।। सा विद्या या विमुक्तये ।।

# स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED**

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

## ACADEMIC (1-BOARD OF STUDIES) SECTION

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**संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील तृतीय वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१–२२ पासून लागू करण्याबाबत.**

# प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, मा. विद्याशाखेने **दिनांक ३१ मे २०२१ रोजीच्या बैठकीतील केलेल्या शिफारशीप्रमाणे व दिनांक १२ जून २०२१ रोजी संपन्न झालेल्या ५१ व्या मा. विद्या परिषद बैठकीतील विषय क्र. २६/५१–२०२१**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील तृतीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१–२२ पासून लागू करण्यात येत आहेत.

1. B.Sc.-III Year-Biophysics
2. B.Sc.-III Year-Bioinformatics
3. B.Sc.-III Year-Biotechnology
4. B.Sc.-III Year-Biotechnology (Vocational)
5. B.Sc.-III Year-Botany
6. B.Sc.-III Year-Horticulture
7. B.Sc.-III Year-Agro Chemical Fertilizers
8. B.Sc.-III Year-Analytical Chemistry
9. B.Sc.-III Year-Biochemistry
10. B.Sc.-III Year-Chemistry
11. B.Sc.-III Year-Dyes & Drugs Chemistry
12. B.Sc.-III Year-Industrial Chemistry
13. B.C.A. (Bachelor of Computer Application)-III Year
14. B.I.T. (Bachelor of Information Technology)-III Year
15. B.Sc.-III Year-Computer Science
16. B.Sc.-III Year-Network Technology
17. B.Sc.-III Year-Computer Application (Optional)
18. B.Sc.-III Year-Computer Science (Optional)
19. B.Sc.-III Year-Information Technology (Optional)
20. B.Sc.-III Year-Software Engineering
21. B.Sc.-III Year-Dairy Science
22. B.Sc.-III Year-Electronics
23. B.Sc.-III Year-Environmental Science
24. B.Sc.-III Year-Fishery Science
25. B.Sc.-III Year-Geology
26. B. A./B.Sc.-III Year-Mathematics
27. B.Sc.-III Year-Microbiology
28. B.Sc.-III year Agricultural Microbiology
29. B.Sc.-III Year-Physics
30. B. A./B.Sc.-III Year Statistics
31. B.Sc.-III Year-Zoology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
**जा.क्र.:** शैक्षणिक–१/परिपत्रक/पदवी–सीबीसीएस अभ्यासक्रम/२०२१–२२/७५

**दिनांक :** १२.०७.२०२१.

स्वाक्षरित
**सहा.कुलसचिव**
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :
१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.
७) अधीक्षक, परिक्षा विभाग विज्ञान व तंत्रज्ञान विद्याशाखा प्रस्तुत विद्यापीठ.

स्वामी रामानंद तीर्थ
मराठवाडा विद्यापीठ,नांदेड.

# SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

**SEMESTER PATTERN CURRICULUM**

**UNDER**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**COURSE STRUCTURE (NEW SCHEME)**

**B. SC. THIRD YEAR**

**SUBJECT: FISHERY SCIENCE**

**FROM JUNE 2021**

SWAMI RAMANAND TREETH MARATHWADA UNIVERSITY, NANDED
SEMESTER PATTERN CURRICULUM UNDER
CHOICE BASED CREDIT SYSTEM (CBCS)

**Faculty of science**
**Under Graduate (UG) Programme**
**Subject Fishery Science**
**(w.e.f. June 2021)**

| Semester /Annual | Course Name. | | Paper No.& Title Of paper | Total Periods/ Periods Per week | Marks for | | Credits/ Marks |
|---|---|---|---|---|---|---|---|
| | | | | | Internal (CA) | External (ECS) | |
| Semester V | CCFS-V | Section A | XII (A): Indian Marine Fisheries | 45 03/week | 10 | 40 | Cre. 02 Mar.50 |
| | | Section B | XIII (B I): Aquaculture Techniques & fish Nutrition **OR** XIII (B II): Soil & water management in aquaculture | 45 03/week | 10 | 40 | Cre. 02 Mar.50 |
| Annual pattern | SECFS III | | (A): Fish feed production Technology (Theory + practical) **OR** (B): Culture of fish food Organisms (Theory + practical) | 25 2+1 | 25 | 25 | Cre. 02 Mar.50 |
| Semester VI | CCFS-VI | Section A | XIV(A): Ornamental fish production and Management | 45 03/week | 10 | 40 | Cre. 02 Mar.50 |
| | | Section B | XV (B I): Fisheries Economics co-operative & marketing management **OR** XV (B II**):** Nutrition and feed technology | 45 03/week | 10 | 40 | Cre. 02 Mar.50 |
| Annual pattern | SECFS IV | | (A) Fabrication of aquarium (Theory + practical) **OR** (B) Breeding technique of ornamental fishes (Theory + practical) | 25 2+1 | 25 | 25 | Cre. 02 Mar.50 |
| Annual pattern | CCFSP IV | | Practical XVI (A): Based on theory papers XII (A)+ XIV (A) | 20 | 10 | 40 | Cre.02 Mar.50 |
| Annual pattern | CCFSP V | | Practical XVII (B I): Based on theory papers XIII (B I) + XV (B I) **OR** Practical XVII (B II): Based on theory papers XIII (B II) + XV (B II) | 20 | 10 | 40 | Cre.02 Mar.50 |
| **Total credits of semester V&VI** | | | | | **110** | **290** | **Cre.16 Mar.400** |

