. Allan, G.L., Heasman, H. &Bennison, S. 2008. Development of industrial-scale inland saline aquaculture: coordination and communication of research and development in Australia. Final Report to the Fisheries Research and Development Corporation for Project No. 2004/241. NSW Department of Primary Industries – Fisheries Final Report Series No. 99. 245 pp.
2. Allan, G.L., Dignam, A. & Fielder, S. 2001. Developing commercial inland saline aquaculture in Australia: Part 1. Research and development plan. Final Report to Fisheries Research and Development Corporation. Project No. 1998/335.

3. 3.Allan, G.L., Banens, B. & Fielder, S. 2001. Developing Commercial inland saline aquaculture in Australia: Part 2. Resource inventory and assessment. Final Report to Fisheries Research and Development Corporation. Project No. 1998/335. 33 pp.
4. Collins A., Russel B., Walls A. & Hoang T. 2005. Inland prawn farming. Studies into the potential for inland marine prawn farming in Queensland. Queensland Department of Primary Industries and Fisheries. 79 pp.

5. Gavine, F. &Bretherton, M. 2007. Aquaculture in saline groundwater evaporation basins. A Report for the Rural Industries Research and Development Corporation (RIRDC). RIRDC Publication No. 07/114. 40 pp.
6. Fisheries and Aquaculture Journal (ISSN 2150-3508) Open Asses. Omics publishing group (www.omicsonline.org)
7. New technologies in Aquaculture: Improving production efficiency, quality and environmental management. Edited Gavin Burnell and Geoff Allan.
8. Inland saline Aquaculture: Proceedings of a workshop held in Perth, Western Australia, 6-7 August, 1997, Edited by Baryney Smith and Chris Barlone.
9. Recent advances and new species in aquaculture, edited by Ravi Fotedar and Bruce Phillips.
10. Gupta, S.K., and I.C. Gupta (2004). Salt affected soils: Reclamation and management. 316pp.
11. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N., 1979. Saline – Alkali Soils of India. ICAR, New Delhi. 286p.
12. S.K. Garg and B.S. Saharan, 2003. Proceedings of the workshop on Development of Intensive Aquaculture in fresh and saline water in Haryana, India. 209p.
13. Anonymous, 2004. Reclamation and Management of Salt-affected soils. Central Soil Salinity Research Institute, Karnal (India). 160p.

AQC 510 Aquaculture for Sports and Recreational Fishing(1+0)

Objective

1. To acquaint the students with biology, breeding and culture of trouts, snow trout, mahseer*etc*., broodstock development and care, artificial breeding, hatchery management for rainbow trout, brown trout, artificial diets, feeding and table size fish production.
2. To impart knowledge on sport fishes and their life history. Equipments for sports fishing, fishing methods, suitable area for sports fishing *etc*.

Theory

Unit I

Introduction to coldwater fisheries. Biology, breeding and culture of trouts (*Oncorhynchusmykiss, Salmotruttafario, Schizothoraichthysesocinus, S.longipinnis, S.niger, Schizothoraxrichadsonii*),Mahseer (*Tor putitora, Tor tor, Tor khudree),* Common carp *(Cypinuscarpiocummuinis, Cyprinuscarpiospecularis*.

Unit II

Criteria for site selection, construction and management of coldwater fish farms. Effect of exotic fish introduction on indigenous fish fauna.

Unit III

Breeding and hatchery management: Broodstock development and care, artificial breeding, hatchery management for rainbow trout, brown trout, artificial diets, feeding and table size fish production.

Unit IV

Artificial breeding, brood stock care of mahseer and snow trouts, hatchery managementand its operation.Transport of seed and fry of trout, mahseer and snow trouts.Polyculture of exotic carps in mid hill region based on three Chinese carps, post-harvest andharvest issues in trouts with regards to cold water species.

Unit V

Introduction to sports fisheries: Sports fishes and their life history. Equipments for sports fishing, fishing methods, area suitable for sports fishing *etc*.Management and conservation of sports fisheries through aquaculture.Sports fisheries and tourism, recreational aquaculture; creel census.

