॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994. Recognized By the UGC U/s 2(f) and 12(B). NAAC Re-accredited with'B++' grade

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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Academic-1 (BOS) Section

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरणा नुसार पदव्युत्तर प्रथम वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत प्रथमच संलग्नित महाविद्यालयामध्ये पदव्यूत्तर स्तरावर Fishery Science अभ्यासक्रमास मान्यता मिळालेली आहे. दिनांक १४.०९.२०२४ रोजीच्या मत्स्यशास्त्र अभ्यासमंडळाच्या बैठकीमधील ठरावातील शिफारसी प्रमाणे M. Sc. I year अभ्यासक्रम शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्याच्या दृष्टीने मा. कुलगुरू महोदयांनी विद्यापरिषदेच्या मान्यतेच्या अधीन राहून मान्यता प्रदान केली आहे. त्यानुसार राष्ट्रीय शैक्षणिक धोरणानुसार खालील अभ्यासक्रम शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्यात येत आहे.

1. M. Sc. I year Fishery Science (Affiliated college)

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.:शै–१/एनइपी/पीजीप्रथमवर्षअभ्यासक्रम/२०२४–२५/286
दिनांक ०८.१०.२०२४

सहा.कुलसचिव
शैक्षणिक (१–अभ्याससमंडळ) विभाग

प्रत : १) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
५) मा. प्राचार्य, न्यू मॉडल डिग्री कॉलेज हिंगोली.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, सदर परिपत्रक संकेतस्थळावर प्रसिध्द करण्यात यावे.

SWAMI RAM SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED - 431 606

स्वामी रामानंद तीर्थ
मराठवाडा विद्यापीठ, नांदेड

TWO YEAR MASTERS PROGRAMME

IN SCIENCE

(As per NEP-2020)

Syllabus for
Subject
M.Sc. Fishery Science
(Semester - I & II)

(Affiliated Colleges)
Under the Faculty of

Science and Technology

Effective from Academic year 2024-2025

स्वामी रामानंद तीर्थ
मराठवाडा विद्यापीठ, नांदेड

Details of the Board of Studies Members in the subject Fishery Science under the faculty of Science & Technology of S.R.T.M. University, Nanded

01.	**Dr. Sunil Deoram Ahirrao** Department of Fishery Science Shri. Shivaji College, Parbhani	**Chairman**
02.	**Dr. Japrakash Manikrao Gaikwad** Department of Fishery Science Shri. Shivaji College, Parbhani	**Member**
03.	**Dr. K. S. Shillewar** Department of Fishery Science Science College, Nanded	**Member**
04.	**Dr. Seema Shesherao Korde,** Department of Fishery Science Azad Mahavidyalaya, Ausa, Dist. Latur.	**Member**
05	**Dr. Shivaji Prabhakar Chavan** School of Life Sciences, SRTM University Nanded	**Member**
06.	**Dr. Guiab D. Khedkar** Dr. Babasaheb Ambedkar Marathwada University, Sambhaji Nagar	**Member**
07.	**Dr. Madhuri Shrikant Pathak** ICAR- Central Institute of Fisheries Education (ICAR-CIFE) Panch Marg. Off Yari Road Mumbai	**Member**
08.	**Dr. Manoj M. Sharma** F/ 17-18, Raj Green Heights, Behind ICICI bank, Rander Road, Jahangirpura, Surat- 395005	**Member**
09.	**Dr. Dhanaji Waman Patil** Department of Fishery Science, Toshniwal Arts Commerce and Science College, Sengaon, Dist. Hingoli	**Invitee Member**
10.	**Dr. Sandip Surendra Markad** Department of Fishery Science Toshniwal Arts Commerce and Science College, Sengaon, Dist. Hingoli	**Invitee Member**

Guidelines for Course Assessment

A. Continuous Assessment (CA) (20% of the Maximum Marks):

This will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his **CA** score(col 6).

B. End Semester Assessment (80% of the Maximum Marks):

(For illustration we have considered a paper of 04 credits, 100 marks and need to be modified depending upon credits of an individual paper)

1. **ESAQuestion paper will consists of 6 questions, each of 20 marks.**
2. **Students are required to solve a total of 4 Questions.**
3. **Question No.1 will be compulsory and shall be based on entire syllabus.**
4. Students need to solve **ANY THREE** of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.

