CURRICULUM
OF
AGRICULTURAL ENGINEERING

M. Tech. (Agricultural Engineering)
Specialization: Aquacultural Engineering

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Course Structure

Semester I

Sl. No	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	1AE401	Open Channel Hydraulics & Coastal Engineering	3	0	0	3
2.	1AE402	Planning and Design of Aquaculture Project	3	0	0	3
3.	1AE4xx	Programme Elective – I	3	0	0	3
4.	1AE4xx	Programme Elective - II	3	0	0	3
5.	1ST101	Research Methodology & IPR	2	0	0	2
6.	1ST1xx	Audit Course - 1	2	0	0	0
7.	1AE403	Water Quality Management Lab	0	0	4	2
8.	1AE404	Aquaculture Facilities and Equipment Lab-1	0	0	4	2
		Total	**16**	**0**	**8**	**18**

Semester II

Sl. No	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	2AE405	Design of Aquaculture Facilities	3	0	0	3
2.	2AE406	Processing and Preservation of Aquacultural Products	3	0	0	3
3.	2AE4xx	Programme Elective - III	3	0	0	3
4.	2AE4xx	Programme Elective – IV	3	0	0	3
5.	2ST1xx	Audit Course - 2	2	0	0	0
6.	2AE407	Aquaculture Facilities and Equipment Lab-II	0	0	4	2
7.	2AE408	Recirculatory Aquaculture System Lab	0	0	4	2
8.	2AE409	Mini Project	0	0	4	2
		Total	**14**	**0**	**12**	**18**

Semester III

Sl. No	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	3AE4xx	Programme Elective – V	3	0	0	3
2.	3ST2xx	Open Elective	3	0	0	3
3.	3AE410	Dissertation Phase - I	0	0	20	10
		Total	**6**	**0**	**20**	**16**

Semester IV

Sl. No	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	4AE411	Dissertation Phase - II	0	0	32	16
		Total	**0**	**0**	**32**	**16**

Programme Elective – I

1AE412	Planning and Design of Aquacultural Farms
1AE413	Computer Programming and Application in Engineering
1AE414	Fishery Biology and Fish Culture Techniques

Programme Elective – II

1AE415	Water Quality Management Practices
1AE416	Environmental Engineering Fundamentals
1AE417	Land Husbandry and Watershed Management

Programme Elective – III

2AE418	Design of Aquaculture Equipment
2AE419	Recirculatory Aquaculture Systems
2AE420	Water and Wastewater Treatment Engineering

Programme Elective – IV

2AE421	Unit Operations in Aquaculture Products Processing
2AE422	Advanced Water and Wastewater Treatment
2AE423	Advanced Aquaculture Technology

Programme Elective – V

3AE424	Principles of Fishing Technology
3AE425	Modelling of Aquaculture & Fisheries Systems
3AE426	Manpower Economics

Audit Course 1&2

1ST102	English for Research Paper Writing
1ST103	Disaster Management
1ST104	Sanskrit for Technical Knowledge
1ST105	Value Education
2ST106	Constitution of India
2ST107	Pedagogy Studies
2ST108	Stress Management by Yoga
2ST109	Personality Development through Life Enlightenment Skills.

Open Elective Courses

3ST201	Business Analytics
3ST202	Industrial Safety
3ST203	Operations Research
3ST204	Cost Management of Engineering Projects
3ST205	Composite Materials
3ST206	Waste to Energy

Core courses

1AE401, Open Channel Hydraulics & Coastal Engineering

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Solve the problem related to open channel and Coastal Engineering.
- Acquainted with the different type of open channel and their properties.
- Analyze flow profile analysis of open channel
- Strengthen the knowledge to manage the problem related to Ocean Water

Syllabus Contents

Unit 1: Open Channel and their Properties, Energy and Momentum Principle, Critical flow, Uniform Flow, Design of Channels for Uniform flow.

Unit 2: Gradually Varied Flow, Flow Profile Analysis, Flow Over Spillway, Hydraulic Jump, Flow Through Non-prismatic Channel, Gradually Varied Unsteady Flow.

Unit 3: Equilibrium and Dynamic Theory of Tides, Types of Tides and Tidal Theory, Tidal Propagation in the Channel, Estuaries and Coastal Inlets, Tidal Mixing.

Unit 4: Properties of Ocean Water, Provinces of Ocean, Generation and Prediction of waves, Propagation and Transformation of Waves, Longshore Currents, Rip Current, Littoral Transport,

Unit 5: Artificial Protection of Coastline- Structure and forces acting on them, Coastal Protection Planning for Design of Aquacultural Farm.

