FISHERIES RESOURCE MANAGEMENT

CODE	COURSE TITLE	CREDITS
FRM 501(FS)*	INLAND FISHERIES RESOURCES	2+1
FRM 502(FS)*	MARINE FISHERIES RESOURCE MANAGEMENT	2+1
FRM 503(FS)*	MARINE ECOSYSTEMS, BIODIVERSITY AND CONSERVATION	2+1
FRM 504(FS)*	TROPICAL FISH STOCK ASSESSMENT	2+1
FRM 505(FS)	FISHERIES REGULATIONS	2+1
FRM 506(FS)	REMOTE SENSING AND GIS FOR FISHERIES MANAGEMENT	1+1
FRM 507(FS)	INTEGRATED COASTAL ZONE MANAGEMENT	2+1
FRM 508(FS)	AQUATIC FLORAL RESOURCES	2+1
FRM 509(FS)	FEEDING AND REPRODUCTIVE BIOLOGY OF FINFISH AND SHELLFISH	2+1
FRM 510(FS)	DEVELOPMENTAL BIOLOGY OF FINFISH AND SHELLFISH	2+1
FRM 511(FS)	FISHING AND ALLIED TECHNOLOGIES	2+1
FRM 512(FS)	MODERN TECHNIQUES IN ICHTHYOTAXONOMY	2+1
FRM 591(FS)	MASTER'S SEMINAR	1+0
FRM 599(FS)	MASTER'S RESEARCH	20
FRM 601(FS)**	ASSESSMENT OF AQUATIC BIODIVERSITY	2+1
FRM 602(FS)**	APPLICATIONS OF FISHERIES MODELS IN STOCK ASSESSMENT	2+1
FRM 603(FS)**	CONSERVATION AND MANAGEMENT OF EXPLOITED FISHERIES RESOURCES	2+1
FRM 604(FS)	CORAL REEF MANAGEMENT	2+1
FRM 605(FS)	DATA COLLECTION AND ESTIMATION OF EXPLOITED FISHERIES RESOURCES	0+2
FRM 606(FS)	FISHERIES ENVIRONMENTAL ASSESSMENT	2+1
FRM 607(FS)	ISSUES IN CAPTURE FISHERIES	1+1
FRM 691(FS)	DOCTORAL SEMINAR I	1+0
FRM 692(FS)	DOCTORAL SEMINAR II	1+0
FRM 699(FS)	DOCTORAL RESEARCH	45

* Compulsory for Master's programme; ** Compulsory for Doctoral programme

Course Contents

FRM 501 INLAND FISHERIES RESOURCES 2+1

Objective

To understand the present exploitation and future potential of inland Fisheries.
To learn the methodologies for assessments of Inland Fisheries Resources.

Theory

UNIT I

Categorization of different freshwater fisheries resources: Ponds, lakes, bheels, tanks, estuaries, brackish water lagoons, wetlands, biosphere reserves and mangroves and derelict water bodies their problems and management aspects.

UNIT II

Bheel fisheries resources of India: Open and closed bheels, productivity conditions, Capture scenario, prospects of culture based systems.

UNIT III

Riverine fisheries resources: Present trend of dwindling fisheries resources, direct and Indirect effects of human intervention in rivers, habitat modification and improvement (rehabilitation of channels and flood plains), protection and restoration of fish movements (different types of fish passes and enhancement of fish migration), management and repair of riverine vegetation, stock enhancement strategies like introduction of new species, pre- and post- stocking management, potential risk of stocking.

UNIT IV

Cold water fisheries of India: Present trends, problems due to habitat destruction, management aspects, prospects of sports fisheries in India.

UNIT V

Reservoir Fisheries: Classification of reservoirs, present productivity levels, management practices.

UNIT VI

Estuarine fisheries: classification of estuaries- present productivity level- potential; Problem – management practices.

UNIT VII

Assessment of carrying capacity of different inland water bodies; Water budgeting. Community participation in fishery resource management.

Practical

Freshwater fish identification – tagging – different types of tags – Visit to nearest freshwater body; catching methods – catch data analysis on major freshwater resource – Estuaries - Reservoirs – Major lakes - of India – Biodiversity indices – Gear selectivity.

Suggested Readings

Blaber JM. 1997. *Fish and Fisheries in Tropical Estuaries*. Chapman & Hall.

FAO. Technical Papers on Freshwater Fisheries.

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.

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

Jhingran VG. 1991. *Fish and Fisheries of India*. 3rd Ed. Hindustan Publ. Sugunan VV. 1997. *Reservoir Fisheries of India*. Daya Publ. House.

FRM 502 MARINE FISHERIES RESOURCE MANAGEMENT 2+1

Objective

To know the present level of exploitation of marine resources and to impart knowledge on conservation measures.
To learn the recent methodologies of sustainable exploitation of renewable resources.

Theory

UNIT I

Major fishing nation of the world, major fishing regions, present trend of marine capture fisheries.

UNIT II

Important finfish and shellfish resources in demersal and pelagic systems;
conservation strategies.

UNIT III

Principles of management of fisheries resources objectives of management, issues and challenges of managing multi-gear fisheries.

UNIT IV

Mud bank fishery- wedge bank fishery-Commonly used tools for input and output regulation.