**CCFS: Core Course Fishery Science, CCFSP**: **Core Course Fishery Science Practical**
**SECFS: Skill enhancement Course Fishery Science CA: Continuous Assessment, ECS: End of semester examination**

## Syllabus Introduction and Outcome

Swami Ramanand Teerth Marathwada University, Nanded has implemented choice based credit system (CBCS) pattern at UG and PG level from academic year 2016-17 as per the guidelines of University Grant Commission (UGC) New Delhi. Revision and updating of the curriculum is continuous process to provide updated knowledge & technical knowhow to students.

As a part of revision and updating of the curriculum; Swami Ramanand Teerth Marathwad University Nanded, revised syllabus of First Year courses at under graduate as well as post graduate level for the academic year 2019-20 while syllabus of Second year courses was revised from academic year 2020-21. The revised syllabus found very advantageous for the students to acquire updated knowledge and skills. The process of revision and implementation of new curriculum for B.Sc. Third year students have been continued from June 2021.

Newly framed syllabus for the subject of Fisheries science subject of third year B.Sc. program has been designed according to the 03 year syllabus structure which was submitted during the academic year 2019-2020.

All members of Board of studies in fishery science took lot of efforts to design this new curriculum. The new syllabus includes six theory papers, three practical papers and four Skill Enhancement Course (SEC) paper. Out of six theory papers, Section A in each semester (Sem V and VI) contains one compulsory papers. On the other hand, Section B in each semester (Sem V and VI) contains Two elective papers from which any one can be selected for teaching. Thus student has to study four theory papers, two (one compulsory and one elective) theory paper for each semester to complete fishery science subject for third year. Similarly, student can opt any one SEC course in each semester out of two SEC papers offered in each semester for completion of third year. Thus student has to undergo two SEC papers out of four papers offered. Out of three practical papers, Practical paper no XVI based on section A of theory papers is compulsory. On the other hand, Practical Paper XVII has two elective practical papers based on elective theory papers of Section B, of which one paper has to be completed by the students.

All theory papers [XII, XIII (BI/BII), XIV & XV (BI/BII)], practical papers [XVI (A) & XVII (BI/BII)] as well as SEC paper of Third year Fishery Science subject have been revised.

Theory Paper-XII entitled “Indian Marine Fisheries” from Section A of fishery science subject for Semester V is compulsory paper encompassing the study of fisheries of different

marine finfish and shellfish species, study of mariculture activities of some commercially important species as well as fisheries of important lakes and estuaries in India.

Theory Paper- XIII of Section B of Semester V contains two elective papers namely, Aquaculture Technique and Fish nutrition (Elective B I) & Soil and Water Quality Management in Aquaculture (Elective B II). Student has to complete any one of these two elective papers during semester V. Aquaculture Technique and Fish nutrition (Elective B I) contains the detailed study of culture techniques of some commercially important finfishes and shell fishes along with detailed studies on fish nutrition, ingredients for fish feed, fish feed formulation & storage as well as probiotics in aquaculture along with their selection, composition, dosages and modes of action. This paper will impart the knowledge and skills in the student to undertake aquaculture activities for their livelihood and self-employment. Second elective paper entitled Soil and Water Quality Management in Aquaculture (Elective B II) deals with the study of Physical and chemical properties of water and soil, Aquatic microorganism and their role in nutrient cycles, soil and water quality monitoring, fertilizers and manures as well as soil and water quality management in different aquaculture systems.

Section A of fishery Science subject for Semester VI contains compulsory Theory Paper no XIV entitled "Ornamental Fish Production and Management (A)". This paper will impart the knowledge as well as technical knowhow with respect to the ornamental fish production and management. This paper includes the study of different ornamental aquatics species, their breeding and larval rearing, disease management of ornamental fishes, aquarium fabrication, setting and management. On successful completion of this paper, student would be able to start their own ornamental related business ventures and activities.

Section B of Fishery Science Subject for Semester VI offers two elective theory papers *viz.* Fisheries Economics co-operative & marketing management XV (Elective B I), Nutrition and Feed Technology (Elective B II). Student has to study any one of these two courses based on the selection of elective paper from Section B in Semester V. Fisheries Economics co-operative & marketing management XV (Elective B I) provides detailed insight to student into fishery economics, fishery marketing, fish cooperative and fisheries extension. Nutrition and Feed Technology (Elective B II) offers study of Fish nutrition, nutritional requirements of fishes, nutritional physiology, fish feed resources, feed additives, fish feed formulation and manufacture, feeding methods and schedules as well as performance of feed and its economics. Completion of this paper will enable student to star fish feed manufacturing venture.

