Department of Fisheries Engineering

1. Name of the Department / Section : Department of Fisheries Engineering, College of Fisheries, Shirgaon, Ratnagiri, 415 629 Maharashtra, India

2. About Department :

The College of Fisheries, Ratnagiri was started in the year 1981 with a intake capacity of twenty students per year leading to three year B.F.Sc. program. The well mandated departments of the College are Fisheries Biology, Aquaculture, Fisheries Technology, Fisheries Hydrography, Fisheries Engineering and Fisheries Resources, Economics, Statistics & Extension Education.

The Departments of Fisheries Engineering undertakes various courses of Fisheries Engineering totaling to 14 credits for the UG program including theory, practical.

Initially, the Department started the M.F.Sc. Program in "Fisheries Engineering" in the year 2008-09. However, from the year 2010-11, M.F.Sc. Program in Fisheries Engineering & Technology" is conducted as per the ICAR Syllabus with a intake capacity of two students per year and from the year 2022-23, M.F.Sc. Program in Fishing Technology & Engineering" is conducted as per the ICAR , BSMA Syllabus.

Academic Programs:

Doctoral Programs : Not yet started.

Masters Programs :

Name of the program: M.F.Sc. (Fishing Technology & Engineering)

Course No.	Credits	Title of the course offered by the department
FET 501	2+1=3	Advanced Fishing Gear Technology
FET 502	2+1=3	Advanced Fishing Craft Technology
FET 503	2+1=3	Responsible Fishing
FET 504	2+1=3	Refrigeration and Electrical Engineering
FET 505	1+1=2	Marine Engineering
FET 506	1+1=2	Aquaculture Engineering
FET 507	0+1=1	Engineering Graphics
FET 508	1+1=2	Fishing Harbour & Fleet Management
FET 509	1+1=2	Environmental Engineering And Pollution
FET 510	1+0=1	Sea Safety and Disaster Management
FET 511	1+1=2	Fish Processing Machinery
FET 512	1+1=2	Acoustics, Navigation and Seamanship

3. Bachelor Programs

Semester No.	Term No.	Course No.	Credits	Title of the course offered by thedepartment
II	II	ENG 121 (New)	1+1=2	Refrigeration and Equipment Engineering
II	II	ENG 122 (New)	0+1=1	Marine Engines and Propulsion System
IV	II	ENG 243 (New)	1+1=2	Fishing Craft Technology
IV	I	ENG 244 (New)	2+1=3	Aquaculture Engineering
V	I	ENG 355 (New)	1+1=2	Fishing Gear Technology
VI	II	ENG 366 (New)	1+1=2	Fishing Technology
VI	II	ENG 367 (New)	1+1=2	Navigation and Seamanship

Course Contents

M.F.Sc. in Fishing Technology and Engineering

I. **Course Title : Advanced Fishing Gear Technology**

II. **Course Code : FET 501**

III. **Credit Hours : 2+1**

IV. **Aim of the course**

To teach advanced fishing gear technology, To learn design modification of existingfishing gears, To learn selectivity of various fishing gears.

V. **Theory**

Unit I

Fishing gear design drawings: Survey of various fishing gears; Conventional and current practice for the representation of fishing gear by FAO specifications for scale drawing; The use of computers in the scale drawing of fishing gear to determine the defects in gear, design to develop new gears.

Unit II

Fishing gear selection: Use of fishing gear materials and their comparison; Selection of fishing gear, Analysis of the parameters of specific fishing gears and the derivation of empirical relationships for use in the design process.

Unit III

Fishing gear design and construction: Factors responsible for the choice of fishing gears; Design and construction of bottom, Mid-water and surface trawl; Gill nets and tangle nets; Types of gill nets – Simple gill net, vertical lines gill net, Framed gill nets, tangle nets and their technical characteristics, Two and three walled trammel nets, Combined gill nets; Purse seines and their classification, Longlines, Pole and Lines, Trolling line, Traps – Their classification and general principles of construction.

Unit IV

Light and electricity in fishing: Attraction of fish – fishing with electricity and application in various fishing methods, Light fishing, Fish pumps; Operation and mechanization of long lining and jigging.

Unit V

Gear Selectivity: The selectivity of trawl fishing gears, Gill nets, Purse seine and longline, Design of otter boards for various types of trawl fishing; Factors to be considered in gill netting in selection of meshes for the different fishes; Aimed fishing using the modern electronic devices like echo sounder, Sonar and Net sonde.

Unit VI

Testing fishing gear: Case studies relating to towed, surrounding and static fishing gear and their energy consumption, Fishing gear testing – full scale and model testing in flume tanks, methods of testing a fishing gear, External forces acting on fishing gears, The influence of design features on the overall economic performance of fishing gears.

VI. Practical

Exercises on scale drawing of different types of fishing gears. Use of computer software's programme in the design of trawl gears. Model net calculations, Calculations of energy requirements of different gears. Onboard experience of different fishing methods. Use of net monitoring instruments. Study of fishing gears through models of nets and field study. Making sketches. Reading of gear designs. – Trawl nets, Purse seines, Gill net and Long line. Familiarization with design drawing software. Design of otter boards and other accessories. Survey of gears and preparation of designs according to scale by taking measurements from a net.

Suggested Reading

- Baranov FI. 1969. *Selected Works on Fishing Gear* Vol. I *Commercial Fishing Techniques*, Israel Programme for Scientific Translations, Jerusalem, 631p.
- Baranov FI. 1977. *Selected Works on Fishing Gear*. Keterpress Enterprises. Israel: 259 p.• Ben-Yami M. 1994. Purse seining manual, FAO Fishing manual, 416p.
- Biswas KP. 1996. *Harvesting Aquatic Resources*. Daya Publishing House – Delhi: 207 p.
- Bjordal and Lokkeborg S. 1998. *Long Lining*, Fishing News Books Ltd. Farnham, 208p.
- Brandt AV. 1984. *Fish Catching Methods of the World*. Fishing news books Ltd., London, 432p.
- FAO. 1987. *Small Scale Fishing Gear*: 19 – 44pp.

- Fridman AL. 1986. *Calculations for Fishing Gear Designs*, FAO Fishing manual, Fishing News Books, Ltd., Farnham, 264p.
- John Garner. 1988. *Modern Deep-Sea Trawling Gear*. Fishing News Books Ltd. England: 91p
- Kristionsson H. 1975. *Modern Fishing Gear of the World*. The White Friars Press Limited. London: 594 p.
- Shaul Hameed M and Boopendranath MR. 2000. *Modern Fishing Gear Technology*: 193p.
- Sreekrishna Y and Shenoy Latha. 2001. *Fishing Gear and Craft Technology*. Indian Council of Agricultural Research. New Delhi, 342p.

I. Course Title : Advanced Fishing Craft Technology

II. Course Code : FET 502

III. Credit Hours : 2+1

IV. Aim of the course

To teach advanced aspects of fishing craft design, To learn about modification of existing craft layout, To learn about fishing craft stability.

V. Theory

Unit I

Fishing craft: Different types of fishing crafts – trawler, stern and side trawler, Purse seiner, Long liner, Gill netter, troller etc; Main differences in the method of construction and design; Consideration regarding the speed and other fishing requirements, Deck layout and deck equipments of fishing vessels based on the fishing method; Planning internal capacities of fish hold, Engine room, Crew accommodation, Fuel tanks and Freshwater tanks.

Unit II

Boat materials: Choice of the construction materials; Comparison of materials used in fishing boat construction; Bio-deterioration of wood – marine fouling and boring organisms, Preventive measures, Raw materials, properties, Merits and demerits of FRP, Steel, Aluminium and Ferro-cement, Corrosion – types, Fundamentals, measurement and preventive measures.

Unit III

Steering gear and Hull: Principles of operating steering arrangement; Remote control; Rudder – principles – types; Steering gear – Principle and operation – Mechanical and Hydraulic; Principal dimensions of boat, Importance of shape of underwater hull, Classification and description of hull forms based on shape; Form coefficients and proportionality coefficient for different types of vessels; Various ship motions at sea; Hull resistance; Behaviour of boats to waves from different sides.

Unit IV

Stability aspects of fishing vessels: Factors affecting stability; Longitudinal stability – Trim, Moment of change of trim by 1 cm; Transverse stability – List, heel, LOLL, Meta centric height and meta centric radius, GZ curve, Degree of vanishing stability, Free surface effect, Hydrostatic curves, Dynamic stability, Stability criteria, Safety measures to restore stability in fishing vessels; Inclining experiment.

Unit V

Propellers and Power: Powering of fishing boats; power transmission system in fishing vessels; Effects of wetted surfaces on speed; Types of propellers; Designing principle power requirements of various types of fishing boats, Auxiliary power, Propulsive efficiency, Use of kort nozzle.

Unit VI

Construction of fishing boat: Layout of a typical boat building yard, Various stages of construction, Description of various machines and tools used in boat building yard, Stages of wooden boat building – Sheathing of wooden hull – Steel boat construction and FRP boat construction, Inspection of fishing boat under construction, Care and maintenance of fishing boats – Factors causing damage, Hull protection methods and maintenance schedule, Inspection of damaged fishing vessels, Regulation of fishing vessels and classification of societies in various countries.

VI. Practical

Basic principles of drawing, drawing of fishing vessels – line drawing – sectional view of the boat and keel assembly – half breadth & body. Visit to boat building yards for on – the – spot study of different stages of wooden boat construction and to study the layout. Identification of various tools and machines used in boat building. Study of various stages of boat construction with the help of boat models and making

their sketches. Calculation of various dimensions; Study of deck lay outs of different types of fishing vessels and preparation of sketches; Visit to dry dock.

- Fyson JF. (ed). 1985. *Design of Small Fishing Vessels*, Fishing News Books, Oxford.
- Marine institute. 1988. *Proceedings of the World Symposium on Fishing Gear and Fishing Vessel Design*, The Newfoundland and Labrador Institute of Fisheries and Marine Technology, St. John's, Newfoundland, Canada, 610p.
- Pike D. 1992. *Fishing Boats and Their Equipments*. Fishing News Books. Oxford: 184p.
- Ponnambalam A. 2003. *Fishing Craft Technology*. CIFNET. Cochin: 157p.
- Ponnambalam A. 2003. *Fishing Craft Technology*. CIFNET. Cochin: 158p.
- Sanisbury JC. 1996. *Commercial Fishing Methods-an Introduction to Vessels and Gear*, Fishing News Books Ltd., Farnham, 352p.
- Shenoy Latha. 1988. *Course Manual in Fishing Technology*, CIFE, Mumbai, 95p.
- Sreekrishna Y and Shenoy Latha. 2001. *Fishing Gear and Craft Technology*. Indian Council of Agricultural Research, New Delhi, 342p.
- Tan-olofTraung. 1967. *Fishing Boats of the World*. Fishing News (book) limited. London. 635p.
- Yadav YS. 2002. *Traditional Fishing Craft of the Bay of Bengal*. BOBP. Chennai: 55p.