UNIT V
Sustainability: Principles, social economic ecological biological and legal issues Fisheries co-management.
UNIT VI
Marine Biodiversity of selected areas including coral reef conservation.
UNIT VII
Fisheries and fishing methods in open waters: Inshore fisheries (up to 50 m depth), offshore fisheries (50-200 m depth) High sea fisheries (beyond 200m) up to outer limit of EEZ and in International waters.
UNIT VIII
Conservation aspects: Biodiversity principles, categorization of species into endangered; Indeterminate and extinct varieties- managing the highly exploited fishery resources.
UNIT IX
Case studies of fisheries conflicts depending on problems in different states.

Practical

Marine fishery resources – visit to nearest marine landing center – length frequency analysis – catching method – catch data analysis on marine fishery resources of India– closed season studies – gear selectivity.

Suggested Readings

Bal DV & Rao KV. 1990. *Marine Fishes of India*. 1st Revised Ed. TataMcGraw Hill.
Chandra P. 2007. *Fishery Conservation, Management and Development.* SBS Publ.
Dholakia AD. 2004. *Fisheries and Aquatic Resources of India*. Daya Publ. House.
Kurian CV & Sebastian VO. 1986. *Prawns and Prawn Fisheries of India*. Hindustan Publ. Corp.

Peter BM & Joseph JC. Jr. 2000. *Fishes- An Introduction to Ichthyology*. 4th Ed. Prentice Hall.
Samuel CT. 1968. *Marine Fisheries in India*. Narendra Publ. House. Shanbhogue SL. 2000. *Marine Fisheries of India*. ICAR.

Yadav BN. 1997. *Fish and Fisheries.* 2nd Ed. Daya Publ. House.

FRM 503 MARINE ECOSYSTEMS, BIODIVERSITY AND CONSERVATION 2+1

Objective

To study the biodiversity of flora and fauna and its assessment using the various biodiversity indices for conservation of aquatic resources.
To understand the ecological impacts on various resources.

Theory

UNIT I
Biology of selected endangered species of sponges, corals, gastropods, bivalves, sea cucumbers, fishes, sea snakes, turtles, birds and marine mammals.
UNIT II
IUCN criteria –- Red List, Wild life protection act, International treaties and conventions, Marine Protected Areas, Sanctuaries and Biosphere reserves. Establishment of National marine parks, *in situ* and *ex situ* conservation.
UNIT III
Marine and Coastal Ecosystems – Overview; physico-chemical environment; ecological notions; plankton; benthos, mangroves; sea grasses and corals.
UNIT IV
Human impact on Marine ecosystem, its biodiversity.
UNIT V
Marine biodiversity: threats, planning and management, tools for conservation.

Practical

Identification of scheduled aquatic organisms- Predators of endangered animals. Observation of stranded marine mammals, corals, seafans and other endangered aquatic Organisms, Visit to various aquatic ecosystem for recording the biodiversity and richness indices, Conservation planning.

Suggested Readings

Balakrishnan Nair N & Thampy DM. 1980. *A Text Book of Marine Ecology*. The MacMillan Co.

Castro P & Huber ME. 1997. *Marine Biology*. 2nd Ed. Mc-Graw Hill. Duxbury AC, Duxbury AB & Sverdrup KA. 2000. *An Introduction to the World's Oceans.* 6th Ed. McGraw Hill.

Gross G. 1993. *Oceanography: A View of the Earth.* 6th Ed. Prentice Hall.
Iversen ES. 1996. *Living Marine Resources*. Chapman & Hall.
McCormick JM & Thiruvathaakal JV. 1976. *Elements of Oceanography*.WB Saunders.

Nybakken JW. 1997. *Marine Biology - An Ecological Approach*. 4th Ed.Addison Wesley.
Raymont JEG. 1973. *Plankton and Productivity in the Oceans*. Pergamon Press.

Sverdrup HV, Johnson MW & Fleming RH. 1959. *The Oceans - TheirPhysics, Chemistry and General Biology*. Prentice Hall.

FRM 504 TROPICAL FISH STOCK ASSESSMENT 2+1

Objective

To understand the application of various models to estimate fish population.
To get an idea of the interaction of tropical fish population in the ecosystem.

Theory

UNIT I

Stock concept.

UNIT II

Estimation of growth parameters and mortality rates.

UNIT III

Virtual population methods.

UNIT IV

Gear selectivity. Sampling of commercial catches.

UNIT V

Yield per recruit model.

UNIT VI

Surplus production model. Swept area method - Box model.

UNIT VII

Stock recruitment relationship – Stochastic model – estimation of technical reference point MSY and other yield base reference point.

UNIT VIII

Multispecies, ecosystem and economic and social reference points. Eumetric fishing.

UNIT IX

Ecopath and Ecocism models.

Practical

Data collection and estimation of growth and mortality parameters. Gear selection – Yield per recruit – Analytical and holistic models – growth parameters – Cohort analysis – Jones method. Gill net, trawl selectivity – Swept area method. MSY- Stock recruitment relationship.

Suggested Readings

Beverton RJH & Holt SJ. 2004. *On the Dynamics of Exploited Fish Population*. The Blackburn Press.
Callucci VG, Saila SB, Gustafson DJ & Rothschild BJ. 1996. *Stock Assessment, Quantitative Methods and Applications for Small Scale Fisheries*. Lewis Publ.
Gulland JA. 1977. *Fish Population Dynamics*. John Wiley & Sons.
Gulland JA. 1992. *A Review of Length Based Approaches to Assessing Fish Stocks*. FAO Tech. Paper No. 323, Rome.
Nickolskhi GV. 1980. *Theory of Fish Population Dynamics as the Biological Background for Rational Exploitation and Management of Fishery Resources*. Bishen Singh Mahendra Pal Singh, Dehra Dun.
Ricker WE. 1971. *Methods for the Assessment of Fish Production in Freshwaters*. Blackwell, Oxford & IBH.
Sparre P & Venema SC. 1998. *Introduction to Tropical Fish Stock Assessment*. Part 1 Manual. FAO. Fisheries Tech. Paper No. 301, Rome.