Practical paper XVI is based on the theory papers of the Section A of Semester V and VI. Practical paper XVII contains two elective practical papers XVII B I and XVII B II based on the elective theory papers of Section B I and B II respectively. If theory papers of Section B I of

Fishery Science subject for semester V & VI are elected, student has to undergo Practical Paper XVII (B I). On the other hand, if theory papers of Section B II of Fishery Science subject for semester V & VI are elected, student has to undergo Practical Paper XVII (B II). All the three practical papers are framed and designed to cater the technical and practical knowledge as well as hands-on training with respect to the identification of commercial important aquatic species, fisheries of commercially important finfish and shell fish species, culture of different aquatic species, soil and water quality management in aquaculture, ornamental fish breeding, rearing and management, fish economics, fishery marketing, fish cooperatives, fishery extension, fish nutrition and feed technology, etc.

In addition to this, fishery science subject for third year offers four papers of Skill Enhancement Course (SEC) for fulfillment of the B.Sc. degree program as per University norms and regulations. These skill enhancement courses not only provide technical knowledge and knowhow but also imparts hands-on training for different skills with respect to fishery industry. These skill enhancement courses will be helpful for students to initiate fishery activities and related business ventures for self-employment and livelihood generation.

Two optional papers offered under Skill Enhancement course (SEC) of Fishery Science subject during each of the semester V and VI. During V Semester, SEC III (A) and SEC III (B) are offered for selection while SEC IV (A) and SEC IV (B) are available selection during VI Semester. Students can opt any one out of the two available SEC papers for each semester during third year.

SEC III (A) paper entitled "Fish feed production Technology" will provide student with detailed knowledge, technical knowhow and hands-on training with respect to Fish feed, feed ingredients & additives, fish feed formulation, feed types, feed processing and manufacture, quality control and storage of fish feed, etc.

Theory and practical syllabus of SEC III (B) paper entitled "Culture of Fish Food Organisms" will provide detailed insight into different fish food organisms, their life cycles, culture techniques of different fish food organisms, etc.

SEC IV (A) paper entitled "Fabrication of Aquarium" will provide detailed information and handson training with respect to aquarium, types of aquarium, accessories used for aquarium, fabrication and setting of aquarium, management of aquarium, etc. SEC IV (B) paper entitled "Breeding Techniques of Ornamental Fishes"will impart the skills and knowledge with respect to different ornament fishes, their breeding behavior, breeding techniques of different ornamental fishes, etc.

Framing, designing and updating of any curriculum is very challenging task, which can't be fulfilled by single person. It requires combined efforts, inputs and expertise of educators as

well as industry personal. Being a chairman of Board of studies in fishery science, I have endeavored to seek the contribution of all BOS members in fairly good unanimity with one another and have uniformity of the concept in order to bring out a new curriculum which will be very useful for students. Therefore, I am very grateful to all BOS members who have cooperated me very sincerely during designing this syllabus, even during the challenging time period due to covid-19 pandemic.

## Objectives of course

- To introduce and popularize the fisheries education among the society.
- To provide information regarding fisheries of different commercial important species.
- To impart the knowledge and skills with respect to culture of different commercially important aquatic species.
- To create awareness and provide detailed knowhow regarding fish nutrition as well as fish feed formulation and manufacture.
- To train and provide skills for water quality monitoring and management in different aquaculture and fishery activities.
- To provide detailed knowledge and skills required for ornament fish activities.
- To provide detailed insight into fishery economics, marketing, cooperatives and extension education.
- To create entrepreneurs in different fishery activities and businesses.
- To create skilled and technically sound manpower to serve for different fishery activities in government, private and industrial sector.
- To create the job opportunities, self-employment and entrepreneurship development through fisheries education.
- To promote research and development with respect to fishery sector among the students.
- To provide the latest knowledge, tools and techniques of fish production as well as management for fish farmers.
- To make awareness regarding conservation and management of natural freshwater recourses and biodiversity.
- To provide and promote the skill based practical knowledge through skill development courses.

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED**
**Choice Based Credit System (CBCS) Course Structure (New Scheme)**
**B. Sc. Third Year (V - SEMESTER)**
**Effective from June 2021**
**FISHERY SCIENCE**
**CCFS V (Section-A)**
**Theory Paper - XII Indian Marine Fisheries (A)**

**Total period 45** **Marks 50**

**Unit – I:**

**Study of marine fisheries** (classification, external feature, distribution, food & feeding, reproduction)

1) Sardine fishery.
2) Bombay duck fishery.
3) Mackerel fishery.
4) Sole fishery

**Unit – II**

1) Hilsa fishery.
2) Pomfret fishery.
3) Mollusk fishery, (Cephalopod, Chanks)
4) Prawn fishery.