Note: Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course 45 lectures.

****

Abbreviations:

1. **DSC:** Department/Discipline Specific Core (Major)
2. **DSE:** Department/Discipline Specific Elective (Major)
3. **DSM:** Discipline Specific Minor
4. **GE/OE:** Generic/Open Elective
5. **VSC:** Vocational Skill Course
6. **SEC:** Skill Enhancement Course
7. **AEC:** Ability Enhancement course
8. **ENG:** English Compulsory
9. **MIL:** Modern Indian languages
10. **IKS:** Indian Knowledge System
11. **VEC:** Value Education Course
12. **OJT:** On Job Training (Internship/Apprenticeship)
13. **FP:** Field Projects
14. **CEC:** Community Engagement and Service Courses
15. **CC:** Co-Curricular Courses
16. **RM:** Research Methodology
17. **RP:** Research Project/ Dissertation

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: **Fishery Science**

Year	Sem	Major subject		RM	OJT/FP	Research Project	Practical	Credits	Total Credits
		Major	DSE						
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	I	SFISCT401 (4 Cr) SFISCT402 (4 Cr) SFISCT403 (4 Cr)	SFISET401 (3 Cr)	SFISRM401 (3 Cr)	--	--	SFISCP401 (1 Cr) SFISCP402 (1 Cr) SFISCP403 (1 Cr) SFISEP401 (1 Cr)	22	44
	II	SFISCT451 (4 Cr) SFISCT452 (4 Cr) SFISCT453 (4 Cr)	SFISET451 (3 Cr)	--	SFISOJ451/ SFISFP451/ SFISCS451 (3 Cr)	--	SFISCP451 (1 Cr) SFISCP452 (1 Cr) SFISCP453 (1 Cr) SFISEP451 (1 Cr)	22	
2	III	SFISCT501 (4 Cr) SFISCT502 (4 Cr) SFISCT503 (4 Cr)	SFISET501 (3 Cr)	--	--	SFISRP501 (4 Cr)	SFISCP501 (1 Cr) SFISCP502 (1 Cr) SFISCP503 (1 Cr) SFISET501 (1 Cr)	23	48
	IV	SFISCT551 (4 Cr) SFISCT552 (4 Cr)	SFISET551 (3 Cr)	SFISPE551 (2 Cr)	--	SFISRP551 (6 Cr)	SFISCP551 (1 Cr) SFISCP552 (1 Cr) SFISEP551 (1 Cr)	25	
								92	**92**

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: **Fishery Science**

M.Sc. Fishery Science: First Year Semester I

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
1	2	3	4	5	6	7	8
Major	SFISCT401	Fishery and Taxonomy of fishes	04	--	04	04	--
	SFISCT402	Aquaculture: Principles and practices	04	--	04	04	--
	SFISCT403	Anatomy & Physiology of fishes	04	--	04	04	--
Elective (DSE)	SFISET401	A. Breeding & seed production of fishes B. Soil & water quality in aquaculture	03	--	03	03	--
Research Methodology	SFISRM401	Research Methodology	03	--	03	03	--
DSC Practical	SFISCP401	Lab Course 1 Based on Theory paper SFISCT401	--	01	01	--	02
	SFISCP402	Lab Course 2 Based on Theory paper SFISCT402	--	01	01	--	02
	SFISCP403	Lab Course 3 Based on Theory paper SFISCT403	--	01	01	--	02
DSE Practical	SFISEP401	Lab Course 4-A Based on Theory paper SFISET401 (A) Lab Course 4-B Based on Theory paper SFISET401 (B)	--	01	01	--	02