FRM 505 FISHERIES REGULATIONS 2+1

Objective

To understand the importance of enforcement of fisheries regulations and policies.

Theory

UNIT I

Fisheries regulatory and developmental setup in Centre and States and their spheres of responsibility; need for fisheries management; regulatory, legal and enforcement regimes.

UNIT II

Monitoring, Control and Surveillance (MCS) systems for capture fisheries: definition; components; role in fisheries management; design considerations; operational procedures such as data collection, fisheries patrols, boarding, inspection procedures, verification of catches, verification of position, transshipment, Port State control and FAO "flagging arrangement", and fisheries prosecutions.

UNIT III

Regulatory and developmental issues concerning deep sea fishing – Guidelines for operation.

UNIT IV

Indian deep sea fishing vessels in Indian EEZ. Maritimes Zones of India Act 1981 (Regulation of fishing by

Foreign vessels). Draft Marine Fisheries Policy.

UNIT V

Marine fisheries legislations in various States of India; Land Reforms Act; Coastal Aquaculture legislations, (Environmental Protection Act, Biodiversity Act, Aquaculture Authority Act) regulations concerning discharge of effluents in water bodies.

UNIT VI

International Law of the Sea: Historical perspectives; international negotiations and settlements over open seas; conflict management; shared stocks.

UNIT VII

Code of Conduct for Responsible Fishing.

UNIT VIII

Management needs associated with aquaculture development; Coastal Regulation Zone (CRZ) in the context of aquaculture. Sustainability, Integrated Coastal Zone Management and ecosystem management.

UNIT IX

Inland Fisheries Regulation and Development: Inland fisheries governance, Inland Fisheries Act, Inland property regime, leasing policies for waterbodies. Issues of property rights in Inland water bodies.

UNIT X

National Water Policy; water needs for agriculture, industry, potability and fisheries, fishing rights in open waters; and role of fisheries cooperatives, aqua/ecotourism. Concepts and implication of Interlinking of rivers on fisheries and biodiversity.

Practical

Given a real life or imaginary set of MCS situation data for a specific area, to formulate a management plan (with the help of prevailing legislation) with the following objectives : (1) Resource (2) Environment (3) Biodiversity (4) Technology (5) Society (6) Economics and (7) Conflicts; compilation of these into an overall management plan. Visit to appropriate Government/NGO and preparation of working report. Mesh size studies for trawl, gillnets and purse seine. Comparative studies on the Fisheries Acts of any two states of India and preparation of a report.

Suggested Readings

Anon. 1998. *Maritime Law of India in the International Context*. Bhadarkar Publ.

Brahtz JFP. 1972. *Coastal Zone Management*. U.N. International Economic and Social Affairs, New York.

Churchill RR & Lowe AV. 1988. *Law of the Sea*. Manchester University Press.

Henkin L, Pugh RC & Smit H. 1993. *International Law: Cases and Materials*. West Publ. Co.

Sinha RK. (Ed.). 1996. *Marine Resources and Applicable Laws* (World Environmental Series - 009). Commonwealth Publ.

Verghese CP. 1989. *Fishing Regulation in India's Territorial Waters*. World Fishing.

FRM 506 REMOTE SENSING AND GIS FOR FISHERIES MANAGEMENT 1+1

Objective

To know the satellite information and its application in fisheries resource management.

Theory

UNIT I

Basic terms and concepts; Electromagnetic radiation and its properties, atmospheric interactions, target interactions.

UNIT II

Sensor platforms – boats, balloons, air-crafts and satellites, Sensor systems– global acquisition systems and sequential acquisition systems.

UNIT III

Environmental satellites – The Landsat series, NOAA and IRS; Digital image processing and interpretation.

UNIT IV

Elements of GIS, Application of remote sensing and GIS to fisheries and aquaculture planning and development.

Practical

Study of satellite information, interpretation of satellite pictures for resource management, case studies on remote sensing and GIS applications.

Suggested Readings

Decker D. 2000. *GIS Data Sources*. Riley & Sons.

Jeff Thurston Thomas K Poiker & J Patrick Moore. 2000. *Integrated Geospatial Technology - A Guide to GPS, GIS and Data Logging*. John Wiley & Sons.

Kraak MJ & Ferjan O. 2003. *Cartography, Visualization of Spatial Data*. Prentice Hall.

Meaden GJ & Kaptesky JM. 1991. *Geographical Information Systems and Remote Sensing in Inland Fisheries*

and Aquaculture. FAO Fisheries Tech. Paper No. 318, Rome.
Patel AN & Singh S. 1992. *Remote Sensing – Principles and Applications*. Scientific Publ.
Valavanis VD. 2002. *GIS System in Oceanography and Fisheries*. Taylor & Francis.

FRM 507 INTEGRATED COASTAL ZONE MANAGEMENT 2+1

Objective

To impart knowledge on the coastal resources, integrated coastal zone management strategies and disaster management.

Theory

UNIT I

Coastal resources: Coastal natural resources systems: flora and fauna, trophic relationship, nutrient production, cycle and transport; Mangrove ecosystem - species diversity and distribution of mangroves in India, Other inter-tidal system- Seagrass system, Coral reef system, Sandy beach system, Lagoon and estuary system.