**Unit – III:**

**Mericulture**

1) Prawn Culture.
2) Mussel Culture (Edible oyster)
3) Pearl oyster culture.
4) Seaweed culture.

**Unit – IV:**

**Important lakes and Estuarine fisheries of India**

1) Hooghly-Matla estuary
2) Chilka lake
3) Pulicat lake
4) Kolleru lake

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**FISHERY SCIENCE**
**CCFS V (Section-B)**
**Theory Paper – XIII**
**Aquaculture Technique and Fish nutrition (Elective B I)**

**Total period 45** **Marks: 50**

**Unit – I: Fish culture**

1. Culture of Indian major carps.
2. Culture of air breathing fishes.
3. Culture of milk fish – *Chanos chanos.*
4. Culture of sea bass.
5. Culture of crabs.

**Unit – II: Marine water prawn culture**

1. Study of general characteristics.
2. Food and feeding.
3. Selection of site.
4. Collection of broods.
5. Mating and spawning.
6. Development.
7. Water quality for culture.
8. Prawn rearing.
9. Larval food supply.
10. Methods of fishing.

**Unit- III : Fish Nutrition**

1) Ingredients for fish feed.
   i) Mill - by – Products.
   ii) Oil extractives.
   iii) Animal by- products.
   iv) Miscellaneous.
2) Fish feed formulation.
   i) Balancing crude protein level.
   ii) Steps in feed formulation.
   iii) Best-bye techniques.
   iv) Storage and distribution.

**Unit- IV: Aquaculture and Probiotics**

1) Introduction and Definition.
2) History of probiotics.
3) Selection criteria for probiotics
4) Composition and dosages.
5) Potential of probiotics
   i) Pathogen inhibition
   ii) Growth promoters
   iii) Water quality maintenance
6) Overall significance of probiotics in aquaculture.

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED**
**Choice Based Credit System (CBCS) Course Structure (New Scheme)**
**B. Sc. Third Year (V - SEMESTER)**
**Effective from June 2021**
**FISHERY SCIENCE**
**CCFS V (Section-A)**
**Theory Paper XIII**
**Soil and Water Quality Management in Aquaculture (Elective B II)**
**Total period 45** **Marks-50**

**UNIT I: Soil and water interaction**

1. Physical properties of water
2. Chemical properties of water
3. Physical properties of soil
4. Chemical properties of soil
5. Aquatic microorganisms and their role in carbon, nitrogen, phosphorus and Sulphur cycles and impact on aquatic habitats and species.

**UNIT II: Soil and water quality monitoring**

1. Soil and water quality standards.
2. Soil and water quality monitoring and management.
3. Productivity and eutrophication of water resources

**UNIT III: Fertilizers and manures**

1. Different kinds of fertilizers, biofertilizers, manures and their applications.
2. Use of treated sewage for pond fertilization,
3. Ecological changes taking place after fertilizing.
4. Utilization of bioactive compounds by microorganisms.

**UNIT IV: Soil and water quality management**

1. Waste water treatment, water filtration devices, aeration, chlorination, Ozonization and UV radiation.
2. Aquatic weed management.
3. Water quality management in hatcheries,
4. Productivity and eutrophication of water resources

**Suggested Readings:**


- Adhikari S & Chatterjee D K. (2008). Management of Tropical Freshwater Ponds. Daya Publ.
- APHA, AWWA, WPCF. (1998). Standard Methods for the Examination of Water and Wastewater, 20th Ed. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Washington, D. C.
- Boyd, C. E. and Tucker, C. S. (1992). Water Quality and Pond Soil Analyses for Aquaculture, Alabama Agricultural Experimental Station, Auburn University.
- Boyd C E. (1979). Water Quality in Warm Water Fish Ponds. Auburn University.
- Handbook of Fisheries and Aquaculture. ICAR, New Delhi.

1. Introduction
2. Importance of feed
3. Factors affecting feed design, production and feeding
4. Nutritional requirement of fishes
5. Formulated fish feed
   a. Ingredients for fish feed (Animal origin & plant origin)
   b. Feed Additives (Binders, antioxidents, antimicrobial agents, chemo attractants, feeding stimulants, Pigments, anabolic agents, miscellaneous)
   c. Fish Feed Formulation
   d. Feed types (Wet feed, Moist, Dry, Larval)
   e. Selection of ingredients
   f. Formulation of feed
   g. Feed processing (Premix processing, grinding, mixing, pelleting, extrusion cooking, cooling, drying, crumbling, fat spraying, bagging, storage, quality control)
   h. Storage
   i. Quality control

**Suggested Readings:**

- De Silva, S. S. and T. A. Anderson. 1995. Fish nutrition in aquaculture, Chapman and Hall, London.
- Paulraj, R. 1997. Hand book on Aquafarming: Aquaculture Feed. Manual, MPEDA, Cochin. 103 pp. http://eprints.cmfri.org.in/id/eprint/6890.