References

1. Chow, Ven TE, Open Channel Hydraulics, McGraw-Hill International book Company.
2. Kamphuis, J.W. Introduction to coastal engineering and management. Advance series in ocean engineering.
3. Pillay, TVR and Kutty. M N. Aquaculture: Principles and Practices

1AE402, Planning and Design of Aquaculture Project

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Finalize the project site for Aquaculture design the aquaculture Farm.
- Generate scenarios of protection of coastline- structure and forces acting on them.
- Address the pertinent coastal protection planning for design of aquaculture farm.

Syllabus Contents

Unit 1: Selection of Aquacultural Project Site - Water Supply, Soil Type, Topography, Drainage.

Unit 2: Computations for Water Requirement, Seepage and Evaporation, Seed Requirement, Seed Availability.

Unit 3: Environmental Considerations, Tidal Effects, Effects of Flood and Cyclone, Requirements of Manpower, Energy and Equipment. Proposed Cultural Practices and Calculations for Expected Productions.

Unit 4: Market Study and Evaluation of Economic Viability of the project. Society and Social Benefits, Project Layout

Unit 5: Types of Ponds and their Designs, Flow Scheme for Water Supply and Drainage, Flow Channel Design, Inlet and Outlet Designs.

References

1. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer.
2. J.F. Muir and R.J. Roberts, In Recent advances in aquaculture, Croom Helm
3. T.V.R. Pillay M.N. Kutty., Aquaculture: Principles and Practices.

1AE403, Water Quality Management Lab

Teaching Scheme

Lecture: 4 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Maintain water quality parameter in Fish Farm

- Solve the problem related to water quality parameter.

Syllabus Contents

The lab practice consists of the tutorials and experiments as decided by the course supervisor of the course, Water Quality Management Lab. It includes but not restricted to the following:

1. Determination pH of aquaculture pond.
2. Determination of dissolved oxygen concentration of aquaculture pond.
3. Determination of nitrogenous compound of aquaculture pond.
4. Determination of BOD of Aquaculture Pond.
5. Determination COD of Aquaculture pond

References

1. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer.
2. J.F. Muir and R.J. Roberts, In Recent advances in aquaculture, Croom Helm
3. Boyad, C.E. and Tuker C.S. Pond Aquaculture Water Quality Management, Springer

1AE404, Aquaculture Facilities and Equipment Lab-1

Teaching Scheme

Lecture: 4 hours/week

Courses Outcomes

At the end of this course, students will be able to

- design the aquaculture farms.
- calculate the water holding capacity of Aquaculrural Farm
- decide suitable the nature of water flow for fisheries.

Syllabus Contents

The lab practice consists of the tutorials and experiments as decided by the course supervisor of the course, Aquaculture Facilities and Equipment Lab-1. It includes but not restricted to the following:

1. Exercise based on aquaculture farm design.
2. Design of primary dike for aquaculture pond
3. Design of secondary dike for aquaculture pond
4. Determination of water holding capacity of aquaculture pond
5. Determination of Reynolds' number and Froude number in open channel
6. Demonstration of laminar and turbulent flows.

7. Exercise based on different types of open channel flow
8. Demonstration of critical flow and critical depth.

References

1. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer.
2. J.F. Muir and R.J. Roberts, In Recent advances in aquaculture, Croom Helm
3. Boyad, C.E. and Tuker C.S. Pond Aquaculture Water Quality Management, Springer

2AE405, Design of Aquaculture Facilities

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Select the suitable size of Tank and Raceway for Aquaculture
- Design the pens, cages and raceways
- Understand need of Development of Hatchery

Syllabus Contents

Unit 1: Tanks and Raceways: Type, Uses and Design and Selection Criteria in Aquacultural Farms.

Unit 2: Water Circulation Systems: Type and Material of Construction

Unit 3: Design and construction of enclosures for mariculture operations, pens, cages, raceways, flow through systems and re-circulatory systems. Selection of materials for mariculture facilities. Sea farming, site selection and structures. Cage farming

Unit 4: Carp Hatchery: Component of carp hatchery, Design, Construction and Operation, Fish Seed Transport.

Unit 5: Fresh Water Prawn Hatchery: Component of carp hatchery Design, Construction and Operation

References

1. Thomas B Lawson. Fundamentals of Aquaculture Engineering
2. Wheaton, F.W. Aquaculture Engineering 1942 Wiler Inter-science publication
3. Santhosh Kumar Garg. Water supply Engineering

2AE406, Processing and Preservation of Aquacultural Products

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Understand the need of fish protein and significance of omega 3 and omega 6 fatty acid
- Prevent the fish product from Spoilage
- Analyze basic concept of quality control methods for Processing and Preservation of Aquacultural Products

Syllabus Contents

Unit 1: Nutritional Aspects of Fish and Fishery Products, Elementary idea of structure and classification of carbohydrate, protein, lipid and amino acids. Essential amino acids and fatty acids. Significance of omega3 and omega 6 fatty acids

Unit 2: Causes of Spoilage of Fresh Fish, Principles of Preservation and Processing.Handling and Transport of Wet Fish-Icing, Containers and Packages. Chilling and Freezing- physical aspects, Methods of Freezing, Typical Frozen Products

Unit 3: Thermal Processing-Principles of Canning, Canning Process, Canned Products. Drying of Fish- Fundamentals, Salting, Methods of Drying, Smoking, Typical Dry Products Miscellaneous Products-Crabs, Molluscs

Unit 4:. Utilization of fishery wastes such as prawn shell, fish offal, fish meal, chitin, chitosan. Fish silage.