UNIT II

Developmental activities and biodiversity loss: Ecological issues, Non- sustainable development, Pollution, threats to biodiversity, habitat destruction, Depletion of fisheries resources, impacts of global environment changes, Multiple uses of the Coastal Zone, Urban settlement, Industrial development, waste disposal, Shore protection works, ports and marine transportation. Land transportation infrastructure, Water control and supply projects, sea fisheries, Aquaculture, Coastal forest industries, Coastal agriculture, industries.

UNIT III

Coastal Zone Management: Integrated Coastal Zone Management (ICZM): its need and benefits, Principles, Goals and objectives of the ICZM programme; Scope, Extent of jurisdiction, Boundaries of the coastal zone, policies and planning for coastal resource management; Management mechanisms- Pollution control, Protected areas (sanctuaries, marine parks and biosphere reserves), Protection from natural hazards; Socioeconomic impacts and its assessment, Disaster management for coastal environment.

UNIT IV

Coastal tourism: Beach resorts, restaurants and parks within the coastal zone as per existing rules and regulations. Impact of pollution on coastal resources.

Practical

Analysis of soil and water characteristics of coastal areas where man made impacts have established; Assessment of damages of water quality; Collection, preservation and identification of coastal biological communities; Survey of different coastal zones; Visit to the protected areas.

Suggested Readings

Brahtz JFP. 1972. *Coastal Zone Management*. U. N. Department of International Economic and Social Affairs, New York.
Cairns J Jr. 1994. *Implementing Integrated Environmental Management*. Virginia Tech. University.
Clark JR. 1992. *Integrated Management of Coastal Zones*. FAO Fisheries Tech. Paper No. 327, Rome.
Coastal Area Management and Development. 1982 U. N. Department of International Economic and Social Affairs, New York.
David S & Jeremy P. 2001. *Inshore Fisheries Management. Methods and Technologies in Fish Biology and Fisheries*. Vol. II. Kluwer.
Khanna BK. 2000. *All You Wanted to Know About Disasters*. New India Publ. Agency.

FRM 508 AQUATIC FLORAL RESOURCES 2+1

Objective

To gain in-depth knowledge on the categorization, utilization, conservation and management of aquatic floral resources.

Theory

UNIT I

Taxonomy and phenology of freshwater microphytes and macrophytes;
their importance in resource management.

UNIT II

Brackishwater flora – micro and macrophytes; their taxonomy, phenology and ecological importance and conservation practices.

UNIT III

Marine algal resources; Taxonomy, biodiversity, life history, ecological and economical importance and conservation techniques.

UNIT IV

Seagrass resources; Taxonomy, biodiversity, life history, ecological and economical importance and conservation techniques.

UNIT V

Commercially important aquatic floral resources.- Agar-algin- phytocolloids- food grade algal resource- other uses like pollution treatment, fodder, fertilizer production, etc.

Practical

Collection and identification of freshwater and brackishwater plants and seaweeds. Phenological observations of aquatic flora, seaweed resources and preparation of charts – Herbaria preparation.

Suggested Readings

Chapman VJ & Chapmen DJ. 1980. *Seaweeds and Their Uses*. Chapman & Hall.
Chapman VJ. 1976. *Mangrove Vegetation*. J. Cramer.
Chaudhuri AB. 2007. *Biodiversity of Mangroves*. Daya Publ. House.
Firth FE. 1971. *The Encyclopedia of Marine Resources*. Von Nostrand Reinholt.
Iversen ES. 1996. *Living Marine Resources*. Chapman & Hall.
Petr T. 2000. *Interactions Between Fish and Aquatic Macrophytes in Inland Waters- A Review*. FAO Fisheries Tech. Paper No. 396, Rome.
Richmond A. (Ed.). 2004. *Handbook of Microalgal Culture*. Blackwell.
Sundaralingam VS. 1990. *Marine Algae (Morphology, Reproduction and Biology).* Bishen Singh Mahendra Pal Singh, Dehra Dun.

FRM 509 FEEDING AND REPRODUCTIVE BIOLOGY OF FINFISH AND SHELLFISH 2+1

Objective

To study the role of feeding and reproductive biology in the context of fisheries resources.
To learn the application of biological inferences for the management of finfish and shellfish resources.

Theory

UNIT I

Food of different types of fin and shell fishes.

UNIT II

Feeding types- filter feeders, carnivores, omnivores and their trophic levels. Ontogenic changes in feeding- Forage theory- Mismatch hypothesis of Cushing.

UNIT III

Morphological and anatomical adaptation for feeding; feeding behavior of wild and cultured species.

UNIT IV

Techniques in the analysis of gut contents and indices, digestion rates, food consumption rates etc.

UNIT V

Mode of reproductions: sexual , Asexual, hermaphroditism, protoandric, protogynic,.

UNIT VI

Reproductive cycles - Semalparity and iteroparity-maturation and spawning periodicity and maturity stages.

UNIT VII

Factors influencing reproduction-Biotic and abiotic.

UNIT VIII

Migration- various types of spawning migration.

UNIT IX

Assessment of mean trophic level and prey - predator relationship.

Practical

Morphological and anatomical features of fin fishes and shellfishes with different feeding habits. Analysis of gut contents. Use of indices in feeding, digestion and food consumption rates of fishes. Identification of spawning season, maturity stages, estimation of gonadosomatic index and intraovarian periodicity.