1. Introduction:
2. Micro algae Culture
3. Infusoria Culture
4. Rotifer Culture
5. Artemia nauplii Culture
6. Moina-Cladocerans Culture
7. Tubifex worms Culture
8. Chironomids Culture

**REFERENCES**

1. V. G. Jhingran, (1991). Fish and fisheries of India. Edition-3, Hindustan Pub. Corp. (India), 727.
2. S. Ayyappan, J. K. Jena, A. Gopalakrishnan, Dr. A. K. Pandey, (2011). Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, New Delhi, 755.
3. FAO Technical Paper No.361. Manual on production and use of live food in aquaculture.
4. Pronob Das, Sagar C. Mandal, S. K. Bhagabati, M. S. Akhtar and S. K. Singh (2012). Important Live Food Organisms And Their Role In Aquaculture, Frontiers in Aquaculture, 2012: 69–86.
5. Handbook on Aqua farming: Aquaculture Feed, MPEDA.

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED**
**Choice Based Credit System (CBCS) Course Structure (New Scheme)**
**B. Sc. Third Year (VI - SEMESTER)**
**Effective from June 2021**
**FISHERY SCIENCE**
**CCFS VI (Section-A)**
**Theory Paper – XIV**
**Ornamental Fish Production and Management (A)**

**Total period 45** **Marks 50**

**Unit – I**

1) Study of important ornamental fishes: Commercially important ornamental fishes and other ornamental organisms (Taxonomy and general characters only)
   a) **Indigenous ornamental fishes:** i) *Brachydanio rerio* (Zebra fish), ii) *Chanda nama* (Glass fish), iii) *Botia lohachata* (Reticulated loach), iv) *Notopterus notopterus* (black knife fish)
   b) **Exotic ornamental fishes:** i) *Carassius auratus* (Goldfish), ii) *Betta splendens* (Siamese fighting fish), iii) *Poecillia reticulate* (Guppy), iv) *Xiphophorus helleri* (Sword tail fish)
   c) **Other aquatic Ornamental organisms:** i) Octopus ii) Haddons carpet anemone iii) Red knob sea star iv) Red lobster
2) Introduction to ornamental fish industry at national and international level
3) Benefits of ornamental fish keeping hobby.

**Unit- II: Aquarium management**

1) Aquarium fabrication
2) Importance of aquarium
3) Types of aquarium
4) Accessories of aquarium
5) Setting of aquarium
6) Care and maintenance of aquarium
7) Aquarium water quality and management
8) Aquarium plants
9) Food for Aquarium fishes
10) Culture of live fish food organism: a) Artemia b) Tubifex worm c) Infusoria

**Unit – III: Breeding of ornamental fishes**

1) Identification of male and female brooders
2) Breeding technique of ornamental fishes
   a) Egg layers: i) Barbs, ii) Gold fish, iii) Zebra danio, iv) Gourami
   b) Live Bearers: i) Guppy, ii) Mollies, iii)Sword tail, iv) Platty
3) Transportation of live aquarium fishes.

**Unit IV: Disease management of ornamental fishes**

(Disease causing organisms Symptoms, treatment and control measures)

1) Protozoan disease
2) Bacterial disease
3) Crustacean disease
4) Fungal disease
5) Helminth disease

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**FISHERY SCIENCE**
**CCFS VI (Section-B)**
**Theory Paper – XV**
**Fisheries Economics co-operative & marketing management XV (Elective B I)**
**Total period 45** **Marks 50**

**Unit- I: Fish economics**

1. Definitions and principals of fisheries economics.
2. Terms in economics.
3. Demand.
4. Supply.
5. Cost.

**Unit - II: Fish Marketing**

1. Introduction and definition.
2. Characteristics of fish marketing.
3. Types of marketing: a) Traditional fish market b) Modern fish market.
4. Types of distribution channel: a) Direct distribution channel. b) Indirect distribution channel.
5. Marketing functions:
   a) Functions of exchange, b) Functions of physical supply, c) Facilitating functions.
6. Price structure and problems in fish marketing.

**Unit - III: Fish Co-operatives**

1. Definitions and principals of co-operative societies.
2. History of co-operatives movements in India.
3. Organs of co-operatives
   i) President ii) Vice-presidents iii) Directors iv) Members
   v) Treasurer vi) Auditors vii) Types of meetings
4. Structure of fisheries co-operative society.
   a. Primary co-operative
   b. Regional federation
   c. State level federation
   d. National federation
5. Function of fishermen co-operative society
6. Problems of fishermen co-operative society and their remedial measures.