Unit 5: – Basic concepts, quality and quality control. Sanitation procedures in seafood processing plants. Waste management in fish processing industries. Risk factors in seafood biotoxins, seafood pathogens, endogenous parasites. Quality control programmes - pre-shipment inspection, IPQC, MIPQC, HACCP and ISO Series in seafood industry. Quality standards in India and major importing countries like USA, Japan and EU

References

1. Biswas, k. P., Fish Processing and Preservation. Daya Publishing House
2. Ninawe, A., kumar R.K., Fish Processing Technology and Product Development. Narendra Publishing House

2AE407, Aquaculture Facilities and Equipment Lab-II

Teaching Scheme

Lecture: 4 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Determine efficiency of Aeration System
- Design the Carp and Prawn hatchery
- Select the suitable and economically viable pumping unit for Aquacultural Farm

Syllabus Contents

The lab practice consists of the tutorials and experiments as decided by the course supervisor of the course, Aquaculture Facilities and Equipment Lab-I1. It includes but not restricted to the following:

1. Performance evaluation of centrifugal pumps
2. Design of aeration system.
3. Determination of SOTR and SAE of aerator.
4. Exercise based on Design of Carp hatchery
5. Exercise based on Design of Prawn hatchery

References

1. Thomas B Lawson. Fundamentals of Aquaculture Engineering
2. Wheaton, F.W. Aquaculture Engineering 1942 Wiler Inter-science publication
3. Santhosh Kumar Garg. Water supply Engineering

2AE408, Recirculatory Aquaculture System Lab

Teaching Scheme

Lecture: 4 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Understand the necessity of recirculatory aquacultural System.
- Select the suitable filter media for RAS
- Evaluate the performance of component of RAS

Syllabus Contents

The lab practice consists of the tutorials and experiments as decided by the course supervisor of the course, Recirculatory Aquaculture System Lab. It includes but not restricted to the following:

1. Demonstration of Recirculating Aquaculture System.
2. Performance evaluation of sand filters
3. Performance evaluation of cartridge filters
4. Performance evaluation of Trickling filters
5. Performance evaluation Disinfection unit
6. Exercise based on performance evaluations of recirculating aquaculture system

References

1. Thomas B Lawson. Fundamentals of Aquaculture Engineering
2. Wheaton, F.W. Aquaculture Engineering 1942 Wiler Inter-science publication
3. Santhosh Kumar Garg. Water supply Engineerin

2AE409, Mini Project
Teaching Scheme Lectures: 4 hours/week
Course Outcomes At the end of this course, • Students will solve a live problem using software/analytical/computational tools. • Students will learn to write technical reports. • Students will develop skills to present and defend their work in front of technically qualified audience.
Syllabus Contents Students can take up small problems in the field of design and development or design refinement of farm machines or computer application in tractor and farm machinery design as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, comparative performance of various farm equipment, conducting experiments on various engineering subjects, studying a software tool for the solution of an engineering problem etc.

3AE410, Dissertation Phase - I
Teaching Scheme Lectures: 20 hours/week
Course Outcomes At the end of this course, • Students will be exposed to self-learning various topics. • Students will learn to survey the literature such as books, national/international refereed

journals and contact resource persons for the selected topic of research.
- Students will learn to write technical reports.
- Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

Guidelines

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

4AE411, Dissertation Phase - II

Teaching Scheme

Lectures: 32 hours/week

Course Outcomes

- At the end of this course,
- Students will be able to use different experimental techniques.
- Students will be able to use different software/ computational/analytical tools.
- Students will be able to design and develop an experimental set up/ equipment/test rig.
- Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
- Students will be able to either work in a research environment or in an industrial environment.
- Students will be conversant with technical report writing.
- Students will be able to present and convince their topic of study to the engineering community.