Suggested Readings

Adiyodi KG & Adiyodi RG. 2000. *Reproductive Biology of Invertebrates*: Vol. X. Part B. *Progress in Developmental Endocrinology*. John Wiley & Sons.
Agarwal NK. 1996. *Fish Reproduction*. APH Publ. Corp.
Barrington EJW. 1981. *Invertebrate Structure and Function*. 2nd Ed. The English Language Book Society & Nelson.
Bone Q, Marshall NB & Blaxter JHS. 1995. *Biology of Fishes*. 2nd Ed. Blackie.
Carl EB. 1979. *Biology of Fishes*. 2nd Ed. John Wiley & Sons.
Hoar WS & Randall DJ. (Ed.) 1969. *Fish Physiology*. Vol. III. Academic Press.
Jobling M. 1995. *Environmental Biology of Fishes*. Chapman & Hall.
Khanna SS. 1993. *An Introduction to Fishes*. Central Book Depot.
Maria JR, Augustine A &. Kapoor BG. 2006. *Fish Reproduction*. Science Publ.
Nikolsky GV. 1983. *Fisheries Biology*. Academic Press.
Saxena AB. 1996. *Life of Crustaceans*. Recent Advance in Entomology Series-10. Anmol Publ.
Venkataramanujam K & Ramanathan N. 1994. *Manual of Finfish Biology*. Oxford & IBH.

FRM 510 DEVELOPMENTAL BIOLOGY OF FINFISH AND SHELLFISH 2+1

Objective

To impart knowledge on the collection and identification of eggs and larvae of commercially important finfish and shellfish.

Theory

UNIT I

Identification of eggs and larvae of commercially important finfishes, crustaceans, molluscs and echinoderms.

UNIT II

Quantitative samplings of fish eggs and larvae; spatial and temporal distribution, dispersion of eggs and larvae in food webs, effect of environmental parameters on eggs and larvae.

UNIT III

Natural food of shellfish and finfish larvae from egg to adult (commercially important shellfishes and finfishes).

Practical

Identification of commercially important species of crustacean, molluscan eggs and larvae, spat. Morphometry of eggs and larvae of finfishes, identification keys. Quantitative sampling- shellfish and finfish larvae; food and feeding habits of larval stages of shell and finfishes.

Suggested Readings

Barrington EJW. 1981. *Invertebrate Structure and Function*. 2nd Ed. The English Language Book Society & Nelson.

Diwan AP & Dhakad NK. 2004. *Embryology of Fishes.* Recent Advances in Embryology Series-1. Anmol Publ.

Ede DA. 1978. *An Introduction to Developmental Biology*. Blackie.

Hoar WS & Randall J. (Ed.). 1988. *Fish Physiology*. Vol XI. *The Physiology of Developing Fish*. Part B. *Viviparity and Post hatching Juveniles*. Academic Press.

Jobling M. 1995. *Environmental Biology of Fishes*. Chapman & Hall.

Khan SA, Raffi SM & Lyla PS. 2003. *Larvae of Decapod Crustaceans*. Centre of Advanced Study in Marine Biology, Parangipettai, Tamil Nadu.

Silas EG. 1983. *Development of Penaeid Prawns*. CMFRI Bull. No. 28.

FRM 511 FISHING AND ALLIED TECHNOLOGIES 2+1

Objective

To gain knowledge on the design, fabrication and operation of fishing gear and operation of fish finding equipments.

Theory

UNIT I

Design, fabrication and operation of various fishing gears: trawls (pelagic and bottom), purse seine, gillnets, trammel nets, dol nets, FADs (Floating and bottom – artificial reefs), traps and lines.

UNIT II

Harvesting methods in inland water bodies and their improvisation: Gillnets, cast nets, lines, dragnets, bag nets etc.

UNIT III

Destructive and prohibited fishing practices.

UNIT IV

By-catch reduction devices: Definition of bycatch, types of bycatch reduction devices and the principles of operation.

UNIT V

Turtle Excluder Devices: Definition, types of TEDs – soft and hard types, materials used for their construction and maintenance.

UNIT VI

Acoustics: Acoustic surveys for fishing, acoustic aids in fishing and acoustic measurements.

UNIT VII

Safety at sea: Safety devices – Accidents associated with marine environment, boat design and navigation, mitigation measures.

UNIT VIII

GMDSS and other safety devices. Advanced communication Systems – VHF, SSB, INMARSAT System.

UNIT IX

Vessel Monitoring Systems (VMS): Importance, uses, role in fisheries management.

UNIT X

Satellite navigation system: GPS – Components of GPS, working, functions, hand held GPS,

important applications of GPS in fisheries and aquaculture.

UNIT XI

Fishing harbours: Classification, facilities, layout of a typical fishing harbour, stages in the planning of fishing harbours.

UNIT XII

Code of Conduct for Responsible Fishing (CCRF): Articles of CCRF, Elaboration of Article 8: Fishing Operations.

Practical

Drawing and reading gear designs - Field visits to fishing harbour and preparation of drawing of its lay out - Training onboard fishing vessels in fishing techniques, familiarization with navigation and communication equipments -Study of layout and operation of a fish landing centre; Study of fish aggregating devices - Familiarization with various safety devices.

Suggested Readings

Duncan A. 1980. *A Fisherman's Guide to Ecosounding and Sonar Equipment. Acoustic Fish Detection Instruments*. University of Rhode Island. Marine Bull. 41.

FAO. 1972. *Catalogue of Fishing Gear Designs*. Fishing News Books. FAO. 1980. *Definition and Classification of Fishery Vessel Types*. FAO

Fisheries Tech. Paper No. 267, Rome.

John S. 1996. *Commercial Fishing Methods - An Introduction to Vessels and Gear*. Fishing News Books.