**Unit – IV: Fisheries Eextension**

1. Role of FFDA
2. Role of remote sensing
   a) Direct methods b) Indirect methods
3. Exclusive economic zone (EEZ)
4. Fisheries institutions of India
   i) Central marine fisheries Research institute - CMFRI
   ii) Central institute of fisheries Technology - CIFT
   iii) Central institute of fisheries Education - CIFE
   iv) Central institute of freshwater Aquaculture - CIFA
   v) Fisheries survey of India - FSI
   vi) National institute for oceanography - NIO

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED**
**Choice Based Credit System (CBCS) Course Structure (New Scheme)**
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**Effective from June 2021**
**FISHERY SCIENCE**
**CCFS VI (Section-B)**
**Theory Paper – XV**
**Nutrition and Feed Technology (Elective B II)**

**Total period 45** **Marks 50**

**UNIT I**

1. Fish nutrition: Principles of fish nutrition and terminologies.
2. Nutritional requirements of cultivable finfish: larvae, juveniles and adults.
3. Nutritional biochemistry: Classification, nutrient quality and evaluation of proteins, lipids and carbohydrates.
4. Role of nutrients: amino acids, fatty acids, proteins, lipids, carbohydrates, vitamins and minerals.

**UNIT II**

1. Nutritional physiology:
   a) Digestion,
   b) Accretions
   c) Nutrient flow,
   d) Factors affecting digestibility.
2. Nutrient deficiency and symptoms

**UNIT III**

1. Feed Resources: Nutritional value of feed ingredients and live feed.
2. Importance of natural food to nutrient requirements of fish
3. Feed additives -attractants, growth stimulants and probiotics and binders

**UNIT IV**

1. Feed Manufacture: Feed formulation and processing.
2. On-farm feed manufacture.
3. Commercial feed manufacture.
4. Feed storage.
5. Supplementary feed.
6. Feeding methods and scheduling.
7. Feed performance and economics.

**Suggested Readings:**


- ADCP (1980). (Aquaculture Development and Co-ordination Programme).
- Fish Feed Technology. ADCP/REP/80/11. FAO.
- Cyrino EP & Bureau D & Kapoor BG. (20080. Feeding and Digestive Functions in Fishes. Science Publ.
- D' Abramo LR, Conklin DE & Akiyama DM. (1977). Crustacean Nutrition:Advances in Aquaculture. Vol. VI. World Aquaculture Society,Baton Roughe.
- De Silva SS & Anderson TA. 1995. Fish Nutrition in Aquaculture. Chapman & Hall Aquaculture Series.
- Halver J & Hardy RW. (2002). Fish Nutrition. Academic Press.
- Halver JE & Tiews KT. (1979). Finfish Nutrition and Fishfeed Technology Vols. I, II Heenemann, Berlin.
- Hertrampf JW & Pascual FP. (2000). Handbook on Ingredients for Aquaculture Feeds.
- Kluwer. Houlihan D, Boujard T & Jobling M. (2001). Food Intake in Fish. Blackwell.
- Lavens P & Sorgeloos P. (1996). Manual on the Production and Use of Live Food for Aquaculture.
- FAO Fisheries Tech. Paper 361,
- Lovell RT. (1998). Nutrition and Feeding of Fishes. Chapman & Hall.
- Ojha JS. (2005). Aquaculture Nutrition and Biochemistry. Daya Publ.

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**FISHERY SCIENCE**
**SECFS IV (Theory + Practical)**
**Fabrication of Aquarium (A)**

1. Introduction
2. Types of aquarium
3. Different shape & sizes of aquarium
4. Accessories for aquarium fabrication
5. Fabrication of aquarium
6. Aquarium tank accessories
7. Setting of aquarium

** **Practical based on theory paper**

1) Glass cutting with the help of glass cutter
2) Manufacture of aquarium in different size
3) Identification of different aquarium accessories
4) Setting of aquarium
5) Identification of aquarium plants
6) Identification of aquarium fishes

1. Introduction
2. Breeding of egg-scatterers (With adhesive eggs & non-adhesive eggs)
3. Breeding of egg-depositors
4. Breeding of egg-buriers
5. Breeding of nest-builders
6. Breeding of live-bearers

**** Practical based on theory paper**

**Reference:**

1. P. C. Thomas, Suresh Rath and Kanta Das Mohapatra (2014). Breeding & seed production of fin fishes & Shell fishes, Daya Publishing House (Astral International Pvt. Ltd.), New Delhi, 402p.
2. C. W. EMMENS: Keeping and Breeding Aquarium Fishes
3. Training Manual on Advances in Keeping & Breeding Ornamental Fishes

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**FISHERY SCIENCE**
**Practical Paper – XVI**
**(Based on XII + XIV)**