I. Course Title : Responsible Fishing

II. Course Code : FET 503

III. Credit Hours : 2+1

IV. Aim of the course

To teach various responsible fishing techniques, To learn about damage to the environment & biodiversity by existing fishing methods, To learn about methods of reducing by catch in trawl net.

V. Theory

Unit I

CCRF: Scope and objectives of FAO Code of conduct for Responsible Fisheries, Articles of CCRF – Description of the code, Analysis of marine catch data (present& past); analysis of CCRF concept.

Unit II

By-catch: Elaboration of Article 8 – Fishing operations; By-catch and discards – Definitions, By-catch estimation methods, by-catch reduction devices, turtle excluder devices, Finfish and shrimp excluder devices. Selective fishing gear and practices: Selectivity of trawls, gill nets and lines – Environmentally friendly fishing methods and fishing gears – Energy conservation and resource enhancement.

Unit III

Fish Aggregation Devices (FADs and Artificial reefs): Objectives, Types of FADs and artificial reefs; Design and construction of FADs and artificial reefs; Energy optimization in fisheries – Methods of energy conservation in fish harvesting. Remote Sensing and PFZ: Application of Remote sensing, PFZ and GIS in fisheries.

Unit IV

IUU - Illegal, Unregulated and Unreported fishing methods; Destructive and prohibited fishing systems and practices. Effect of fishing on non-target species: Effect of bottom trawl and gill nets on benthic fauna and habitats; Conservation methods issues and implications for biodiversity.

VI. Practical

Study of design and operation of BRDs and TEDs; Preparation of document listingand prohibited fishing practices; compilation of package of practices for energy conservation; interpretation of SST and Ocean colour charts, Study of Potential Fishing Zone (PFZ) maps; problems on fishing gear selectivity; studies on impact of various fishing gears on environment and biodiversity.

VII. Suggested Reading

- Bergstrom M. 1983. *Review of Experiences with and Present knowledge about Fish Aggregating Devices*, BOBP/WP/23 Bay of Bengal programme, Madras.
- CIFNET MODULE III & IV. *Code of Conduct for Responsible Fisheries*. 61-69pp.
- FAO. 1995. *Code of Conduct for Responsible Fisheries*, FAO, Rome, 41p.
- FAO. 1996. *Fishing Operations*, FAO Training Guidelines for responsible fisheries No.1, FAO, Rome 26p.
- FAO. 2003. *Fisheries Management*. 2. The ecosystem approach to fisheries, FAO

- Michel Kaiser and Groot. *Effect of Fishing on Non-target species and Habitats* Blackwell publishing
- *Technical Guidelines for Responsible Fisheries* – No.4, Suppl.2, FAO Rome.

I. Course Title : Refrigeration and Electrical Engineering

II. Course Code : FET 504

III. Credit Hours : 2+1

IV. Aim of the course

To teach engineering aspects about refrigerators, freezers, To learn about heat-load calculation and COP, To teach electrical aspects of fishing vessel.

V. Theory

Unit I

Principles of refrigeration: Refrigeration cycle; Vapour Compression system, Vapour absorption system, Steam Jet Refrigeration System, Solar energy based refrigeration systems; Application of Refrigeration in fisheries, Refrigeration in sea food processing plant – Refrigeration in deep sea fishing vessels – design and working of RSW and CSW – Coefficient of Performance (CoP) – ton of refrigeration
– Refrigerator efficiency calculations.

Unit II

Heat load and efficiency: Heat load calculations – Insulations in freezers and cold stores – Frosting and defrosting in freezers and cold stores; Refrigeration in factory Trawlers; Types of Refrigerated transport.

Unit III

Refrigerants: Types and properties, Use of different refrigerants in seafoodprocessing industry; Brine solution and dry ice refrigeration.

Unit IV

General structure of electrical power systems: Power transmission and distribution via overhead lines and underground cables, Steam, Hydel, Gas and Nuclear power generation, Principal and application of DC Networks, Single phase AC Circuits, Three phase AC circuits, Magnetic Transformers, Induction motor,DC Motors etc.

Unit V

Electrical Measuring Instruments: DC PMMC instruments shunt and multipliers, multi-meters, Moving iron ammeters and voltmeters, Dynamometer, Wattmeter, AC watt-hour meter, Extension of instrument ranges.

Unit VI

Principles and working of electronic components: Audio, R.F. circuits; Electron tubes, Transistors; Principles of electronic circuits; Amplifiers, Oscillators, Rectifier, Tuned circuits – Transmission of reception.

VI. Practical

Practical Visit to refrigeration plants, heat load calculations. Handling and operation of refrigeration equipments – compressor, condenser, evaporator, liquid return system, gas purging, oil drain, oil charging, refrigerant charging, defrosting; Ice making and harvesting; study of various automatic control devices; expansion valves,

L.P. and H.P. switches, solenoid valves. Study of various types of fish processing machineries; electrical motors, transformers, GPS, SONAR etc.

VII. Suggested Reading

- Ayyappan VP. 2002. *Elements of Electrical Technology*. CIFNET. Cochin. 96p.
- Joshy CD and Devadhason M. 2001. *Basic Electronics and Fish Finding Equipments*. CIFNET. Cochin: 42p.
- Shawyer M and Medina Pizzali AF. *The Use of Ice on Small Fishing Vessels*. FAO. Rome: 102p.
- Sternin UG, Nikonorou IV and Bumeister Yu K. 1976. *Electrical Fishing*. Keter. Publishing House Jerusalem Ltd. 258p.

I. Course Title : Marine Engineering

II. Course Code : FET 505

III. Credit Hours : 1+1

IV. Aim of the course

To teach engineering aspects of marine engines, To learn about effective utilization engine powers during fishing and propulsion, To study about system of fishing vessels.

V. Theory

Unit I

Engine characteristics: Capacity of cylinders, IHP, BHP, FHP, BMEP, Torque determinations; SFC values, IC engines – Working cycles – Indicator diagrams – Performance number – Supercharging – Engine performance curves – Duel-fuel engines, Handling of IC engine and maintenances – Engine and boiler room arrangements – Steering gears – auxiliary engines – Heat exchangers – Propeller Shaft driver steam generators.

Unit II

Efficiency of engines: Compression ratio and thermal efficiency; Volumetric efficiency; Mechanical efficiency different ratings – continuous, peak, intermittent, Feel and lubricant – Strokes – Cooling method – Running characteristics – Size weight – Power requirement; Propulsion system – Combinations of engine, power transmission and propeller.

Unit III

Function of main engine: Friction, Clutch, Hydraulic coupling, Gearbox, Thrust; Bearing, Shafting, Propeller, Auxiliary machinery systems – Requirements of a

winch, windlass, line and net hauler – estimation of their driving torque and power; Operation of a hydraulic steering gear; Rudder torque.

Unit IV

Engineering structure; Floating offshore structures –Diving – Underwater vehicles, Estimation grower requirement for various types of fishing – Efficiency group of fishing techniques – Resistance group of fishing methods – Computation of engine power.

VI. Practical

Study of basic machine parts, shafts, keys, couplings, levers, joints, pulleys, belts, gears and bearings. Study of Engine parts, engine testing, dissembling and assembling a running condition marine engine; study of marine diesel engines, fuel consumption testing with load; Propeller calculations using the computers; calculations related to engine power- Power transmission in fishing vessels.

VII. Suggested Reading

- Calder N. 1992. *Marine Diesel Engines*. Waterline Books. England: 153-168pp.
- Fishery Engineering. CIFNET. Cochin, 68-211pp.
- Nina Morgan. 1990. *Marine Technology Reference Book*. Butterworth – London.
- Rethinadhas C. 2002. *Marine Engineering*. CIFNET, Kochi, 156p.
- RK Rajput. 2006. *Thermal Engineering* Laximi Publication, New Delhi
- Watson GO and Harvey RA. 1971. *Steering Gear*. Newnes – Butterworths, London: 306–328 pp.

Course Title : Aquaculture Engineering

Course Code : FET 506

Credit Hours : 1+1

Aim of the course :

To familiarize engineering aspects of fish farm and hatchery, farm machinery operation and maintenance.

Theory

UNIT I

Site selection for aquaculture; surveying and leveling, earthwork calculations. Design of dykes, sluice, channels.

UNIT II

Tide fed farms; studies on water supply; aquaculture in open systems design of cages, rafts, pens, rakes, ropes etc.

UNIT III

Fluid mechanics, pumps, flow estimation and measurement; aquaculture in ponds, raceways and tanks.

UNIT IV

Recirculating aquaculture system; aeration, sterilization and disinfection, ponds, tanks and other impounding structures; filtration. Aeration – Gases in water. Gas transfer – Theory of oxygenation – Types of aerations. Efficiency of Aerators. Recirculation and water – Reuse systems – water exchange – water reuse methods – Recirculation – Advantage – Designs of re-use systems.

UNIT V

Fundamentals of concrete; building materials, cement, RCC. Engineering aspects of fish and shrimp hatchery. Farm machinery operation and maintenance. Pond sealing techniques. Shapes roof design – Load carrying system. Floors, walls, ventilation.

UNIT VI

Automatic feeding system – Feed dispensers – Demand feeders. Design and construction of aquaculture system pond construction – water transportion system – Pump houses – Inlet and outlet structures – Water treatment plants.

Practical

Visit to hatcheries and farms; Instruments used in aquaculture; Operations of aerators, filters, water supply systems. Calculations related to earth requirement aerated efficiency and pump selection. Pump installations .Design of pump house. Computation of water requirement, pump, and pumping rates.

Suggested Readings

Bose AN,Ghosh SN, Yang CT & Mitra A. 1991. *Coastal Aquaculture Engineering*. E. Arnold.
Ivar LO. 2007. *Aquaculture Engineering*. Daya Publ. House.
Lawson TB. 1997. *Fundamentals of Aquaculture Engineering*. CBS. Wheaton EW. 1970.
Aquaculture Engineering. Wiley-Interscience.

Course Title : Engineering Graphics

Course Code : FET 507

Credit Hours : 0+1

Aim of the course :

To teach practical aspects of computer aided engineering graphic.