Guidelines

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

PROGRAMME ELECTIVES – I

1AE412, Planning and Design of Aquacultural Farms

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Enhance the knowledge for selection of Aqua-farm.
- Strengthen the knowledge to identify problem related to farm constructions.
- Design the peripheral and secondary dikes

Syllabus Contents

Unit 1: Site selection of aquaculture farm, General study of chain survey, plain table survey, contouring and leveling. General principles of Theodolite survey Calculation of area of land by trapezoidal and Simpsons rule. Importance of engineering survey for Aquaculture farm

Unit 2 Unit 3: Types of soil, different properties of soil, soil sampling methods, structure and textural classification, grain size distribution, bearing strength, prevention of erosion. Methods of soil compaction and seepage reduction

Unit 4: : Design and construction of aquafarms – type of ponds, shape, size and their orientation from meteriological point. Design of various components of aquafarms – peripheral dykes, secondary dykes, feeder canals, drainage canals.

Unit 5: water intake and outlet systems – seawater intake systems, sluice gate, monks and spillways. Calculation of earthwork for constructing ponds and requirement of water during water exchange.

References

1. Thomas B Lawson. Fundamentals of Aquaculture Engineering
2. Wheaton, F.W. Aquaculture Engineering 1942 Wiler Interscience publication
3. Santhosh Kumar Garg. Water supply Engineering
4. Odd-IvarLekang . Aquaculture Engineering
5. Pillay, TVR and Kutty. M N. Aquaculture: Principles and Practices
6. Michael B.T and Thomas L. Aquaculture water reuse systems

1AE413, Computer Programming and Application in Engineering

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

- Acquaint with comprehensive concept of differentiation and standard integration.

- Understanding simulation programming in MATLAB for Aquaculture related issues.,

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Syllabus Contents

Unit 1: C-programming, arrays, pointers and structures.

Unit 2: MATLAB programming, 2-D and 3-D plotting, Simulation programming in MATLAB.

Unit 3: Computational algorithms and computer arithmetic. Iterative methods and solution to polynomial and simultaneous non-linear equations. Solution to simultaneous algebraic equations.

Unit 4:. Interpolation, Least square approximation of functions, Taylor series representation, Chebyshev series.

Unit 5: Differentiation and integration, Simpson's rule, numerical solution for differential equations.

References

1. King, K.N. 1996. C Programming: A Modern Approach, 1st Edition. W.W. Norton & Co. Inc., New York.
2. Chapman, S.J. 2007. MATLAB Programming for Engineers. Thomson Learning, London.
3. Steffensen, J.F. 2006. Interpolation: Second Edition (Dover Books on Mathematics), Dover Publications, New York.
4. Mircea, V. 2012. Computer Arithmetic: Algorithms and Hardware Implementations. Springer-Verlag Berlin Heidelberg, New Jersy.
5. Atkinson, K., Han, W. and Stewart, D. 2009. Numerical Solution of Ordinary Differential Equations. John Wiley & Sons, Inc., New Jersy.

1AE414, Fishery Biology and Fish Culture Techniques

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Understand the anatomy of Aquatic animal.
- Establish the hypothesis of Ecology and Aquatic Ecosystems
- Develop the novel Culture Techniques in Freshwater.

Syllabus Contents

Unit 1: Principles of Taxonomy, Classification and Nomenclature; Species Concept, External Morphology of Culturable Fin-Fishes, Shell- fishes and Other Commercially Important Aquatic Organisms,

Unit 2: Anatomical Features and Physiological Systems of Fish and Prawn.

Unit 3: Ecology and Aquatic Ecosystems - Freshwater and Marine. Techniques of Artificial Propagation of Different Organisms of Fisheries Importance.

Unit 4: Different Culture Techniques in Freshwater, Brackishwater and Seawater- Composite Fish Culture, Prawn Culture, Mariculture, Cage and Pen Culture, Intensive Fish Culture, etc.

Unit 5: Recycling of Waste Through Aquaculture and Integrated Aquaculture.

References

1. Srivastava C.B.L. A Text book of Fishery Science and Indian Fisheries. Kitab Mahal.
2. Timmons. B. Michal, Recirculating Aquacultural System. Ithaca Publishing Company.
3. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer.
4. Robert R. Stickney, Aquaculture : An Introductory Text, CABI Publishing

PROGRAMME ELECTIVES – II

1AE415, Water Quality Management Practices

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

Understand the importance of water quality parameter for aquatic life.

Buildup knowledge for pond dynamics

Design the water quality management system.

Syllabus Contents

Unit 1: Water quality: Water quality criteria for industrial, drinking, irrigation and aquatic life. Concept of water reuse and recirculation.

Unit 2: Important water quality parameter: pH. Dissolved oxygen, carbon dioxide, Biological Oxygen demand, Chemical oxygen demand and nitrogenous compound

Unit 3:. Pond dynamics. Water Treatment Methods: Aeration, nitrogen removal, carbonate system and pH control, solids removal, disinfection and ion exchange

Unit 4:. Design and Operation of Water Quality Management System and Equipment: Aerator, mechanical and biological filters, settling basin, water exchange and water reuse system.