**Mark 50**

1. Identification, classification and commercial importance of following fishes.

   i) Sardine ii) Mackeral iii) Bombay duck iv) Sole fish

   v) Pomfret vi) Ribbon fish vii) Hilsa viii) Mugil

2. Identification, classification and commercial importance of following Non fish organisms

   i) *Penaeus indices* ii) *Penaeus monodon* iii) Edible oyster iv) Pearl oyster

   v) Sepia vi) Loligo vii) Chanks. viii) Mytilus

3. Study of fishing crafts and gears (Five each)
4. Identification penaeid and non penaeid prawns with sex.
5. Identify and describe the aquarium accessories with their use and maintains. (any five).
6. Preparation of an aquarium tank of suitable size.
7. Setting of aquarium.
8. Maintenance of an aquarium.
9. Identification of aquarium Egg layers &Live Bearers fishes (any eight).
10. Identification of aquarium ornamental organisms(any three)
11. Identification of aquarium plants (any five).
12. Study of fish pathogens

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**FISHERY SCIENCE**
**Practical Paper – XVII (B I)**
**[Based on elective Theory paper XIII (B I) + XV (B I)]**

**50 Marks**

1. Study of cultivable fishes: *Labeo* ,*Catla*, Cirrhina, *Chanos chanos*, Sea bass, *Clarius*, Anabus, Channa, *Heteropneustes fossilis*
2. Non fish organisms - *P. indicus* , *P.monodon*, Crab
3. Study of phytoplankton and zooplanktons (Any 5)
4. Study of locally available feed ingredients (Any 5)
5. Formulation of fish feed
6. Estimation of crude protein from feed ingredients and feed.
7. Estimation of lipid from feed ingredients and feed.
8. Estimation of carbohydrate from feed ingredients and feed.
9. Estimation of vitamin from feed ingredients and feed.
10. Collection and submission of locally available feed ingredients.
11. Submission of prepared fish feed.
12. Calculate per hector income of fish production from given data.
13. Visit to fisheries co-operative society/ Fish market

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**FISHERY SCIENCE**
**Practical Paper- XVII (B II)**
**[Based on elective Theory paper XIII (B II) + XV (B II)]**

**Marks-50**

1. Study of fish feed ingredients.
2. Study of equipments used in water and soil analysis.
3. Study of different types of organic and inorganic fertilizers.
4. Study of Aquatic weeds.
5. Study of Planktons
6. Estimation of dissolved oxygen, carbon dioxide, salinity, temperature and conductivity of water
7. Estimation of crude protein, Carbohydrate, and lipid from feed ingredients.
8. Estimation of Nitrogen, Phosphorus, Potassium of soil sample.
9. Fish feed formulation
10. Submission of feed ingredients and prepared fish feed
11. Submission of different types of fertilizers
12. Submission of Aquatic weeds and Planktons
13. Submission of Tour report and Record book

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**FISHERY SCIENCE**
**Practical Paper – XVI**

**Time: 3 hrs** **Marks: 50**

1] Identify, Classify and Comments on commercially important fishes (Any two) 06

2] Identify, classify and Comments on commercially important Non fish organism (Any Two) 06

3] Identify and Comments on fishing crafts and gears (One each) 06

4] Identify& describe aquarium fishes & aquarium plant. (Two each) 12

5] Identification and Preparation of permanent slide of fish pathogen (Any one) 10

**Internal Marks**

1] Submission of Record book, viva voce. 05

2] One test on practical 05

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**FISHERY SCIENCE**
**Practical Paper – XVII (B1)**
**[Based on elective Theory paper XIII (B I) + XV (B I)]**

**Time: 3 hrs** **Marks: 50**

1] Identify, Classify and comments on cultivable fishes. (Any three) 09

2] Identify, Classify and comments Non fish organism (Any Two) 06

3] Identify & describe fish feed ingredients (Any two) 06

4] Estimation of protein /Carbohydrate /Lipid from fish feed (Any one) 08

5] Calculate per hector income of fish production from given 06

6] Submission of fishing crafts & gears model, prepared fish feed and feed ingredients. 05

**Internal marks**

1] Record book & Excursion Report 05

2] Test on practical 05

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**FISHERY SCIENCE**
**Practical Paper XVII (B II)**
**[Based on elective Theory paper XIII (B II) + XV (B II)]**

**Time 3 Hours** **Marks 50**

| | | |
|---|---|---|
| 1. | Identify and described as per instructions (Any Three)<br>(Feed ingredients/ Aquatic weeds/ Planktons) | 09 |
| 2. | Identify and described as per instructions (Any Three)<br>(Equipments/ Fertilizers) | 09 |
| 3. | Estimation of $CO_2$,/DO/, Salinity from given water sample (Any One)<br>OR<br>Estimation of N/P/K from given sample (Any One) | 08 |
| 4. | Estimation of Crude Protein/ Carbohydrate/ Liquid from feed ingredients. (Any one) | 08 |
| 5. | Submission of Aquatic weeds, Planktons and Fertilizers. | 06 |

Internal Marks

| | |
|---|---|
| 1. Record book and Viva voce | 05 |
| 2. One test on practical | 05 |