Practical

- Introduction to Engineering Graphics – Drawing instruments and their use – Different types of lines – Lettering & dimensioning – Familiarization with current India Standard Code of Practice for Engineering Drawing. Introduction to scales. Introduction to orthographic projections – Horizontal, vertical and profile planes – First angle and third angle projections – Projection of points in different coordinates – Projections of lines inclined to one of the reference planes.
- Projections of lines inclined to both the planes – True lengths of the lines and their angles of inclination with the reference planes – Traces of lines. Projection of plane laminae of geometric shapes inclined one of the reference planes – inclined to both the planes – auXiliary projections.
- Projections of polyhedral and solids of revolution – Frustum – projection of solids with aXis parallel to one of the planes and parallel or perpendicular to the other plane – Projections with the aXis inclined to one of the planes. Projections of solids with aXis inclined to both the planes – Projection of spheres. Sections of solids by planes perpendicular to at least one of the reference planes – True shapes of sections, Developments.

Suggested Reading

Bhatt ND. *Elementary Engineering Drawing*, Charter Publishing House, Anand, 2002.

I. Course Title : Fishing Harbour and Fleet Management

II. Course Code : FET 508

III. Credit Hours : 1+1

IV. Aim of the course

To teach fishing harbour design and construction, To learn about fishing fleet that management and manning regulations in fishing harbour.

V. Theory

Unit I

Fishing vessel: FAO classification of fishing vessels, Indigenous fishing boats of India – fishing boats of maritime states of India, Fishing boats used in the inland and brackish waters, Account of mechanized boats introduced in India.

Unit II

Rules and Management: Personnel management, Planning of fishing cruises, Fishing fleet capacity, Fleet registration, fleet insurance, Seaworthiness assessment, Tonnage measurements Statutory rules and regulations under MSA, Classified societies, Manning regulations and requirements; Regulations to prevent collisions at sea.

Unit III

Classification and functions of fishing harbour: Facilities – waterside and landside facilities, Services and utilities provided, Layout of a modern fishing harbour, Stages in the planning of fishing harbours, Dredging.

Unit IV

Economic evaluation: On fishing harbour project, Dry docks and slipway – Fishing harbour management and maintenance.

Practical

Visit to dry dock; Visit to Fishing harbour, Study of boats with the help of boat models and making sketches; Visit to various vessel types of fishing vessel.

VII. Suggested Reading

- FAO. 1960. *Report to Government of India on Fishing Harbours Based on the Work of Carl GB Juke and CRB Juke*. FAO Report No. 1242 ETAP, pp.147.
- FAO. 1962. *Second Report to Government of India on Fishing Harbour Based on the Work of BW Johnson*. FAO Report No. 1538 EPTA, pp. 99.
- Ramakrishnan TK. 2007. *Ocean Engineering*. Gene – Tech Books. New Delhi: 233p.
- Sciortino SA, Barcali A and Carlesi M. 1995. *Construction and Maintenance of Artisanal Fishing Harbours and Village Landingss*. FAO. Rome: 136p.
- Sreekrishna Y and ShenoyLatha. 2001. *Fishing Gear and Craft Technology*. Indian Council of Agricultural Research, New Delhi, 342p.

I. Course Title : Environmental Engineering and Polution

II. Course Code : FET 509

III. Credit Hours : 1+1

IV. Aim of the course

To understand engineering aspects of environment to protect the environment from pollution.

Theory

UNIT I

Introduction – Quality of water – Quantity of water – conveyance of water – treatment of water – filtration of water – Disinfections of water – water softening.

UNIT II

Distribution system of water. Collection and conveyance of refuse – pumps – sewage disposal – primary and secondary treatment of sewage.

UNIT III

Environmental Pollution – Ecological Balances – Ozone layer – Green House effect – Fossil Fuels. Atmosphere pollution – water pollution. Marine oil pollution – Cause – Oil filtering equipment. Oil record book and controlling monitoring of marine pollution. Bunkering. MORPOL regulations.

UNIT IV

Air pollution – Control of Air pollution. Air pollution causes, Setting chambers, Cyclone Filters. Solid waste disposal. Sources of Pollutants –Classification. Air- pollution –Emission of harmful touchils. Littering of the sea – Plastics – Foods – Papers – Metals – Garbage – Regulation.

UNIT V

Low cost waste treatment systems and their Design. Ballest water management in ships. Discharge of ballast water – Problems of ballast water – Log book maintenance –Managing ballast water. Waste water and treatment, Industrial waste water management – Solid waste disposal. Environment and corrosion, Mathematical modeling for environment pollution control.

Practical

Visit to various pollution control stations. Familiarization of pollution control instrument. Pollution control in Fishing harbours. Pollution control in aquacultural farms.

Suggested Readings

Bist DS. 2000. *Safety and Security at Sea - A Guide to Safer Voyages*. Butterworth- Heinemann.
Salvato JA, Nemerow NL & Agardy FJ. 2004. *Environmental Engineering*. John Wiley & Sons.
Sciortino JA & Ravikumar R. 1999. *Fishery Harbour Manual on the Prevention of Pollution*. BOBP. Chennai.

I. **Course Title : Sea Safety and Disaster Management**

II. **Course Code : FET 510**

III. **Credit Hours : 1+0**

IV. **Aim of the course**

To teach theoretical aspects of sea safety and disaster management, To learn about bad weather preparation and situation handling. Crew management during disaster.

V. **Theory**

Unit I

Introduction to sea safety: Safe navigation procedures for fishing vessels; Distress Signals and DAT (Distress Alert Transmitter), and communication systems like VHF, SSB and INMARSAT; Familiarization with safety devices like SART, EPIRB and GMDSS.

Unit II

Accidents: Accidents associated with marine environment-crossing surf, Bad weather, Poor visibility storms, Loss of power at sea, Loss of way, Grounding, Collisions. Injuries from fish, Animals and machinery, Man, overboard and capsizing. **Signals for fishing vessel safety:** Agencies involved in fishing vessel rescue operations, Keeping

watch at sea – Preventing collusions – Heavy weather preparations -Crew management.

Unit III

Fire onboard and Firefighting equipment: Fir accidents at sea- Types and causes for fire accidents-Firefighting methods- fire eXtinguishers-First aid at sea; **Weather warning:** Weather warning signals and weather reporting system for fishing vessels; Bad weather preparations for fishing vessels. Stranding and beaching of fishing vessels and refloatation procedures; Measures to enhance sea safety; International conventions related to sea safety

Unit IV

Types of natural and man-made hazards in fisheries: Cyclone, Tsunami etc., Characteristics and impact of various disasters, Preparedness for disasters at sea, Mass evacuation, storm shelters and survival platforms.

VI. Practical

Study on various Distress Signals, Study on communication systems like VHF, SSB and INMARSAT; Familiarization with safety devices, study of fire fighting equipments used in fishing vessels, study of impact of various disasters, Disaster preparedness at sea. Weather warning signals. Sea safety equipments, Crew management during disaster.

VII. Suggested Reading

- Bist. 2000. *Safety and Security at Sea a Guide to Safer Voyages*. Butterworth, New Delhi.
- FAO. 1975. Code of Safety for Fisherman and Fishing Vessels. International Maritime Organization – London: 109p.
- *International Convention for the Safety of Life at Sea*. Universal Publishing Corporation. Mumbai: 1-334pp.
- Larkin FJ. 1998. *Basic Coastal Navigation*, 2nd edn, Sheridan House Inc., New York: 273p.
- Sreekrishna Y and Shenoy Latha. 2001. *Fishing Gear and Craft Technology*. Indian Councilof Agricultural Research. New Delhi, 342p.
- Udayaprakasan. 1997. *Rule of the Road Signal and Buoyage*. CIFNET, Cochin: 1- 78p.

I. Course Title : Fish Processing Machinery

II. Course Code : FET 511

III. Credit Hours : 1+1

IV. Aim of the course

To teach engineering aspects of various equipments related to fish processing, To learn about design and layout of factory vessels and Processing factory designs

V. Theory

Unit I

Machines: Theory of machines; Transmission of power; Friction wheels; Toothed gears; Belt drive and drivers- Importance and need for the use of machineries in fish processing, Advancements in fish processing machineries.

Unit II

Graders and Deskinners: Conveyers-types and working, Graders-basic principles and types, Washers and Slime removing in fishes- Deskinners-types and working principles, **Descaling and filleting machines:** Descaling – machineries-types and working, Filleting machines, types and working, Gutting machines and Deheaders, Types and working, Quick freezers.

Unit III

Slicers and filleting machines: Fish slicing machines-types and working, Fish filleting machines-types and working, Deboners, Types and working, Advanced Thermal processing machineries, High pressure processing equipments, Advanced canning machineries

Unit IV

Boilers and extruders: Boilers -types and working. Extruders-types and working- Twin screw extruders, Various Packaging machines. Machineries for fish meal plants. **Maintenance:** Fish processing Equipment Maintenance- Daily, weekly, monthly and annual Maintenance. Safety aspects of machineries and workers.

VI. Practical

Study of various types fish processing machineries-washer, grader, deheader, filleting machine, retorts; calculation of power requirements and power transmission. Study of boilers and its operation, canning equipments, Twin screw extruders. RSW and CSW in fishing vessel- design and capacity calculations. Implements required for sushmi grade tuna processing onboard of the vessel. Packing machineries, Maintenance of various fish processing machineries

VII. Suggested Reading

- EIRI Engineers. 2000. *Modern Packaging Technology Engineers* India Research Institute, Delhi.
- Gopakumar K. 2002. *Text book of Fish Processing Technology*. ICAR Publication, New Delhi.
- Heldman. 1975. *Food Process Engineering*, AVI Publishing Company, Westport.
- Kondrashova. 1984. *Shipboard Refrigeration and Fish Processing Equipment*. Amerind Publishing Co. Pvt. Ltd., New Delhi.
- Novikov. 1982. *Hand Book of Fishery Technology* – Vol. I, Amerind Publishing Co. Pvt.Ltd., New Delhi.
- Slade. 1967. *Food Processing Plant*. Leonard Hill book, London.

Stansby. 1963. *Industrial Fishery Technology* Reinhold Publishing Corpn. London.

I. Course Title : Acoustics, Navigation and Seamanship

II. Course Code : FET 512

III. Credit Hours : 2+1

IV. Aim of the course

To learn engineering aspects of fish acoustic equipments, To learn navigation and seamanship for fishing vessel safety.

V. Theory

Unit I

Basics of acoustic fish detection: Basics of sound in water-Ultra sonic sound and its characteristics-Acoustic surveys in fish population studies- Acoustic equipments used in fishing.

Unit II

Acoustic Equipments: Advanced models of Echo sounder – Major components, specifications and uses; Sonar – specifications, types; Instruments used for evaluation of underwater gear performance, Acoustic trawl monitoring system.