Nirgess K. 1966. *Fishing Boats and Equipments*. Fishing News Books. Sreekrishna Y & Shenoy L. 2001. *Fishing Gears and Craft Technology*.

ICAR.

Traung JO. 1955. *Fishing Boats of the World*. 1. Fishing News Books. Traung JO. 1960. *Fishing Boats of the World*. 2. Fishing News Books. Traung JO. 1967. *Fishing Boats of the World*. 3. Fishing News Books. Tucker DG. 1967. *Sonar in Fisheries - a Forward Look.* Fishing News

Books.

FRM 512 MODERN TECHNIQUES IN ICHTHYOTAXONOMY 2+1

Objective

To enable the students in differentiating genera/ species up to stock level using classical, molecular and computer based techniques.

Theory

UNIT I

Identification of stocks based on classical and modern taxonomical methods.

UNIT II

Classical taxonomy – morphometrics – meristics.

UNIT III

Modern taxonomical tools – Electrophoretic studies (muscle myogen, eyelens protein, enzyme pattern and serology), Karyotyping.

UNIT IV

Molecular markers – PCR, RAPD, RFLP, Microsatellites, mini satellites and Mitochondrial DNA, and their application in fish phylogenetic studies.

Practical

PAGE – Muscle myogen, eyelens proteins, enzymes of different species of finfishes; fish chromosomes preparation and identification DNA Isolation and quantification, PCR techniques Statistical software used in fish molecular studies.

Suggested Readings

Cooksey K. 1997. *Molecular Approaches to the Study of the Oceans*. Chapman & Hall.

FAO. 2000. *DNA Based Molecular Diagnostic Techniques*.

Kocher TD & Carol AS. (Ed.). 1997. *Molecular Systematics of Fishes*. Academic Press.

Le Gal Y & Halvorson HO. 1998. *New Development in Marine Biotechnology*. Plenum Press.

Mayer E. 1977. *Principle of Systematic Zoology*. Tata McGraw Hill. Ponniah AG & George J. 1998. *Fish Chromosome Atlas*. National Bureau of Fish Genetic Resources (NBFGR), Lucknow.

Whitmore DH. 1990. *Electrophoretic and Isoelectric Focusing Techniques in Fisheries Management*. CRC Press.

FRM 601 ASSESSMENT OF AQUATIC BIODIVERSITY 2+1

Objective

To impart in-depth knowledge on aquatic biodiversity, its assessment and conservation methods.

To understand the ecological impact of various aquatic resources.

Theory

UNIT I

Definitions and measurement: Methods, scales and indices of biodiversity assessment.

UNIT II

Biodiversity (microalgae to aquatic vertebrates) of any three of the following or similar ecosystem: Chilka Lake, Narmada river system, Gangetic system, Jaykwadi reservoir, Himalayan lake, Himalayan river, Hooghly Maltah estuarine system, Coramandondal coast, Gulf of Mannar, Gulf of Kutch, Malabar upwelling, Bhitarkanika.

UNIT III

Threats to biodiversity: Overexploitation, land reclamation, pollution, habitation, conversion of agricultural land and aquacultural farms (case studies pertaining to any sensitive marine/estuarine/freshwater hot spots).

UNIT IV

Conservation and Restoration: Declaration of mangrove sanctuaries and mangrove afforestation, marine protected areas, Ganga Action Plan, introduction of exotic species and their implications; potential consequences and conflicts of linking rivers.

UNIT V

Impacts of anthropogenic intervention on aquatic biodiversity: Damming of rivers, construction of sea walls, micro hydel power stations, oil rigs.

UNIT VI

Legal regimes of biodiversity: International and national conventions and Acts for biodiversity.

UNIT VII

Institutionalization of biodiversity conservation (Such as creation of Biodiversity Boards/Authority.

Practical

Preparation of records and inventories of biodiversity of any three critically important ecosystem based on secondary data and field visits- Compilation of all important International and National laws and conventions related to biodiversity

Suggested Readings

Brian G. 1992. Global Biodiversity - Status of the Earth's Living Resources. Chapman & Hall.

Denton TE. 1973. *Fish Chromosome Methodology*. Charles Thomas Publ.

Elliott AN. (Ed.). 1993. *Global Marine Biological Diversity*. Inland Press.

Gunderson DR. 1993. *Surveys of Fisheries Resources*. John Wiley & Sons.

Khanna DR, Chopra AK & Prasad G. 2005. *Aquatic Biodiversity in India*. Daya Publ. House.

Kumar U & Asija M. J. 2000. *Biodiversity Principles and Conservation*. Agrobios.

Lakra WS, Abidi R, Singh AK, Sood N, Rathore G & Swaminathan TR. 2000. *Fish Introductions and Quarantine: Indian Perspective*. National Bureau of Fish Genetic Resources (NBFGR), Lucknow.

Lambshead PJD, Paterson GLJ & Gage JD. 1997. *Biodiversity Professional*. Version 2. National History Museum and the Scottish Association of Marine Science.

Magurran AE. 1988. *Ecological Diversity and its Measurement*. Taylor & Francis.

Mahanta PC & Tyagi LK. 2003. *Participatory Approach for Fish Biodiversity Conservation in North East India*. National Bureau of Fish Genetic Resources (NBFGR), Lucknow.

Ponniah AG & Gopalakrishnan A. (Eds.). 2000. *Endemic Fish Diversity of Western Ghats*. National Bureau of Fish Genetic Resources (NBFGR), Lucknow.

Zoological Survey of India. 2007. *National Symposium on Conservation and Valuation of Marine Biodiversity*.