Unit 5: Mixing and water circulation in ponds, tanks and raceways. Effects of interacting factors on water quality management

References

1. Timmons. B. Michal, Recirculating Aquacultural System. Ithaca Publishing Company.
2. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer.
3. Robert R. Stickney, Aquaculture : An Introductory Text, CABI Publishing

1AE416, Environmental Engineering Fundamentals

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Perceive the different issues, domains and management of environmental engineering
- Have meticulous knowledge for the environmental quality (water and air pollution) and control.

Syllabus Contents

Unit I: Introduction to environmental engineering, Domains of environmental engineering, History of environmental engineering, Environmental issues of emerging concern, laws and regulations, Environmental engineering management, Development of environmental regulations, environmental legislation in India, environmental ethics**.**

Unit II: Ecology and the environment, Ecosystems, Nutrient cycles, Biodiversity, Ecology and the environment, Limnology, Water budget, Population growth.

Unit III: Overview of chemistry, Mass relationships, Units of measurement, Equilibrium,

Acidbase

reactions, Solubility reactions, Redox reactions, Chemical reaction rates; Mass balance.

Unit IV: Overview of microbiology, Microbes in the environment, Microbes in engineering systems, Microbial energetic, Microbial growth kinetics, Microbial genetics; Microbial diseases.

Unit V: Environmental quality, Water pollution (Organic pollutants, Inorganic pollutants, Physical pollutants), Water pollution (Oxygen sag curve), Air pollution (Greenhouse gases; Hazardous gases), Pollution control (Wastewater treatment), Pollution control (Water treatment; Desalination & Membranes; Land-based treatment)

References

1. Davis M.L., Cornwell D.A., "Introduction to Environmental Engineering", Tata McGraw Hill Education (P) Ltd., New Delhi
2. De A.K., "Environmental Chemistry ", New Age International (P) Ltd., New Delhi.
3. Khopkar S.M., "Environmental Pollution Analysis", New Age International (P) Ltd., New Delhi.
4. Cunningham W.P., Cunningham M.A., "Principles of Environmental Science", Tata McGraw Hill
5. Krishnamoorthy B., "Environmental Management, Text Book and Cases", PHI Learning (P) Ltd.
6. Chandrappa R., Das D.B., "Solid Waste Management: Principals and Practice"
7. Droste R.L., "Theory and Practice of Water and Wastewater Treatment", Wiley India (P) Ltd.
8. Dara S.S., "A Textbook of Environmental Chemistry and Pollution Control", S. Chand and Company Ltd., New Delhi.

1AE417, Land Husbandry and Watershed Management

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Familiarize with the concept and issues of land husbandry and watershed management.
- Acquainted with the different watershed development plans and their objectives.
- Classify the land based on land capability classification and land use in different climatic regions.
- Strengthen the knowledge to identify the problem of soil erosion and conservation in watershed management.
- Identify the causes and effect of soil erosion and application of soil conservation techniques.
- Analyze and interpret soil fertility and role of different fertilizers and their management for sustainable farming system

Syllabus Contents

Unit I: The concept of watershed, objectives, characteristics, delineation and coding of watershed, importance of land husbandry in watershed management.

Unit II: Watershed development plan, programmes in retrospect, NWDPRA, the hariayali programme, common guide lines.

Unit III: The problem of soil erosion and conservation, agronomic measures in watershed management, Land preparation and planting methods for conservation

Unit IV: Land capability classification and land use in the humid tropics, more crops per drop: importance of water management

Unit V: Maintenance of soil fertility, Organic Recycling: Role of manures, composts and bio fertilizers, fertilizers and their management, diversity farming system for sustainable

References

1. Suresh, R. Soil and Water Conservation Engineering. Standard Publishers, and Distributors, New Delhi
2. Schwab, G. O., Fangeir, D. D., Edminister, W. T., and Frevert, R.K. Soil and Water Conservation Engineering, John Wiley and Sons.
3. Murty, V.V.N. and Jha, M. K. Land and Water Management Engineering. Kalyani Publisher, Ludhiana, India
4. Tideman, E.M. Watershed Management (Guidelines for Indian Conditions) Omega Scientific Publishers, New Delhi.
5. Sing, Rajvir. Watershed Planning and Management. Yash Publishing House, Bikaner.
6. Dhruvanarayan, V.V. Sastry, G., Patnaik, V. S. Watershed Management. Publ. And Inf. Div. ICAR, New Delhi

PROGRAMME ELECTIVES – III

2AE418, Design of Aquaculture Equipment

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Familiarize with the concept and issues of aquaculture equipments.
- Strengthen the knowledge to select the suitable pumping unit, Blower and air compressors

Syllabus Contents

Unit I: Pumps: Centrifugal, Turbine, Propellor, Air-Lift, Selection and Application in Aquacultural Farms,

Unit 2: Blowers and Air-Compressors: Types, Uses and Applications. Reciprocating air compressors, centrifugal compressors, Rotary screw compressors.