Unit III

Navigation: Fishing vessel navigation – Recent advances in fishing vessel navigation – Methods of signalling in fishing vessels- Fixing of vessel position, Navigational charts- Rules of the road.

Unit IV

Electronic Equipments: Global positioning system (GPS); Vessel monitoring systems (VMS) and AIS (Automatic Identification System) Navigation – Types, Navigational equipments, RADAR, Autopilot, Chat plotter.

Unit V

Seamanship: Handling of fishing vessels under all conditions at sea- Ropes and rope works– Their types, Handling; strength and preservation; Knots and splices; Anchoring mooring; Steering; Rolling and pitching.

Unit VI

Accidents at sea: Accidents- causes- Preventive measures- Preparedness for Fishing vessels.

Chart work and navigational equipment, chart reading, position fixing, direction and distance in navigation -calculations; Operation of echo sounder, Sonar, GPS, Radar identification and study of navigation and fishing lights and day signals, distress signals and navigational equipments like compass, chronometer, aneroid barometer, sextant and logs

VII. Suggested Reading

- CIFNET. 2004. *Fishery Engineering:* 212-238pp.
- FAO. 1998. *Fishing Operations. – Vessel Monitoring Systems*, FAO Technical Guidelines for Responsible Fisheries No. 1, Suppl. 1, FAO Rome.
- Joshy CD and Devadhason M. 2001. *Basic Electronics and Fish Finding Equipments*. CIFNET. Cochin: 31-42pp.
- Larkin FJ. 1998. *Basic Coastal Navigation*, 2nd edn, Sheridan House Inc., New York: 273 p.
- MacLennan DN and Simmonds EJ. 1992. *Fisheries Acoustics, Fish and Fisheries Series* 5,Chapman and Hall, London, 323 p.
- Mitson RB. Fisheries SONAR. *Fishing News* Books Ltd. England: 274p.
- Sreekrishnan Y and ShenoyLatha. 2001. *Fishing Gear and Craft Technology.* Indian Council of Agricultural Research, New Delhi, 342 p.

4. Infrastructure :-

a.	**Laboratories :**	The laboratory infrastructure and field facilities are the important assets of the department for execution of teaching and field programs.
b.	**Name of the important instruments / facilities (Subject wise)** :	
1.	**FISHING CRAFT TECHNOLOGY**	
	Models of different stages of boat construction. Models	
	of different plans of boat construction. Various models	
	of traditional fishing crafts of India. Models of different	
	mechanized fishing vessels of India. Tools used in boat	
	construction.	
	Unit of wooden otter boards.	
	Models of 2 stroke and 4 stroke diesel engine.	
	Working model of four cylinder four stroke diesel engine.	
	Model of fuel injection system.	
	Cut-out model of 4 stroke single cylinder diesel engine working model.	
	Model of four stroke single cylinder diesel engine.	
	Model of stern tube assembly along with propeller.	
2.	**FISHING GEAR TECHNOLOGY**	
	Accessories for fishing gear materials (Different types of twine, ropes, floats, sinkers, thimble, Shackles, anchor, swivel, hooks and squid jigs)	
3.	**NAVIGATION AND SEAMANSHIP**	
	Navigational aids - magnetic compass, sextant, pylorus, and station pointer	
	Navigational charts of different areas of India.	
	Sounding instrument - lead line.	
	Various distress signals.	
	Fire fighting (Fire extinguisher and Fireman suit) and life saving appliances (Life jacket and Ring buoya).	
	Electronic navigation (Handheld GPS,) and communication aids (VHF).	
	Models of flags (International code of signal).	
	Models of various Navigational Buoys.	
4.	**FISHING TECHNOLOGY**	
	Models of traditional fishing gear models of cast net, rampan net, dol net, chinese dip net, gill net and trammel net.	
	Models of Modern Commercial fishing gears : - trawl net, purse seine net, gill net, hand line, long line, pole and line, tuna long line and squid jigging machine.	
	Deck equipments : winch, net haulers / drums, gurdies, towing blocks.	
5.	**AQUACULTURE ENGINEERING**	
	Dumpy and chain surveying instrument	
	Plane table and leveling instrument	
	Different models of ideal water pumps	
6.	**REFRIGERATION AND EQUIPMENT ENGINEERING**	
	Model of Refrigeration unit	
	Model of preparation of ice candy machine	

Activities: All practicals related to the different subjects are conducted in theFisheries Engineering Laboratory and on field.

i) Photographs:

Student being introduced models of mechanized fishing vessels

Demonstration to students about indigenous traps for catching shell fish in inshore water

Demonstration to students about indigenous model of cast net, dol net, gill net for catching fish

Students on brackish water shrimp farm

Students with Auto level on brackish water site

Students doing practical related with navigational chart

5. Faculty

a. **Academic staff:** Assistant Professor and above with the details of the staff as given below

Name of the Faculty	Dr. B. R. Chavan Department of Fisheries Engineering, College of Fisheries, Shirgaon
	Dr. B. R. Chavan Department of Fisheries Engineering,
Post Held	Professor & O/I Head of the Department Fisheries Engineering
Date of Birth	15/06/1972
Qualification	M. F. Sc. (CIFE, Mumbai), Ph.D (AIT, Thailand)
Area of Specialization	Aquaculture
Experience (Years)	22
Research Projects guided PhD M.F.Sc. Present area of research	 1 4 Aquaculture, Fisheries Engineering
Contact details Land line No. Mobile Fax Email	 - 7387326984, 8847756011 - brc15672@gmail.com

Name of the Faculty	Mr. Rahul Kishanrao Sadawarte Department of Fisheries Engineering, College of Fisheries, Shirgaon
Post Held	Associate Professor (CAS)
Date of Birth	22/ 04/1973
Qualification	M.Sc. (Fisheries), Ph.D. (FRM)
Area of Specialization	Fisheries Engineering, Fisheries Resource Management, Aquaculture
Experience (Years)	27
Research Projects guided PhD M.F.Sc.	 4
Present area of research	Fisheries Engineering
Contact details Land line No. Mobile Fax Email	 - 8788402537 - sadawarte_rahul2007@rediffmail.com sadawarterahul2017@gmail.com

	Name of the Faculty	Mr. Makarand T. Sharangdhar Department of Fisheries Engineering, College of Fisheries, Shirgaon
	Post Held	Associate Professor (CAS)
	Date of Birth	21/12/1973
	Qualification	M.Sc.(Fish.)
	Area of Specialization	Fisheries Engineering
	Experience (Years)	22
	Research Projects guided M.F.Sc.	2 students.
	Present area of research	Fisheries Engineering, Fresh water Fisheries
	Contact details Land line No. Mobile Fax Email	 02352-231122 8208975945, 7588918587 - makarand.sharangdher@gmail.com

	Name of the Faculty	Dr. V. B. Mulye, Department of Fisheries Engineering, College of Fisheries, Shirgaon
	Post Held	Associate Professor (CAS)
	Date of Birth	27/101974
	Qualification	M.F.Sc
	Area of Specialization	Fisheries engineering
	Experience (Years)	20
	Research Projects guided M.F.Sc. Present area of research	3 Fisheries Engineering & Technology
	Contact details Land line No. Mobile Fax Email	 9422010941 02352-232987 mulyevijayb@gmail.com

b. **Research staff:** - Nil

6. Research Activities and Achievements (including projects)

ON GOING PROJECTS

i) **Name of the Project:** Study on Efficiency of trammel nets along the Ratnagiri of Maharashtra.

Name of PI: Dr. R. K. Sadawarte

Name of Co-PI: B.R.Chavan, V. B. Mulye, S. M. Wasave, V. H. Nirmale, T.G. Kazi, R. R. Jadhav

ii) **Name of the Project:** To Study the Efficiency of fish traps used in reservoir fishery of Maharashtra state.

Name of PI: Dr. R.R. Jadhav

Name of Co-PI: B.R.Chavan, R.K.Sadawarte, V. B. Mulye.

iii) **Name of the Project:** Study of purse seine net dimensions and operations with respect to regulations along the coast of Ratnagiri, Maharashtra.

Name of PI: Dr. R.R. Jadhav

Name of Co-PI: B.R.Chavan, R.K.Sadawarte, V. B. Mulye, N.B. Mirajkar, T.G. Kazi

iv) **Name of the Project:** Efficacy of electric field to harvest the fish.

Name of PI: Dr. N.B. Mirajkar

Name of Co-PI: M.M. Shirdhankar, A.S.Mohite, Dr. R. R. Jadhav, Shri. T.G. Kazi

7. Repository of abstracts of the theses:

1.	Name of the candidate:	Miss. A. R. Banasure
	Degree for which the thesis/project	To study and design, fish traps of Ratnagiri district, Maharashtra.
	Report submitted:	Ratnagiri, Maharashtra state.
	Year of submission:	2022
	Name of the Guide:	Dr. R. K. Sadawarte
	Abstract: - The present study was conducted to document and design various traditional freshwater fish trap used in Ratnagiri district. The study was also designed to develop a new modified freshwater fish trap and to check its efficacy. The Ratnagiri district were divided in nine blocks. Eight different fishing traps have been reported from eight blocks in different rivers viz. Mandangad (Bharaja river), Dapoli (Pachawale and Joge river), Khed (Jagbudi river), Chiplun (Waitarna river), Lanja (Dhokachi river), Sangmeshwar (Ghadghadi river), Ratnagiri (Sheel, Nerool, Somganga and Kajali rivers) and Rajapur (Arjuna and Barasu river) block of Ratnagiri district. No traditional freshwater fish trap found in Guhagar block of Ratnagiri district. The different designs and shape of fish traps were fabricated by local fishermen by using locally available materials namely; Conical trap (*Koiny with ring*), Conical trap (*Koiny without ring*), Basket trap (*Palana*), Cylindrical trap (*Lutha*), Pot trap (*Tokya*), Metal box trap (*Pipe*), Plastic container (*Dapke*) and V-shape trap (*Huda*). The traditional traps were used in Ratnagiri district are seasonal used in post monsoon season. Analysis of variance (ANOVA) showed significant difference ($P < 0.05$) in length, width, funnel opening and catch rate among traditional traps. The Cylindrical trap (*Lutha*) and Conical trap (*Koiny with ring*) showed high catch rate. By using Coefficient of determination (R2), check the effect of trap length, width and funnel opening on catch rate. The trap length showed large effect size (R2 = 0.8725). However, width and funnel opening showed small effect size (R2 = 0.0011) and (R2 = 0.0007). In this study, new collapsible freshwater fish trap was also designed. The advantages of collapsible traps are that they are easy to transport and required less space in a boat. The eco-friendly PVC sheet, metal rod, polypropylene net and nylon ties were used for the construction of a modified fish trap which increase the shelf life of trap. The efficacy of modified fish trap was also checked.	
2.	Name of the candidate:	Shri. M. S. Nagvekar
	Degree for which the thesis/project	To study the design, fabrication and operation of brackishwater crab traps in Ratnagiri.
	Report submitted:	Ratnagiri, Maharashtra state.
	Year of submission:	2022
	Name of the Guide:	Dr. R. R. Jadhav
	Abstract : - The present study investigates the many types of brackish water crab traps utilised in the Ratnagiri block and studies their design, fabrication, and operation. The detail information was collected from seventeen coastal villages. In Ratnagiri block, seven different varieties of crab traps were utilised, each with a different design and method of operation.The information with respect to design specification, operation, catch of all the seven types of traps namelyring trap, foldable crab trap, metal box trap,	