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**Choice Based Credit System (CBCS) Course Structure (New Scheme)**
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**Effective from June 2021**
**Fishery Science Question Paper Pattern**
**Paper No XII, XIII, XIV, XV** **Marks 40**

**All questions carry equal marks**

Q.1 Write a short notes on any four on the following: (Based on all units) Marks 08
A)
B)
C)
D)
E)
F)

Q.2 Write notes on (any two) of the following (Based on I&II units) Marks 08

A)
B)
C)

Q.3 Long answer question (Based on I&II units) Marks 08
OR
Long answer question

Q.4 Write notes on ( any two) (Based on III&IV units) Marks 08

A)
B)
C)

Q.5 Long answer questionon (Based on III&IV units) Marks 08
OR
Long answer questionon

- Marine fisheries: Dr. Bal & K. Virbhadrarao.
- Fishery science and Indian fisheries: C.B.L. Shrivastav.
- The Economic of Fisheries management: Anderoson L 1977 & John Hapkins.
- Fish economic: P.S. Rao
- Fishery economic and Introduction: Cuningan Dunn whit Masesh, Marshall st. Martins.
- Marketing management: Kothar P 1988 prentice Halt.
- Extension Education: Adivia Reddy & Bapatlal.
- Aquaculture Extension: Gibbons M.J. & R. Shrider 1983
- peace cons. Information collection Exchange manual M 18.
- A Text book of aquaculture: M.Srinivasulu Reddy, K.R.S. Sambasiva Rao.)
- A Text book of Fish Fisheries and Technology: K.P.Biswas
- Hand Book of fish aquarium: Dr.C.J.Hiware,Dr.(Mrs.) S.R.Sonawane.
- Aquaculture and aquarium keeping: S.P.Chavan,M.S.Kadam,S.D.Niture. .
- Fish Feed Technology: ADCP/REP/80/11 FAO (1980)
- The Nutrition And Feeding Of Farmed Fish And Shrimp: A Training Manual Feeding
- Methods. FAO (1980)
- Nutrition and Feeding of Fish: Kluwere Academic Publication -Tom Lovell (1998)
- Fish Genetics: Sangita Malvee(2008) : SBS, Publishers & Distributors
- Applied fish genetics: Fishing Chimes, Bhaja Krishna Padhi, Radha Kanta Mandal.
- Probiotics and Health Claims: Wolfgang Kneifel, Seppo Salminen (2010)
- The Use of Probiotics in Fish Hatcheries: Results and Prospect: F.J. Gatesoupe (1991)
- Direct-Fed Microbial and Prebiotics for Animals: Todd R. Callaway, Steven C. Ricke (2011)
- Probiotics Applications and Practical Aspects: Fuller, R.(1997)
- Economics for Fisheries Management: Quentin Grafton, R.(2006)
- Fisheries economics: Volume 1, Part 1United States. National Technical Information Service: Robena J Brown, (1980)
- Fisheries economics: an introduction: Stephen Cunningham, Michael R. Dunn, David Whitmarsh (1985)
- Fisheries and aquaculture: Ravi Shankar Piska.

- Marine fisheries extension: P.N. Ananth.
- Text book of fishery: Surekha M. Gupta.
- Prawns and prawn Fisheries of India: C.V. Kurian and V.O. Sebastian.
- Remote sensing applications in brackish water fisheries: Arbind Sinha and Sham Beharisharma.
- Identification of prawns / shrimps of India and their culture : A.D. Dholakia.
- Textbook of fresh water fish culture: A. N. Kulkarni.
- Fresh Water fish culture Vol. 1 : S.K. Sarkar
- Aquaculture: Dr. N. Armugam (Saras Publication)
- Fresh water Aquaculture: S.H. Ahmad and A.K. Sing.
- Industrial fisheries: K.P. Biswas.
- Genotoxicity Assessment in fishes: A practical approach: N.S. Nagapure, Ravindra kumar, Bardeo Kushwahe, Poonam Jayant Singh, Satish K. Shrivastva and W.S. Lakra.
- Fresh water fish Diversity of Central India: W.S. Lakara and U.K. Sarkar.
- Fish Biodiversity of India: D.Kapoor, R.Dayal and A.G. Porniah.
- Biology, Breeding and farming of important food fishes: N.M. Chakrabarti.
- Manual of Fresh water Biota: Datta Munghi J.S. Fish and fisheries: pandey and shukla.
- Fish Harvesting and processing: R.B. Selvamani and R.K. Mahadevan.
- Textbook of fish and fisheries: G.S. Sandhy.
- Fish processing and preservation: Charls L. Cutting.
- The fishes of India: Francis Day Vol.1 and 2.
- Fish and fisheries of India: V.G. Jhingran.
- Economics of fisheries: P.N. Panday, B.C. Jha, B.K. Gorai.
- Fundamentals of Freshwater Biology: J.D. Munshi and J.S.D. Munshi.

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