Unit 3: Earth Moving Equipments: Types and Uses in Farm Construction. Performance of earth moving equipments.

Unit 4: Weed Control Equipments: Type and Uses and Applications, Performance of Weeding Tools

Unit 5: Feed Mill Equipment: Pellet Mill, Screw Extruder, Hammer Mill and Mixers, Screening and Conveying Equipment, Dryers, Fish Feeders

References

1. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer.
2. J.F. Muir and R.J. Roberts, In Recent advances in aquaculture, Croom Helm.
3. Gupta O. P., Weed Management Principles and Practices

2AE419, Recirculatory Aquaculture System

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Familiarize with the concept and issues of Recirculatory Aquaculture system (RAS).
- Acquainted with the different component of RAS.
- Strengthen the knowledge to identify the problem of RAS
- Develop the small scale Recirculatory Aquaculture system

Syllabus Contents

Unit I: Concept of Recirculatory Aquaculture system, need and components of Recirculatory Aquaculture system, Advantage and disadvantage of recirculatory aquaculture system.

Unit 2: Type of culture unit, requirement of culture unit, constructions of pond and tank, calculations of water holding capacity of pond and Tank. Limitations of embankment type culture unit.

Unit 3: Type of Solid removal unit, mechanical filtration, uses of rapid sand filter, uses and limitation of pressure filter and cartridge filter, efficiency of rapid sand filter, pressure and cartridge filter**.**

Unit 4: Type of Nitrogen removal unit, Biofiltration, trickling filters, types and selection of filter media for the trickling filter, calculation of TAN, Efficiency of trickling filters.

Unit 5: Type of Disinfection unit, selection of type of disinfection unit for RAS, Advantage of UV-unit, Economics of RAS

References

1. Davison, A., Recirculating Aquaculture Systems: A Guide to Farm Design and Operations Aquaculture Technology.
2. Richard, S. W., Flowing Water and Static Water Fish Culture. 1st Edition, Kindle Edition. CRC Press.
3. Losordo, T. M., Aquaculture Water Reuse Systems: Engineering Design and Management. Elsevier Science.
4. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer.

2AE420, Water and Waste water Treatment Engineering

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Aware of the importance and the scope of waste water treatment and management.
- Outline the concept and methods of waste water treatment processes.
- Acquaint and equip with techniques of water and wastewater treatment and management

Syllabus Contents

Unit I: Total Water Management - Hydrologic Cycle, Supply and Demand, Regulations, Watershed Management, Ground and Surface Water, Hydrology, Overview of Water Treatment –Supply Water Characteristics, Water Quality, Drinking Water Standards, Water Chemistry, Chemical Reaction and Kinetics, Water Conveyance and Distribution, Hydraulics

Unit II: Conventional Water Treatment Processes - Aeration, Sedimentation, Rapid Mixing, Flocculation, Coagulation, Filtration, Disinfection, Flouridation, Water Softening, Turbidity Removal, Taste and Odor Control, Advanced Water Treatment Processes - Ion Exchange, Ozonation, Adsorption, Ultra Filtration, Membrane Processes, UV Disinfection

Unit III: Overview of Wastewater Management - Wastewater Characteristics, Flows and Pollutant Loads, Biochemistry and Microbiology, Sanitary and Stormwater Collection Systems, Effluent Quality Standards, Receiving Stream Quality, Design Standards, Economic Analysis

Unit IV: Wastewater Preliminary and Primary Treatment Processes - Screening, Grit Removal, Sedimentation, Secondary Wastewater Treatment Processes - Activated Sludge, Trickling Filters, Rotating Biological Contactors, Stabilization Ponds, Lagoons, Aeration, Clarification, Filtration, Chlorination-Dechlorination

Unit V: Advanced Wastewater Treatment Processes - Chemical Coagulation, Carbon Adsorption, Phosphorus Removal, Nitrogen Removal (Nitrification/Denitrification), Media Filtration, UV Disinfection, Solids Handling Processes - Gravity Thickening, Flotation Thickening, Dewatering, Pressure Filtration, Stabilization, Aerobic and Anaerobic Digestion, Composting, Drying, Incineration, Land filling, Land Application

References

1. Water, waste water and storm water infrastructure management by Neil S Grigg

2. Water, sanitary and waste services for buildings by a F E Wise and J A Swaffield
3. Handbook of water treatment by Kurita water industries limited, Japan
4. Standard handbook of environmental engineering by Robert A Corbitt
5. Sanitation and water supply handbook by Tony Gage
6. Handbook of water and wastewater treatment technologies by Nicholas P. Cheremisinoff

PROGRAMME ELECTIVES – IV

2AE421, Unit Operations in Aquaculture Products Processing

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Familiarize with the concept and issues of Unit Operations in Aquaculture Products Processing.
- Strengthen the knowledge to Pre-treatment of fish.
- Analyze and interpret Rigor mortis and methods of controlling spoilage.