	cylindrical fix trap, box trap, plastic container trap, umbrella crab trapwas studied. Crab trap with respect to higher catch (kg) per trip and larger diameter of entrance (cm) was selected. For the selection of crab trap according to the higher catch (kg) per trip and large diameter of entrance (cm), statistical test i.e.From the statistical analyses, two crab trap were selected from the local crab traps with respect to higher catch (kg). Modified brackish water crab trap was developed. Two crab traps were compared to the modified brackish water crab trap with respect to catch (kg) per trip. Each of the trap was operated for 4 hr and then hauled in brackish water for ten times. Catch from each trap was recorded in terms of weight and number of crabs and the obtained data was compared. From that statistical analysis, there were no significant difference between them with respect to catch (kg). From that analysis efficacy of modified brackish water crab trap was proved. The present study highlights the variety of crab traps and efficacy of crab traps found in Ratnagiri block.	
3.	Name of the candidate:	Mr. M. U. Tandel
	Degree for which the thesis/project	Study of Design, layout and soil parameters of tidecum pump fed and pump fed operational brackish water farms of Surat district, Gujarat
	Report submitted:	Ratnagiri, Maharashtra state.
	Year of submission:	2021
	Name of the Guide/Co guide:	Dr. R. K. Sadawarte

Abstract: -

Present study was taken to examine design, layout and soil parameters of operational brackish water farms of Surat district. This study also investigate the effect of tidal amplitude on brackish water farms of Surat district. Surat district was divided in six different research sites as per the major creek present in the district. There were four research sites in Olpad taluka (viz. OS_1, OS_2, OS_3, OS_4) two research sites in Choryasi taluka (viz. CS_1, CS_2). All brackish water farms were divided as per their water taking procedure (viz. tide cum pump fed and pump fed) and further divided as per the farms size (viz. small, medium and large).

Farm details such as general information, site selection, design and layouts, Specifications of ponds (length, width,depth,pond bottom slopes, pond water spread spread area), dikes (peripheral and partitional dike), canals of the farms (feeder canal, subsidiary canal and drainage canal), sluice gates, water pumping station, electrical distribution system, aerators, farm safety and security features and farm bottom soil parameters were analyse during present study.

Total brackish water area of farms were found 2 to 50 ha with 0.94 to 30.99 haof water spread area that had 3 to 69 numbers of ponds in the farms. In specificationof ponds, pond area were recorded 0.02 to 2.00 ha, length were 11 to 340 m, width were 7 to 200 m, depth were 2 to 4.80 m, water spread area of particular pond were ranged 0.03 to 1.20 ha and bottom slope of the ponds were ranged 0.2 to 2:1000 vertical to horizontal.

Crest of peripheral dike were ranged 1.58 to 6.70 m, side slope were recorded 1.3 to 2.8 m (vertical to horizontal), free board were 0.30 to 1.95 m while height were ranged 2.10 to 4.10 m. In partitional dike crest were ranged 0.52 to 3.20 m, side slope were recorded 1.40 to 2.80 m (vertical to horizontal), free board were recorded 0.30 to 1.95 m and height of the dike were ranged 1.98 to 3.90 m. Out of 54 farms 15 farms were found with berm at outside slope of the peripheral dike. It was observed that farms with berms had lower erosion rate then the farms without berm. In Surat district, soil texture were clay loam, sandy clay loam and sandy clay which is suitable for the aquaculture. Clay percentage were ranged 18.9 to 50.2%, silt percentage were ranged 5.6 to 30.0% while sand percentage vary from 36.0 to 71.7% in the pond bottom soil of the brackish water farms of Surat district. In tidal amplitude highest high tide were recorded 6.5 m, lowest

low tide were recorded 1.0 m with mean tide of 2.5 to 5.3 m near the coast of Surat district. Peripheral dike side slope were affected by tidal water. Highest erosion as per farm division were recorded in medium pump fed farm with 17% of erosion were recorded which was followed by large pump fed farms (13%), large tide cum pump fed (4.34%), medium tide cum pump fed (3.80%) and small pump fed farms (3.0%). As per the division of research sites OS_2 site had higher erosion followed by OS1, CS2, CS1, OS4 and OS3. In general upper side of Olpad taluka had higher erosion effect on the brackish water farms.

4.	Name of the candidate:	Mr. S. S. Somvanshi
	Degree for which the thesis/project	Comparative evaluation of Design and engineering aspects of brackish water farms of Sindhudurg, Maharashtra.
	Report submitted:	Ratnagiri, Maharashtra state.
	Year of submission:	2021
	Name of the Guide/Co guide:	Dr. V. B. Mulye

Abstract :-

The present study was carried to investigate the brackish water farms of Sindhudurg district. For this study Sindhudurg was divided into three regions namely North, Central and South Sindhudurg Region for the study.

Farm details such as general information, site selection, design, shape of pond, specifications of ponds (length, width, depth, pond bottom slope, pond and water spread area), dikes (Peripheral and Partition dikes), catwalk, sluice gate, water supply system, were measured and other infrastructure parameters such as approach road, farm stead and electrical distribution system were also taken in consideration. Soil characteristics like moisture, pH, electrical conductivity, water holding capacity, bulk density and texture of operational brackish water farms of Sindhudurg were analyzed. Water quality parameters like salinity, temperature, pH, dissolve oxygen, ammonia, total alkalinity, total hardness, and transparency were observed. Layouts of the selected farms were prepared from data collected during the study period.

In Sindhudurg, thirty-eight brackish water farms were observed to be operational. Total area of the brackish water farms 0.35 to 10 ha comprising of the 1 to 11 ponds and having a total water spread area of 0.3 to 8.0 ha.

The length of the ponds ranged between 40 to 150 m and width of the ponds was 35 to 80 m respectively. The maximum depth was found to be 1.7 to 2.3 m. Pond area and water spread area was 0.35 to 2.3 ha and 0.3 to 1.28 ha. Pond bottom slope was 1: 1000 to 1.5:1000 (Vertical: Horizontal).

On the brackish water farms, top width of the peripheral dike was 3.4 to 4.1 m. The side slope and free board was 1:1.2 to 1:2.3 m (Vertical: Horizontal) and 1.5 to 2.0 m respectively. The height of the dike was 3.4 to 3.8 m. On the top width of the partition dike ranged from 2.0 to 2.6 m. The side slope was 1:1.6 to 1:2.4(Vertical: Horizontal) and the free board ranged from 0.7 to 1.1 m. The height of the dike was 3.4 to 3.8 m.

In the Sindhudurg district farms, catwalks were constructed by using bamboo, wooden poles, cemented poles and wooden planks or the combination of these materials were adopted by aqua farmers. Length and width of the catwalk was ranged from 6.0 to 8.0 m and 0.8 to 1.0 m. The height of the catwalk from the pond bottom was found to be 3.6 m.

On the brackish water farms, the sluice gate was found to be constructed in the ponds. The width and height of the sluice gate was observed to be 1.2 m and 4.0 m. Sluice gate was constructed with the help of Reinforced Cement Concrete. Sluice gates were constructed with five numbers of grooves for fitting screens with 60-micron mesh cloth. Twenty wooden planks were fixed within two adjacent grooves of the sluice gate and intermediate area between planks were filled with the pond soil in order to hold desired water level in the pond.

	Equipments and instruments used for the farm operation were pumps, aerators, blowers and check tray, refractometer, DO meter, pH meter, weighing balance; respectively. On brackish water farms the source of electrical power supply was from Maharashtra State Electricity Board (MSEB) and had transformers of 63 to 125 kVA capacity. The alternative power supply was available in the form of diesel generator of 65 to 125 kVA capacity. In the Sindhudurg district brackish water farms, soil texture was Sandy loam and Loamy sand soil. Other soil parameters of the brackish water farms such as soil moisture, pH, electrical conductivity, water holding capacity and bulk density were in the range of 14.4 to 19.8 %, 7.2 to 8.5, 5.22 to 21.8 dS/m, 25.9 to 51.85 % and 0.94 to 1.61 g/cm^3 respectively. The water quality parameters such as salinity, temperature, pH, dissolve oxygen, ammonia, total alkalinity, total hardness and transparency of brackish water farms were analyzed and the results obtained were as 25.12 to 30 PSU, 27 to 30 ^{0}C, 7.7 to 8.4, 5.5 to 6.5 mg/l, 0.25 ppm, 93 to 120 mg/l, 90 to 178 mg/l and 30 to 35 cm respectively. In entire Sindhudurg district all farms were adopted biosecurity measures such as animal fencing and crab fencing. This strict biosecurity practices are the major steps, to make more successful crop for all brackish water farms of Sindhudurg district.	
5.	Name of the candidate:	Shri. V. V. Bansode
	Degree for which the thesis/project	Engineering aspects of operational brackish water farms of Raigad, Maharashtra
	Report submitted:	Ratnagiri, Maharashtra state.
	Year of submission:	2018
	Name of the Guide:	Shri. M. T. Sharangdhar

Abstract: -

Present study was taken to investigate the engineering aspects of the operational brackish water farms of Raigad. Raigad district was divided into three regions namely North, Central and South Raigad Region for the study.

Farm details like general information, site selection, design, leading canal, shape of pond, specifications of ponds (length, width, depth, pond bottom slope, pond and water spread area), dikes (Peripheral and Partition dikes), drainage canal, drainage canal dike, catwalk, sluice gate, water supply system, were measured and other infrastructure parameters such as approach road, farm stead and electrical distribution system were also taken in consideration. Soil characteristics like moisture, pH, electrical conductivity, water holding capacity, bulk density and texture of operational brackish water farms of Raigad were analyzed. Water quality parameters like salinity, temperature, pH, dissolve oxygen, ammonia, total alkalinity, total hardness, and transparency were observed. Layouts of the selected farms were prepared from data collected during the study period.