SuggestedReadings

1. Jhingram, V.G. and Sehgal, K.L., (1978) : Coldwater Fisheries of India. pp. 249. Inland Fisheries Society of India, Barrackpore.
2. Sehgal, K.L. (1987) : Sports Fisheries of India. ICAR, New Delhi, Pub. Pp. 125.
3. Tilak Raj (1982) : Sport Fish and Fisheries in India. Mohan Singh Bishen Singh Publishers, Dehradun, pp. 259.

AQC 511 Culture Based Capture Fisheries (1+1)

Objectives

Utilization of inland waters through culture based capture fisheries.

Theory

Unit I

Overview of global scenario of aquaculture in open waters, open water sources in India, present status, utilization, prospects of production augmentation.

Unit II

Conservation of open water bodies, their utilization for aquaculture techniques to enhance production, seed stocking quality and quantity.Cage and pen culture: cages for sea, estuaries, reservoirs, lakes and canals.

Unit III

Species selection for open water aquaculture (cage and pen farming).Rearing of fingerlings, advanced fingerlings and table size fish in reservoirs.

Unit IV

Ranching in open waters, species quality and quantity, natural feed enhancement, supplmenmary feeding in cages.Stock assessment, harvesting and conflicts with irrigation, drinking water and hydroelectric projects on open water farming.

Practicals

Different types of cage materials, fabrication of cages and pens and their installation.

Suggested Reading

1. Pen culture (Enclosure culture) as an aquaculture system. FAO
2. Review on cage and pen culture - CMFRI
3. Introduction to intensive cage culture of warm water fish. www.ag.auburn.edu
4. Aquaculture Based Fisheries by Kai Lorenzas
5. Better practice approaches for culture based fisheries development in India by Sena de silaetal.
6. Raising fingerlings in pens and cages. Manual, CIFE, Mumbai.

AQC 512 Hydrobiology and Limnology (1+1)

Objective:

To impart knowledge of on physical, chemical and biological properties of Freshwater Ecosystems

Theory

Unit I

Limnology- introduction, Tropical and temperate water bodies, lentic and lotic systems

Unit II

Food webs and trophic levels in relation to ecosystem characteristics, dynamics ofplankton and benthos in lotic and lentic ecosystems, macrophytes and insects

Unit III

Nutrient cycles, status and their budgeting, role of primary productivity in aquaticecosystem

Unit IV

Physical, chemical and thermal stratification, energy flow in aquatic ecosystems andmodels for pond/lake dynamics

Unit V

Eutrophication and aquatic pollution, its management through eco technologies.

Practical

Water and sediment analysis for their physico-chemical and biological properties,qualitative and quantitative estimation of plankton, periphyton and benthos,identification of aquatic weeds and insects, estimation of aquatic primary productivityand tertiary productivity, estimation of biochemical and chemical oxygen demand.

Suggested Readings

1. Limnology by Welch
2. Limnological Methods by Welch
3. Limnology by Wetzel
4. Freshwater Biology by Ward & Whipple
5. Freshwater Biology by Needham and Needham
6. A Treatise on limnology by Hutchinson

AQC 513 Fish Biology (1+1)

Objective

To acquaint the students with taxonomy and anatomy of commercially important finfishes and shellfishes.

Unit I

Taxonomy and anatomy of commercially important fin fishes and shellfishes.

Unit II

Habit and habitat, age and growth of fishes, food and feeding habits.

Unit III

Fecundity, gonadal development, maturity stages and life cycle.

Unit IV

Reproductive biology: Spawning behavior, sexuality, sexual dimorphism and spawning, embryology.

Unit V

Migration of fishes, parental care, bioenergetics.

Practical

Identification and taxonomical classification of teleosts and crustaceans, dissection and study of vital organs, gut content analysis, age and growth study. Study of respiratory system, gonadosomatic index, fecundity, and ova diameter studies, studies of appendages in crustaceans.

Suggested Readings:

1. S.S. Khanna, H.R. Singh, A textbook on Fish Biology and Fisheries.