Syllabus Contents

Unit I: Pre-treatment of fish washing, gutting, filleting, beheading, peeling, deveining etc. Simple mechanical refrigeration systems. Ice plants, chilling, supper chilling, refrigerated and chilled seawater.

Unit 2: Freezing, slow freezing, quick freezing, types of freezers, freezing time, freezing of fish and shell fish. Anti-oxidant treatment-Glazing of fish-Types of glazing- Packaging and packaging materials for frozen fish and shrimps. Storage life, transportation and marketing.

Unit 3: Sanitary and phytosanitary requirements for maintenance of quality during post harvest handling of fish. processing unit construction and management; Water budgeting; Waste management. Sanitation in processing plants and Quality control of fresh and processed fish and fishery products

Unit 4: Post mortem changes occurring in fish muscle. Chemical, microbial and enzymatic action during fish spoilage Stages of fish spoilage- Rigor mortis, Autolysis, microbial changes, Belly burst, Rancidity. Causative agents for fish spoilage. Role of bacteria in fish spoilage, Effect of temperature, pH, Oxygen, Salinity etc. on bacterial growth, methods of controlling spoilage

Unit 5: Principles and methods involved in the separation and analysis of fish muscle constituents: thin layer, paper & column chromatography, spectrophotometry, colorimetry, flame photometry, atomic absorption spectrophotometry, gel electrophoresis.

References

1. Balachandran, K. K., Post-harvest Technology of fish and fish products.
2. Cleland C Andrew, Food Refrigeration Processes,
3. Clucas, I.J., Fish Handling, Preservation and Processing in the Tropics:
4. Fennema,K. et al. Low Temperature Preservation of Foods and Living Matter
5. Fennema, O. R. Principle of Food Science.
6. Gopakumar K. Text Book of Fish Processing Technology.
7. Hall G. M. Fish Processing Technology
8. Regenssein, J.M. & Regenssein, C.E. Introduction to fish technology.
9. Sen D.P. Advances in Fish Processing Technology. 10. Rudolf, K. Freezing and irradiation of fish.

2AE422, Advanced Water and Wastewater Treatment

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Identify the importance and the scope of Advance waste water treatment and management.
- Outline the concept and methods of Advance waste water treatment processes.
- Acquaint and equip with Advance techniques of water and wastewater treatment and management

Syllabus Contents

Unit I: Conventional water and waste water treatment methods, their capabilities and limitations, Need for advanced treatment of water and waste water.

Unit 2: Advanced water treatment- Iron and manganese removal, colour and odour removal,

activated carbon treatment, carbonate balance for corrosion control, ion exchange, electro-dialysis, reverse osmosis and modern methods and flouride management.

Unit 3: Advanced waste water treatment- Nutrient control in effluents, Nitrogen and phosphorus removal methods including biological methods, Methods for the removal of heavy metals, oil and refractory organics, Micro-screening, ultra-filtration, centrifugation and other advanced physical methods- aerobic digestion, anaerobic filtration.

Unit 4: Rotating biological contractor, novel methods of aeration etc., Combined physico-chemical and biological processes, Activated carbon treatment, chlorination of waste water, Pure oxygen systems, Filtration for high quality effluents.

Unit 5: Multistage treatment systems, Land and water treatment and other resources recovery systems

References

1. Water, waste water and storm water infrastructure management by Neil S Grigg
2. Water, sanitary and waste services for buildings by a F E Wise and J A Swaffield
3. Handbook of water treatment by Kurita water industries limited, Japan
4. Standard handbook of environmental engineering by Robert A Corbitt
5. Sanitation and water supply handbook by Tony Gage
6. Handbook of water and wastewater treatment technologies by Nicholas P. Cheremisinoff

2AE423, Advanced Aquaculture Technology

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Understand the requirement of hatchery
- Necessity of Aquaculture with Agriculture and Livestock
- Understand the Environmental Considerations in Aquaculture

Syllabus Contents

Unit I: Maturation, Spawning, Hatchery and Grow-out Techniques for Crustaceans, Culture of Molluscs, Sea Weeds etc.