In Raigad, forty-three brackish water farms were observed to be operational. Total area of the brackish water farms 0.5 to 50.0 ha comprising of the 2 to 47 ponds and having a total water spread area of 0.3 to 48.90 ha.

Leading canal was not observed for any of the 43 farms of Raigad district as the location of the creek was near to the farm area and all the farms were observed to be pump-fed.

The length of the ponds ranged between 28.75 to 280 m and width of the ponds was 18.80 to 231.59 m each. The maximum depth was found to be 1.5 to 2 m. Pond area and water spread area was 0.07 to 2.5 ha and 0.05 to 2.2 ha. Pond bottom slope was 1: 1000 to 2:1000 (Vertical: Horizontal).On the brackish water farms, top width of the peripheral dike was 1.3 to 2.80 m. The side slope and free board was 1:1 to 1:2.5 (Vertical: Horizontal) and 0.30 to 0.60 m respectively. The height of the dike was 1.8 to 2.2 m. On the top width of the partition dike ranged from 0.8 to 2.5 m. The side slope was 1:1 to 1:2.5 (Vertical: Horizontal) and the free board 0.2 to 0.5 m. The height of the dike was 1.5 to 2.0 m. The top width of the drainage canal was 2.60 to 20.5 m. The bottom width was1.5 to 15.6 m and the depth was 2.0 to 3.5 m. On the top width of the drainage canal dike was observed to be 1.4 to 2.8 m and a freeboard of 0.4 to 2.0 m.In the Raigad district farms, catwalks were constructed by using bamboo, wooden poles and wooden planks. Length and width of the catwalk was observed to range from 4.0 to 16.0 m and 0.44 to 2.5 m. The height of the catwalk from the pond bottom was found to be 1.5 to 3.0 m.

It was observed that in some brackish water farms had constructed a feeder canal made of brick and cement. The top width of the feeder canal was 0.65 to 1.80 m and depth 0.20 to 3.0 m. The other farms used PVC pipes, Hose pipes, Canvas and HDPE pipes

for supply of brackish water to the ponds. The inside and outer diameter of pipe varied from 30 to 250.0 mm and 31.2 to 251 mm.

On the brackish water farms, the sluice gate was found to be constructed in the ponds. The width and height of the sluice gate was observed to be 1.30 to 3.65 m and 2.0 to 3.0 m. Sluice gate was constructed with the help of bricks and cement while in some farms hume pipe was used for drainage pipe hume pipe diameter and length were within range of 300 to 1000 mm and 2.5 m. Sluice gates were provided with three to six numbers of grooves for fitting screens with 60-micron mesh cloth. Water level within the ponds was maintained by fixing 10 to 16 numbers of wooden planks in the two adjacent grooves of the sluice gate and filling the area between them with mud.

High-density polyethylene (HDPE) lining was observed in some farms for preventing seepage of water from the ponds. The thickness and shelf life was 0.3 to 0.5 mm and 5 to 7 years.

Instruments and equipments used for the farms were pump, aerator, blower, check tray, auto feeder, CCTV, refractometer, DO meter, pH meter, and weighing balance.

On brackish water farms the source of electrical power supply was from Maharashtra State Electricity Board (MSEB) and having transformers of 60 to 200 kVA capacity. The alternating power supply was available in the form of diesel generator of 15 to 250 kVA capacity.

In the Raigad district brackish water farms, soil texture was Sandy loam and Loamy sand soil. Other soil parameters of the brackish water farms like soil parameters moisture, pH, electrical conductivity, water holding capacity and bulk density were in the range of 2.33 to 16.42 %, 7.0 to 8.5, 1.03 to 5.47 dS/m, 31.47 to

92.17 % and 0.29 to 1.57 g/cm3 respectively. The water quality parameters like salinity, temperature, pH, dissolve oxygen, ammonia, total alkalinity, total hardness and transparency of brackish water farms were analyzed the results obtained were as 15 to 35.5 PSU, 24.2 to 30 0C, 7.2 to 8.2,
3.5 to 6.7 mg/l, 0.0 to 0.05 ppm, 90 to 140 mg/l, 85.4 to 120 mg/l and 24.5to 40 cm respectively. In all farms under Raigad district strictly biosecurity measures such as animal fencing, bird fencing, crab fencing, hand wash, footbath etc. were religiously followed to prevent viral outbreak. This strict biosecurity practices are the major steps, makes more successful crop for all Raigad district brackish water farmers.

6.	Name of the candidate:	Mr. G. B. Chibhade
	Degree for which the thesis/project	Engineering aspects of operational freshwater fish farms of Raigad, Maharashtra
	Report submitted:	Ratnagiri Maharashtra state.
	Year of submission:	2018
	Name of the Guide:	Dr. V. B. Mulye

Abstract: -

Present study was undertaken to investigate the engineering aspect of operational freshwater fish farms of Raigad district, Maharashtra, India. For this study, Raigad district was divided into three Regions namely North, Central and South. Various type of aquaculture systems, types of pond and engineering aspect of aquafarm were studied. In Raigad district, twenty-eight freshwater fish farms were observed to be operational during the study period, comprising of 18 small farms, 6 medium farms and 4 large size farms. In North Raigad Region, medium size farms and South Raigad Region, large size farms were not reported during study period.

It was observed that operational freshwater fish farms were located near the leading canal, open well, tube well, reservoir, dam, and rivers with good water source. Topography of observed farms was plain, marginally slope and hilly areas. The recorded shape of the ponds was rectangular, square and even irregular. Water supply system was constructed with various materials such as PVC, HDPE, Rubber, HDPE Flexible and Galvanized iron. Wood and RCC structure was adapted for construction of the pond sluice and main sluice gates of the farm. Cast net used for sampling/partial harvesting and dragnet was used for complete harvesting of the pond. HDPE lining was recorded on two fish farms to prevent seepage loss. Basic equipment like weighing balance was used for weighing lime, feed, ingredients, fishes etc. on all farms. Essential electric power supply was availed for all farms from MSEB around the Raigad district. For source of alternating power supply Diesel generator was adapted in the three regions, while use of solar power system were observed in addition to generator on one farm from North Raigad Region. Approach road and farm stead facility was observed on 27 farms. Fish processing facility only reported in North Raigad Region. Pump aeration system was erected on single farm from Central Raigad Region. Raigad district operational freshwater fish farms area and water spread area was ranged from 0.10 to 22.25 ha and 0.05 to 4.30 ha; respectively. Top width of leading canal was observed to be range of 1 to 6 m, bottom width 1 to 4 m and depth 1 to 2 m. The length, width and water depth of the ponds was observed from 8 to 143 m, 4 to 91 m and 1 to 5 m; respectively. The range of pond area, water spread area of cultured ponds and bottom slope was observed from 0.001 to 6.84 ha, 0.001 to 3.61 ha and 1000:0.6 to 1000:5; respectively. The top width, side slope, free board and total height of peripheral dike was ranged from 0.3 to 5 m, 2:0.6 to 10:5 m, 0.3 to 1.2 m and 1.3 to 6 m; respectively. The top width of partition dike ranged from 0.3 to 5 m, side slope 2:0.6 to 10:5 m, free board 0.3 to 1.2 m and total height of partition dike ranged from 1.3 to 6 m. The dimensions of drainage canal were recorded; top width, bottom width, depth and bottom slope ranged from 1.5 to 2 m, 0.8 to 1.2 m, 0.9 to 1.5 m and 1000:1; respectively. Top width of the drainage canal dike and free board was ranges from 0.3 to 0.5 m and 1 to 1.3 m; respectively. The length of catwalk was ranged from 1.5 to 15 m, width 0.4 to 0.5 m, height from pond bottom of the catwalk was 2 to 3.5 m; respectively. The demand feeder length 0.3 m, width 0.3 m,

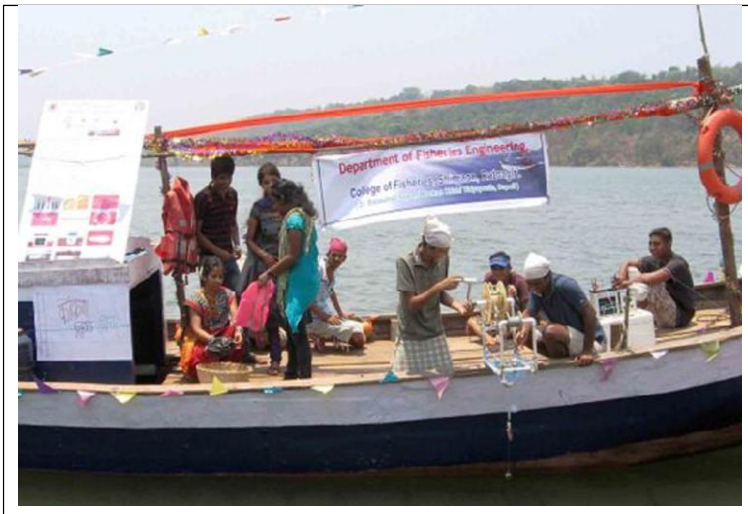
height 0.45 m; respectively. The dimensions of the feeder canal top width, bottom width and depth were ranged from 0.5 to 1.5 m, 0.3 to 0.8 m and 0.5 to 1 m; respectively. Lengthof sluice gate was 2 to 5 m, height 1 to 2 m and width 1 m. The sluice gate of the ponds width was 1 m, and height 1 to 3 m. For water supply system, pipes dimeter and wall thickness were ranged from 16.15 to 140.45 mm and 2.15 to 5 mm; respectively. The range of soil parameters recorded from Raigad district were, pH 6.1 to 8, water holding capacity 50.53 to 72.03 %, conductivity 1.25 to 3.55 dS/m, moisture 9to 16 %, bulk density 1.2 to 1.29 g/cm^3 and water parameters namely salinity 3 to 6 PSU, temperature 27 to 30^0C, pH 7.4 to 8, dissolved oxygen 4 to 5.6 mg/l, ammonia 0.02 mg/l, total alkalinity 100 to 140 mg/l, total hardness 70 to 140 mg/l and transparency were found from 30 to 45 cm. Minor seepage rate of 2 to 7 cm/day was noticed during sampled freshwater fish farms. It was concluded that, in Raigad district majority of the farms are semi-intensive types and most of the parameters like site selection, design and engineering aspects as well as soil and water parameters were found within the ideal limit described by many researchers across the India, with some minor variations. All these fish farms form an important asset for excellent future development of sustainable aquaculture in the studied region, thus forming a backbone, contributing to the livelihood of fish farmers.