FRM 602 APPLICATIONS OF FISHERIES MODELS IN STOCK ASSESSMENT 2+1

Objective

To study the application of various dynamics and holistic models used in fish stock assessment.

Theory

UNIT I

History and development of analytical models; Analytical models; its history and development.

UNIT II

Application of Beverton and Holt's, Thompson and Bell models in trophics.

UNIT III

Logistic models of Schaefer and Fox.

UNIT IV

Prey predator models. Stock recruitment models of Ricker, Beverton and Holt.

UNIT V

Bioeconomic modeling.

UNIT VI

Ecopath and ecosim models.

Practical

Application of logistic and analytical models in marine, riverine and estuarine systems. Ecopath modeling based on secondary data.

Suggested Readings

Beverton RJH & Holt SJ. 2004. *On the Dynamics of Exploited Fish Population*. The Blackburn Press.

Edwards EF & Megrey BA. 1989. *Mathematical Analysis of Fish Stock Dynamics*. American Fisheries Society, Maryland.

Gulland JA. (Ed.). 1977. *Fish Population Dynamics*. John Wiley & Sons. Nickolskhi GV. 1980. *Theory of Fish Population Dynamics as the Biological Background for Rational Exploitation and Management of Fishery Resources*. Bishen Singh Mahendra Pal Singh, Dehra Dun.

Ray H & Carl JW. 1992. *Quantitative Fisheries Stock Assessment Choice, Dynamics and Uncertainty*. Kulwer.

Ricker WE. 1971. *Methods for the Assessment of Fish Production in Freshwaters*. Blackwell, Oxford & IBH.

FRM 603 CONSERVATION AND MANAGEMENT OF EXPLOITED FISHERIES RESOUCES 2+1

Objective

To apprise the students on the various conservation and management strategies of exploited fisheries resources.

Theory

UNIT I

Marine parks, marine protected areas, biosphere reserves, closed seasons.

UNIT II

Cryopreservation of exploited and endangered species.

UNIT III

Fishing regulation policies - A critique on the draft Indian Fisheries policy. A critical appraisal of Inland Fisheries Legislation of any two states of India.

UNIT IV

Protection of habitat of corals, mangrove, seaweeds, sea grass beds. Implementation of square cod end mesh – to reduce by-catch.

UNIT V

Legal proceedings / implementation for protection of exploited and endangered fishery resources.

UNIT VI

Total allowable catch, regulation of mesh size for conservation of exploited fishery resources.

UNIT VII

Management of major reservoirs of India; optimal stocking and production of cultivable resources.

UNIT VIII

A comparative study of the marine regulation acts of any two neighboring countries with reference to Environmental Protection Act (EPA).

UNIT IX

Compile the rules relating to marine fisheries exploitation included in the final UNCLOS III treaty.

Practical

Based on the existing policy, suggest and draft ideal inland and marine fishery legislation for any one Indian State. With reference to the laws of the sea (UNCLOS III) treaty, recommend ways and means to solve dispute of shared stocks. Develop a framework for conflict resolution of traditional and mechanized fisheries.

Suggested Readings

Mahanta PC & Tyagi LK. 2003. *Participatory Approach for Fish Biodiversity Conservation in North East Inidia*. National Bureau of Fish Genetic Resources (NBFGR), Lucknow.

Menon AGK. 2004. *Threatened Fishes of India and their Conservation*. Fishries Survey of India.

Michael RR. 1997. *Fisheries Conservation and Management*. Prentice Hall.

Pascoe S. 2005. *Bycatch Management and the Economics of Discarding*. Daya Publ. House.

Thorpe JE, Talbot C & Miles MS. (Ed.) 1995. *Conservation of Fish and Shell Fish Resource; Managing Diverisity*. Academic Press.

FRM 604 CORAL REEF MANAGEMENT 2+1

Objective

To learn identification and classification of different corals and their habitats.

To impart knowledge on the conservation and management of coral resources.

Theory

UNIT I

Origin of coral reefs – coral reefs of the world.

UNIT II
Type of coral reefs and their distribution.
UNIT III
Ecology of coral reefs; factors influencing growth; productivity of coral reefs; plants and animals associates of living reef corals and fringing reefs.
UNIT IV
Nutrition, production, larval dispersal and settlement of corals.
UNIT V
Soft coral type and their ecology.
UNIT VI
Bioactive substances of soft and hard corals, sedimentation in coral reef environment.
UNIT VII
Economic importance of coral reefs.
UNIT VIII
Management and conservation of coral reefs and soft corals.

Practical

Collection and identification of soft and hard corals; Survey of corals and mapping; identification of associated organisms; preparation of checklist and associated organisms of Indian coast. Predatory animals of corals, Extraction of bioactive substances from soft and hard corals. Observations of destructive methods of corals and coral reef fishes.

Suggested Readings

Bakus GJ. 1994. *Coral Reef Ecosystem*. Oxford & IBH.
Bayer FM, Manfred G & Jakob V. 1983. *Illustrated Trilingual Glossary of Morphological and Anatomical Terms Applied to Octocorallia*. Leiden.
Biswas KP. 2008. *Corals of Tropical Oceans*. Daya Publ. House.
James PSBR. 1986. *Recent Advances in Marine Biology*. Today & Tomorrow.
Peter S. (Ed.).2006. *Coral Reef Fishes: Dynamics and Diversity in a Complex Ecosystem*. Academic Press.
Polunin NVC & Roberts CM. 1996. *Reef Fisheries*. Chapman & Hall. Rogers CS. 1994. *Coral Reef Monitoring Manual for the Caribbean and Western Atlantic*. National Park Service, Virgin Islands.
Rosenberg E & Loya Y. (Eds.). 2004. *Coral Health and Disease*. Springer. Talbot F & Wilkinson C. 2001. *Coral Reefs, Management and Seagrasses. A Source Book for Managers*. Australian Institute of Marine Suck Australia.