Unit 2: Carp hatchery and Seed Transport, Advanced Aquaculture-Farming Systems,

Propagation and Stock Improvement,

Unit 3: Nutrition and Growth, Health and Diseases, Aquaculture with Agriculture and Livestock Farming

Unit 4: Hydroponics in Aquaculture, Use of Geothermal Water, Recirculating Aquaculture Systems, Offshore Farming, Artificial Reefs, Sea Ranching.

Unit 5: Environmental Considerations in Aquaculture, Impacts from Aquaculture Operations Effects on natural resources, Effects of Aquaculture on National Interests.

References

1. Y. Sreekrishna, Latha Shenoy, F ishing Gear and Craft Technology, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research.
2. Balachandran, K. K., Post-harvest Technology of fish and fish products.
3. Richard, S. W., Flowing Water and Static Water Fish Culture. 1st Edition, Kindle Edition. CRC Press.
4. Losordo, T. M., Aquaculture Water Reuse Systems: Engineering Design and Management. Elsevier Science.
5. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer.
6. Cleland C Andrew, Food Refrigeration Processes,

PROGRAMME ELECTIVES – V

3AE424, Principles Fishing Technology

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Familiarize with the concept and issues of land Fishing Gear and Fishing Vessels, Netting Materials.
- Acquainted with the concept of buoyancy and water plane area and volume.
- Strengthen the knowledge Economics of Trawler Operation .

Syllabus Contents

Unit I: Classification of Fishing Methods, Fishing Gear and Fishing Vessels, Netting Materials, Numbering System.

Unit 2: Concept of Buoyancy, Geometry of Ship Hull. Netting Geometry, Fishing Efficiency, Fishing Gear Selectivity. Tailoring of Nets. Ships Transverse Section Area.

Unit 3: Water Plane Area and Volume of Displacement. Analysis of Shape of Flexible Systems. Hydrodynamic Force on Fishing Gear and Resistance of Fishing Vessels

Unit 4: Model Similarity Laws. Concept of Stability of Ship. Material of Construction of Fishing Vessels

Unit 5: Theory of Trawl Motion and Trawl Design. Economics of Trawler Operation. Visit to Fishing Harbour

References

1. Y. Sreekrishna, Latha Shenoy, F ishing Gear and Craft Technology, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research.
2. Regenssein, J.M. & Regenssein, C.E. Introduction to fish technology.
3. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer

3AE425, Modeling of Aquaculture & Fisheries Systems

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Understand the concept and issues of fisheries.
- Strengthen the knowledge to identify the problem of aquaculture and modelling.
- Identify model parameter related to aquaculture to solve the problem.

Syllabus Contents

Unit 1: Modelling –Modelling terminology - systems and models – constraints to modelling aquaculture systems.

Unit 2: Modelling aquaculture systems – need – tools for theoretical analysis study of interactions, use of mathematics and computers.

Unit 3: Empirical modelling – collection and organizing data and calculations, Theoretical models – developing a frame of reference, defining model objectives, determination of model components – relationship between model components –

Unit 4: Estimation of model parameters and calibration of model – testing and validating of model – simulation and forecasting.

Unit 5: Application of modelling in Aquaculture – fish growth model – pond ecosystem model – dissolved oxygen model, ammonia model, water temperature model, salinity model, recirculating aquaculture model.

References

1. Fikret Berkes, Robin Mahon, Patrick mcconney, Richard Pollnac, and Robert Pomeroy. Managing Small-scale Fisheries. International development research centre. New Delhi.
2. Bernard A. Megrey l Erlend Moksness Editors. Computers in Fisheries Research. Second Edition. Springer.
3. Robert R. Stickney. Aquaculture: An introductory text. CABI Publishers.

3AE426, Manpower Economics

Teaching Scheme

Lecture: 3 hours/week

Courses Outcomes

At the end of this course, students will be able to

- Acquainted with the different problem related to Employment.
- Strengthen the knowledge to manage the labour union
- Understand the economics behind human capital.

Syllabus Contents

Unit 1: Nature and scope; Human capital formation; Employment and manpower utilization: supply of and demand for labour, pricing of labour under various market forms,

Unit 2: labour unions and collective bargaining, compensating wage differentials, labour market discrimination;

Unit 3: Concepts and patterns of unemployment and underemployment; Emergence of education

as a work prerequisite; Returns to investment in education.

Unit 4: Economics of training and motivation; Manpower planning: quantitative and qualitative techniques Forecasting and auditing of manpower.

Unit 5: Manpower planning and total quality management; Comparative manpower planning and development policies of selected countries

References

1. E.B. Jakubauskas, N.E. Palomba, Manpower Economics Hardcover, Addison-Wesley Educational Publishers Inc.
2. M.A. Sudhir, Skill Development for Socio-economic Progress, New Century Publications;
3. G. Rowe, Manpower Economic Utilization Indexes by Counties, 1970, Forgotten Books publications