8. Extension Activities :-

a. **Farmer / Fishermen Melawa Organized :-**

1	Title:	Lifesaving appliances and distress signals.	
	Sponsorer:	Phansop Machimar Society, Juna Phansop.	
	Participants: (Nature of the	Fishermen	
	participation	30 Nos.	
	and no. of participants):		
	Name of the speakers along		Shri. M. T. Sharangdhar:
	with their topics.		Lifesaving appliances and distress signals.

Shri.M.T.Sharangdhar demonstrating "**Lifesaving appliances and distress signals"**. At Juna Phansop.



B. F. Sc students and staff Participated in '**fancy boat competition'** event conducted at post chave devud Tal. Dist. Ratnagiri

Prof. Makarand T. Sharangdhar :
Short term training programme on ***"Mud crab breeding and rearing "*** for unemployed youths organized by College of Fisheries, Shirgaon, Ratnagiri under the project „"Studies on seed production of Mud Crab (*Scylla sps.)''* sponsored by Rajiv Gandhi Centre for Science and Technology, Mumbai.

a. Publications:

Books Published: - Nil

Research Publications:				
Sr. No.	**Name of the Authors**	**Title of the Research Article**	**Name of the Journalwith ISSSN Number**	**Vol. No. & Page No. and Publication year**
A) Dr. B. R. Chavan, Professor and Head (CAS) (FENGG)				
1	Somnath R. Yadav, **Balasaheb R. Chavan***, Narinder Kumar Chadha, Suresh D. Naik, Kishore K. Krishnani, Paramita Banerjee Sawant	Effect of stocking density on growth performance, plankton Abundance, body composition and haematological parameters of *Etroplus suratensis* (Bloch, 1790).	Aquaculture Research, 2021; ISSN: 2352-5134 DOI: 10.1111/are.15309	00:1–15. 2021
2	S. Y. Metar*, V. R. Sadawarte, V. H. Nirmale, N. D. Chogale, A. N. Sawant, **B. R. Chavan,** S. B. Satam and H. Singh	Studies on gut content of rabbit fish, Siganus canaliculatus (Park, 1797) along the Ratnagiri coast of Maharashtra.	Journal of Experimental Zoology, India. ISSN 0972-0030. 2020	Vol. 23, Supplement 1, pp. 737-740, 2020.
3	H. B. Dhamgaye*, S. P. Jadhao, S. J. Meshram, **B. R. Chavan**, R. K. Sadawarte	Effect of Fipronil on oxygen consumption and Ammonia excretion of Mahseer (*Tor khudree)* fry.	Indian J. Anim. Hlth. (2020), ISSN 0019-5057.	59(1): 91-96. pp. 91 – 96 2020
4	K. S. Sawant*, S. J. Meshram, H. B. Dhamagaye, **B. R. Chavan,** R. M. Tibile and V. R. Vartak	Growth performance of GIFT tilapia (*Oreochromis niloticus*) fry in Biofloc system using different carbon sources.	Journal of Experimental Zoology, India. ISSN 0972-0030. 2020	Vol. 23, Supplement 1, pp. 765-769, 2020
5	Wasave SS, **Chavan BR*,** Pawase AS, Shirdhankar MM, Mohite AS, Pai R, Wasave SM and Naik SD	Application of agro-wastes to enhance freshwater fish Production of Maharashtra.	International Journal of Fisheries and Aquatic Studies 2020ISSN: 2394-0506	8(4): 206-211. P-2020
6	S. N. Kamble, H. B. Dhamagaye*, S. J. Meshram**, B. R. Chavan** and G. N. Kulkarni	Toxic effect of Fungicide Paclobutrazol on Immunological Parameters of Juveniles Whiteleg Shrimp, *Litopenaeus vannamei*	Journal of Experimental Zoology, India. ISSN 0972-0030. 2020.	Vol. 23, Supplement 1, pp. 895-901, 2020.

7	Somnath R. Yadav1 and **B. R. Chavan***	Performance evaluation of sensors for use in aquaculture.	Journal of Experimental Zoology, India. ISSN 0972-0030.	Vol. 23, No.2, pp. 1007-1018, 2020.
8	S. S. Wasave*, **B. R. Chavan**, S. D. Naik, S. M. Wasave, A. S. Pawase, R. M. Tibile, G. S. Ghode, S. J. Meshram and V. S. Shivalkar	Role of microbes in biofloc systems : a review	*J. Exp. Zool. India ISSN 0972-0030*	Vol. 23, Supplement 1, pp. 903-906, 2020.
9	**B. R. Chavan***, A. Yakupitiyage S. Kumar and V.B. Sutar	Biochemical, Microbial and Sensory Properties of Mackerel (*Rastrilliger kangurta*) Dried in Solar-Biomass Hybrid Tunnel Dryer	Asian Journal of Microbiology, Biotechnology and Environmental Science, ISSN-0972-3005	Vol. 18, No. (1) : 171-179:, 2016
10	**B. R. Chavan*** R. Pai, H. Singh and U. V. Mahadkar	Rearing of Fish Fingerling in Cages in Reservoir for Food Security and Rural Livelihood	International Journal of Tropical Agriculture. ISSN: 0254-8755	Vol. 34, No. 4: 903-907, 2016
11	M.B. Nikam*, S.S. Burark, A.C. Deorukhkar, **B.R. Chavan** and R.P. Mhadik	Integrated Farming Systems for Sustainable Agriculture in Raigad District of Maharashtra..	International Journal of Agriculture, Environment and Biotechnology, Citation: IJAEB: *ISSN : 0974-1712*	13(2): 01-08, June 2020.
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13	Atish Mahendra Mane* Kiran Dube, Tincy Varghese, **Balasaheb Ramdas Chavan**, Manoj Tukaram Kamble	Effects of stocking density on growth performance, survival and production of *Catla catla* and *Labeo rohita* during nursery rearing in cages.2019.	Proceedings of the National Academy of Sciences India Section B: Biological Sci., ISSN:0369-8211.	89(1):275–281, 2019
14	Sonali P. Thool, **B. R. Chavan*** and S. J. Meshram	Present status, Prospectus of Freshwater fish production and future need of Wardha District of Maharashtra.	Contemporary Research in India. Multidisciplinary International Journal. ISSN: 2231-2137.	pp.157-159; 2018

15	N. D. Chogale*, **B. R. Chavan**, V. R. Sadawarte, R. Pai, A. U. Pagarkar, S. Y. Metar, S. B. Satam, K. M. Shinde, A. N. Sawant and H Singh	Production of *Chaetoceros calcitrans* in different nutritive condition in shrimp hatchery, wadamirya, Ratnagiri.	Contemporary Research in India. Multidisciplinary International Journal. ISSN: 2231-2137.	pp.52-56; 2018
16	Y. S. Pawar*, B**. R. Chavan** and S.D. Naik	Tilapia and shrimp integrated culture: Way to improved production, significant reduction of organic load and reduction in disease outcome.	Contemporary Research in India. Multidisciplinary International Journal. ISSN: 2231-2137.	pp.43-46; 2018
17	Manoj T. Kamble, Vijay B. Sutar and **Balasaheb R. Chavan***	Application of agro-wastes to enhance freshwater fish Production of Maharashtra.	Contemporary Research in India. Multidisciplinary International Journal. ISSN: 2231-2137.	pp.38-42; 2018
18	R. V. Bhosle, **B. R. Chavan***, S. J. Meshram, H. B. Dhamagaye, S. S. Wasave and R. Pai	Growth performance of *GIFT* tilapia (*Oreochromis niloticus*) fry in nursery rearing by using brackish water.	Contemporary Research in India. Multidisciplinary International Journal. ISSN: 2231-2137.	pp.32-37; 2018
19	Shrutika S Sawant, **Balasaheb R Chavan***, Salin Krishna R and Manoj T Kamble	Introduction of Australian Jade Perch Culture in India: Lesson to be learned from East Asian Countries.	Contemporary Research in India. Multidisciplinary International Journal. ISSN: 2231-2137.	pp. 28-30; 2018
20	**B. R. Chavan***, S.D. Pawar, M. T. Kamble and S. D. Naik	Microorganisms in maintaining Carbon/Nitrogen (C/N) ratio in Intensive Aquaculture System: A Review	International Journal of Tropical Agriculture. ISSN: 0254-8755	36, 4: 843-849. 2018
21	B. P. Boye, **B. R. Chavan***, V. R. Sadawarte, A. N. Sawant	Effect of different stocking densities on Growth performance of *Catla catla* fry reared in Harvested Rain water in cement tank.	International Journal of Tropical Agriculture. ISSN: 0254-8755	36, 4: 837-842. 2018
22	Manoj Tukaram Kamble*, Amararatne Yakupitiyage, Krishna Rugmini Salin, **Balasaheb Ramdas Chavan**	Effect of *Psidium guajava* and *Phyllanthus acidus* Leaf Extract on Immunostimulant Response of Nile Tilapia Against *Streptococcus agalactiae* Infection	The Israeli Journal of Aquaculture, Bamidgeh, ISSN: 0792-156X, 2018	ISSN: 0792-156X, 2018

23	Shashikant J. Meshram, Shivananda Murthy, Harish B. Dhamgaye*, **B. R. Chavan**, H. S. Swain, M. J. Gitte and A. Ali	Effect of dietary beta-glucan on the hepatopancreas of giant freshwater prawn, *Macrobrachium rosenbergii.*	Contemporary Research in India. Multidisciplinary International Journal. ISSN: 2231-2137.	pp. 88-91; 2018
24	Manoj T. Kamble*, Amararatne Yakupitiyage, Krishna R. Salin and **Balasaheb R. Chavan**	Protective Effect of *Psidium Guajava* and *Phyllanthus acidus* leaf supplementation diet against *Streptococcus agalactiae* infection in Nile tilapia *Oreochromis niloticus*	Contemporary Research in India. Multidisciplinary International Journal. ISSN: 2231-2137.	pp. 92-97; 2018
25	B. P. BHOYE1, **B. R. CHAVAN1***, V. R. SADAVARTE1, H. B. DHAMAGAYE1 , M. T. Kamble2 and B. T. SAWANT1	Rearing of Freshwater Fish '*Catla catla* (Hamilton, 1822)' Spawn to Fry in Green Water System with Harvested Rain Water in Cement Tanks	Current Agriculture Research Journal. ISSN: 2347-4688.	2017; 5 (1).
26	R. P. Rathod, **B. R. Chavan*** and R. K. Pai	Zooplankton Diversity Indices and Seasonal Variations in Kadwai Reservoir, Ratnagiri District, Maharashtra, India	International Journal of Tropical Agriculture. ISSN: 0254-8755	Vol. 34, No. 3: 785-790. 2016
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28	**B. R. Chavan***, A. Yakupitiyage, S. Kumar and V. B. Sutar	Effect of Drying in Solar-Biomass Hybrid Tunnel Dryer On Biochemical, Microbial and Sensory Properties of Mackerel (*Rastrilliger Kangurta*)	International journal of food and fermentation Technology, Print ISSN No 2249-1570.	5 (2): 201-211,
29	B. R. Chavan*, R. Pai and H. Singh	Establishment of fish fingerlings by using fish cages for stock enhancement of underutilized aquatic impoundments.	Bhartiya Krishi Anusandhan Patrika.	29 (4): 201-204 2015