FRM 605 DATA COLLECTION AND ESTIMATION OF EXPLOITED FISHERIES RESOURCES 0+2

Objective

To learn in detail the sampling designs and estimation of catch and effort data.

Practical

Collection of fishery data at landing centres from different gears separately. Details of craft and gear of landing centres. Recording of data in the entry
forms. Definition of length for various groups of fish/crustaceans/molluscs.
Collection of length frequency data of fishes at landing centres. Estimation of age and growth based frequency data.
Growth, mortality, population and stock parameters employing FiSAT, Length structured VPA, Thompson and Bell yield stock prediction for single and multifleet version. Beverton and Holt yield-per-recruit model; biomass-per-recruit. Relative yield-per-recruit model and yield isopleth diagram.

Suggested Readings

Beverton RJH & Holt SJ. 2004. *On the Dynamics of Exploited Fish Population*. The Blackburn Press.
Callucci VG, Saila SB, Gustafson DJ & Rothschild BJ. 1996. *Stock Assessment. Quantitative Methods and Applications for Small Scale Fisheries*. Lewis Publ.
Gulland JA. 1977. *Fish Population Dynamics*. John Wiley & Sons.
Gulland JA. 1992. *A Review of Length Based Approaches to Assessing Fish Stocks*. FAO Tech. Paper. 323.
Nickolskhi GV. 1980. *Theory of Fish Population Dynamics as the Biological Background for Rational Exploitation and Management of Fishery Resources*. Bishen Singh Mahendra Pal Singh, Dehra Dun.
Ricker WE. 1971. *Methods for the Assessment of Fish Production in Freshwaters*. Blackwell, Oxford & IBH.
Sparre P & Venema SC. 1998. *Introduction to Tropical Fish Stock Assessment*. Part 1 *Manual.* FAO Fisheries Tech. Paper No. 301, Rome.

FRM 606 FISHERIES ENVIRONMENTAL ASSESSMENT 2+1

Objective

To know the probable impacts of environmental factors on fishery resources and gain knowledge on the standard methods applicable in fisheries environmental assessment.

Theory

UNIT I

Critically important climatic factors (temperature, rainfall and wind pattern/ monsoon influencing aquatic (inland and marine) productivity and production.

UNIT II

Remotely sensed SST, Chlorophyll and Wind pattern features of Indian seas used in locating Potential Fish Zones (PFZ).

UNIT III

Influence of rainfall intensity, its seasonal and annual variations on fish migration, breeding, recruitment and production. (Correlation of rainfall data from IMD and catch data on fishes from same region for bringing out the impact of rain on production).

UNIT IV

Optimum water quality parameters prescribed for various water bodies (marine and inland) for different user groups including fisheries.

UNIT V

Environmental Impact Assessment of various anthropogenic causes; domestic and industrial water discharge into waters and their impact on fisheries. Tannery discharge and its impact on fisheries.

UNIT VI

Status, structure and trophic profile (at primary, secondary and tertiary levels) of four typical water bodies: i) Marine, ii) Estuarine iii) Reservoir iv) River in relation to nutrient profile, plankton profile and oxygen profile in spatial and temporal terms.

Practical

Preparation of isoclines of temperature, rainfall and chlorophyll pattern of data gathered from satellites and demarcation of the PFZ's. Development of a graphic picture of the vertical and horizontal profiles of various nutrients, temperature, oxygen, plankton and fish density of any well defined aquatic system.

Suggested Readings

Canter LW. 1994. *Environmental Impact Assessment*. Mc-Graw Hill. Grilbert M & Gould R. 1998. *Achieving Environmental Standards*. Pitman Publ.

Peter W. (Ed.). 1988. *Environmental Impact Assessment: Theory and Practice*. World Research Institute, Routledge, London.

FRM 607 ISSUES IN CAPTURE FISHERIES 1+1

Objective

To get comprehensive knowledge on the major issues / challenges faced in capture fisheries.

Theory

UNIT I

Over- capacity (excessive fishing efforts); Over exploitation. By-catch and Discards.

UNIT II

IUU (Illegal, Unregulated and Unreported) Fishing. Problems encountered in Monitoring, Control and Surveillance (MCS).

UNIT III

Ghost fishing, destructive fishing practices.

Practical

Assessment of fishing capacity; stages of overexploitation, case studies and field visits.

Suggested Readings

Bal DV & Rao KV. 1990. *Marine Fishes of India*. 1st Revised Ed. Tata McGraw Hill.

Chandra P. 2007. *Fishery Conservation Management and Development*. SBS Publ.

Dholakia AD. 2004. *Fisheries and Aquatic Resources of India*. Daya Publ. House.

Kurian CV & Sebastian VO. 1986. *Prawns and Prawn Fisheries of India*. Hindustan Publ. Corp.

Moyle PB & Joseph JC Jr. 2000. *Fishes – An Introduction to Ichthyology*. 4th Ed. Prentice Hall.

Samuel CT. 1968. *Marine Fisheries in India*. Oceanographic Laboratory, University of Kerala.

Shanbhogue SL. 2000. *Marine Fisheries of India*. ICAR.

Yadav BN. 1997. *Fish and Fisheries*. 2nd Ed. Daya Publ. House