30	**B. R. Chavan**[*], Yakupitiyage A. Ataguba G.A., Kamble M.T. and Medhe S.V.	Tilapia As Food Fish: Enhancement of *Ω-3* Polyunsaturated Fatty Acids In Tilapia (*Oreochromis Spp*.)	International Journal of Agriculture Sciences ISSN: 0975-3710	Vol. 7, Issue 9: 671-677. 2015
31	**B. R. Chavan**[*], Yakupitiyage A., V. B. Sutar.	Mathematical Modeling And Quality Characteristics of Indian Mackerel (*Rastrilliger Kangurta*) Dried In Solar Cabinet Dryer	Bioinfolet, ISSN-0973-1431	12 (4 A):838-845. 2015
32	Gabriel A. Ataguba[*], Manoj T. Kamble, Gabriel R. Okayi and **B. R. Chavan**	An overview and assessment of two wetlands in Eastern Thailand: Kung krabaen bay and welu wetlands in chanthaburi province	International Journal of Agriculture, Environment and Biotechnology.	8(1): 205-213 2015
33	**B.R. Chavan**[*], A.Yakupitiyage, V.B. Sutar, Bhawesh T. Sawant	On-Farm Feed Formulation and Its Management Strategies For Enhance Higher Economic Efficiency Of Tilapia Culture (*Oreochromis Niloticus*).	Indian Journal of Animal Research	45 (4) : 256 - 263, 2011
34	**Balu Ramdas Chavan**[*]	Improvement of Quality Characteristics of Indian Mackerel (*Rastrelliger kanagurta*) by Solar Drying	Drying Technology,	27: 823-824, 2009
35	**B. R. Chavan**, M.P. Bhilave[*], M. T. Wakode, P. Shinde	Influence of Sugar Concentration in the Food Source on the Foraging Behavior of *Apis mellifera,*	ENTOMON ISSN: 0377-9335 (IF 0.2).	34(1): 51-52, 2008
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37	**B. R. Chavan**[*], A. Yakupitiyage, S. Kumar, S. K. Rakshit	Experimental investigation on biochemical, microbial and sensory properties of mackerel (*Rastrilliger kangurta*) dried by solar-biomass hybrid cabinet dryer.	Journal of Food, Agriculture & Environment.	6 (3&4):167-171. 2008
38	**B. R. Chavan**[*] and Yi Yang	Annual Changes and Constraints of Aquaculture Production in India	Ecology Environment and Conservation,	13(1): 47-51, 2007
39	S. T. Sharangdhar[*], J. M. Koli, , **B. R. Chavan**	Shelf life study of Jawala Chutney Prepared from Jawala (*Aceteus spp*).	Ecology Environment and Conservation,	11 (3-4):477-478, 2005

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41	V.V. Vishwasrao*, J. M. Koli, S. T. Sharangdhar, B**. R. Chavan**, N. D. Chogale and. M. T. Sharangdhar	Studies on freezing and storage characteristics of black kingfish, *Rachycentron canadus* (linnaeus), in fillet and steak,	Ecology Environment and Conservation,	10 (2): 205-212, 2004
B) Dr. R. K. Sadwarte, Associate Professor (CAS) (FENGG)				
1	**R.K.Sadawarte,** S.G.Belsare, V. R. Sadawarte & Kharatmol B.R.	Studies on Effect of 17 alpha Methyltestosterone on 30 days oldRosy Barb *Puntius conchonius*.	Journal of Aquatic Biology. ISSN 0971-4235	Vol.21(3): P.n.: 49-52. 2006
2	Kharatmol B.R., N.P.Sahu & **R.K.Sadawarte**	Optimization of energy to proteinratio in feed for post larvae of *Macrobrachium rosenbergii.*	Ecology, Environmentand Conservation ISSN 0971-765 X	Vol. 12 (1) : P.n.: 101-104. 2006
3	**R.K.Sadawarte,** V. R. Sadawarte, & S.D.Naik, S,S,Sawate, V. B. Mulye, M.T.Sharangdhar.	Studies on Effect of Ethynyl-estradiol on 30 days old RosyBarb (*Puntius conchonius*).	Aquacult ISSN 0972-2262	Vol. 10 (1): P.n.: 57-61 2009
4	S.D.Naik & **R.K.Sadawarte**	Comparative osteology of the pufferfishes (Family: Tetradontidae) of Maharashtra.	Ecology and Fisheries. ISSN 0974-6323	Vol. 2 (1): P.n.: 105-112 2009
5	S.D.Naik, S.T. Sharangdher, H.B.Dhamagay e & **R.K.Sadawarte**	On the aspects of seed production and prospects for brackishwaterculture of Pearl spot, *Etroplus suratensis* .,	Ecology and Fisheries ISSN 0974-6323	Vol. 2 (1): P.n.: 37-42 2009
6	P.H.Sapkale, S.A.Joshi, V.G.Yewle and **R.K.Sadawarte**	Impact of heavy metals on Aquaculture and fisheries: Its determination in water, sediments, fish and feed samples.	Ecology and Fisheries ISSN:0974-6323	Vol. 2 (1): P.n.: 25-30 2009
7	D.S. Wankhede, J. M. Koli, S.T. Shrangdher, M.T. Sharangdher, **R. K. Sadawarte** and V.B. Muley	Biochemical changes in black pomfret (*Parastromates niger*) during storage at low temperature.	Ecology and Fisheries ISSN 0974-6323	Vol. 2 (2): P.n.: 19-26 2009
8	Anil B. Funde, Suresh D. Naik, Archna S. Pawarand **Rahul K. Sadawarte**	The mudcrabs (Family: Portunidae) of the south konkancoast of Maharashtra, India.	Eco. Env. & Cons ISSN 0971-765 X	Vol. 19 (3): P.n.: 725-730 2013

9	*Tasduq H. Shah, S.K.Chakrabo rty A.K.Jaiswar, TarkeshwarKumar, K.M. Sandhya,* ***R.K.Sadawarte***	*Biometric analysis of oil sardine,Sardinella longiceps Vallenceinnes, 1847 (Clupeiformes:Clupeidae) alongRatnagiri Coast of Maharashtra.*	*Indian journal of Geo-marine sciences* ISSN 0379-5136	*43(5),* P.n.: *805-814 May, 2014*
10	Dr.J.M.Koli ***Dr. R. K. Sadawarte*** & Miss. B. S. Peje	Optimization of appropriate method to extract gelatin from Tiger toothed croaker (Otolithesruber) and Pink perch (*Nemipterus japonicus*) waste from surimi industries	***Internation al Conference on "Ethical Prospects: Economy, Society andEnvironment" ISBN 978-93-83046-46-1***	P.n.: 181-190 *March, 2015*
11	***R.K.Sadawarte,*** *V.R.Sadawarte,* Dr.J.M.Koli & Mr.S.S.Sawate	*Effect of 3-Nitro (3-Nitro-4-Hydroxyphenyl-Arsonic Acid 5%Premix) on Fry of Rosy Barb, (Puntius Conchonius).*	***Internation al Conference on "Ethical Prospects: Economy, Society and Environme nt" ISBN 978-93-83046-46-1***	P.n.: *523-526 March, 2015*
12	A.S.Tekade, G.N. Kulkarni, A.U. Pagarkarand **R.K.Sadawarte**	Fly ash: Characteristics and potential for benefit of Aquaculture	Ecology and Fisheries. ISSN 0974-6323	Vol. 9 (1): P.n.: 21-24. January, 2016
13	**R.K.Sadawarte,** V.R. Sadawarte J.M.Koli, G.N.Kulkarni,, S.S.Sawate & K. M. Shinde	Effect of thyroxine on growth of fry of Rosy Barb, *Puntius conchonius*.	Ecology and Fisheries. ISSN-0974-6323	Vol. 9 (1): P.n.: 25-32. January, 2016
14	Bhandkoli, S. L, **Sadawarte, R. K** and Mohite, A. S.	Inboard Diesel Engine fitted with gill Netters Operating along Ratnagiri Coast.	Engineering and Technology in India ISSN 0976-1268	Vol. 7 (1): P.n.: 53-55. April, 2016
15	**R.K.Sadawarte,** V.R. Sadawarte V.B.Mulye, S.J.Meshram,&H.B.D hamgaye	Effect of Ethinyl-estradiol ongrowth of fry of Rosy Barb, *Puntius conchonius*.	Ecology, Environmentand Conservation ISSN 0971-765 X	Vol. 22 (2) P.n.:5201-5203 June, 2016
16	**R.K.Sadawarte,** V.R. Sadawarte V.B.Mulye, S.J.Meshram,&H.B.D hamgaye	Effect of 17 alpha - Methyltestosterone on growth offry of Rosy Barb, *Puntius conchonius*	Ecology, Environment and Conservatio nISSN 0971-765 X	Vol. 22 (2) P.n.: 5205-5208 June, 2016

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20	**R.K.Sadawarte,** V.R. Sadawarte & S.L.Bhandkoli	Effect of natural feed on the growth of Rosy Barb	Ecology and Fisheries. ISSN 0974-6323	Vol. 9 (2) P.n.: 11-14 June, 2016
21	Suhas Bhandkoli, Ashish Mohite and **Rahul Sadawarte**	Marine engines of Wooden Purse Seiners operating along Ratnagiricoast, Maharashtra (India)	GE- International Journal of Engineering Research (GE-IJER) ISSN 2321-1717	Vol. 4, (6) P.n.: 27 to 32 June, 2016
22	Suhas Bhandkoli, AshishMohite **Rahul Sadawarte,** Makarand Sharangdhar and Shrikant Sharandhar	Marine engines of FRP Trawlersof Ratnagiri, Maharashtra (India)	International ResearchJournal of Natural & Applied Sciences (IRJNAS) ISSN 2349-4077	Vol.3, (6) P.n.: 106 to 110 June, 2016
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