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: **Fishery Science**

M.Sc. Fishery Science: First Year Semester I

Examination Scheme

Subject	Course Code	Course Name	Continuous assessment (CA)			*ESA*	*Practical*		*Total*
			Test 1	Test 2	Average (T1+ T2)/2		CA	ESA	
1	2	3	4	5	6				
Major	SFISCT401	Fishery and Taxonomy of fishes	20	20	20	80	--	--	100
	SFISCT402	Aquaculture: Principles and practices	20	20	20	80	--	--	100
	SFISCT403	Anatomy & Physiology of fishes	20	20	20	80	--	--	100
Elective (DSE)	SFISET401	A. Fish Breeding & Seed Production Technology B. Soil & water quality in aquaculture	15	15	15	60	--	--	75
Research Methodology	SFISRM401	Research Methodology	15	15	15	60	--	--	75
DSC Practical	SFISCP401	Lab Course 1 Based on Theory paper SFISCT401	--	--	--	--	05	20	25
	SFISCP402	Lab Course 2 Based on Theory paper SFISCT402	--	--	--	--	05	20	25
	SFISCP403	Lab Course 3 Based on Theory paper SFISCT403	--	--	--	--	05	20	25
DSE Practical	SFISEP401	Lab Course 4-A Based on Theory paper SFISET401 (A) Lab Course 4-B Based on Theory paper SFISET401 (B)	--	--	--	--	05	20	25

[20% Continuous Assessment (CA) and 80% End Semester Assessment (ESA)]

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: **Fishery Science**

M.Sc. Fishery Science: First Year Semester II

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
1	2	3	4	5	6	7	8
Major	SFISCT451	Fish biochemistry and microbiology	04	--	04	04	--
	SFISCT452	Aquarium & ornamental fish management	04	--	04	04	--
	SFISCT453	Freshwater aquaculture	04	--	04	04	--
Elective (DSE)	SFISET451	A. Fish disease management	03	--	03	03	--
		B. Packaging of Fish & fishery products					
On Job Training /Field Project / Case Study	SFISOJ451/ SFISFP451/ SFISCS451	ON Job Training / Field Project / Case Study	--	03	03	--	06
DSC Practical	SFISCP451	Lab Course 1 Based on Theory paper SFISCT451	--	01	01	--	02
	SFISCP452	Lab Course 2 Based on Theory paper SFISCT452	--	01	01	--	02
	SFISCP453	Lab Course 3 Based on Theory paper SFISCT453	--	01	01	--	02
DSE Practical	SFISEP451	Lab Course 4-A Based on Theory paper SFISET451 (A)	--	01	01	--	02
		Lab Course 4-B Based on Theory paper SFISET451 (B)					

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: **Fishery Science**

M.Sc. Fishery Science: First Year Semester II

Examination Scheme

Subject	Course Code	Course Name	Continuous assessment (CA)			*ESA*	*Practical*		*Total*
			Test 1	Test 2	Average (T1+ T2)/2		CA	ESA	
1	2	3	4	5	6				
Major	SFISCT451	Fish biochemistry and microbiology	20	20	20	80	--	--	100
	SFISCT452	Aquarium & ornamental fish management	20	20	20	80	--	--	100
	SFISCT453	Freshwater aquaculture	20	20	20	80	--	--	100
Elective (DSE)	SFISET451	A. Fish disease management B. Packaging of Fish & fishery products	15	15	15	60	--	--	75
On Job Training /Field Project / Case Study	SFISOJ451/ SFISFP451/ SFISCS451	ON Job Training / Field Project / Case Study	--	--	--	--	15	60	75
DSC Practical	SFISCP451	Lab Course 1 Based on Theory paper SFISCT451	--	--	--	--	05	20	25
	SFISCP452	Lab Course 2 Based on Theory paper SFISCT452	--	--	--	--	05	20	25
	SFISCP453	Lab Course 3 Based on Theory paper SFISCT453	--	--	--	--	05	20	25
DSE Practical	SFISEP451	Lab Course 4-A Based on Theory paper SFISET451 (A) Lab Course 4-B Based on Theory paper SFISET451 (B)	--	--	--	--	05	20	25

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program,

Subject: Fishery Science

M.Sc. Fishery Science

Eligibility: Eligibility for the PG program M.Sc. Fishery Science

Student possessing following UG degrees will be eligible for M.Sc. Fishery Science

1. Bachelor of Science (B. Sc.) with Fishery Science
2. Bachelor of Fishery Science (B. F. Sc.)
3. Bachelor of Science (B. Sc.)- with Zoology
4. Bachelor of Vocation (B. Voc.) Commercial Aquaculture/Fisheries/Fish processing
5. Any other Bachelor degree with fishery science/Aquaculture as optional subject.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-I

Discipline Specific Core Course

SFISCT401: Fishery and Taxonomy of fishes

Periods: 60	**No. of Credits: 04**	**Marks: 100**

Course pre-requisite:

- Basic information about fishes and fishery science

Course objectives:

1. To give synoptic understanding about fisheries.
2. To impart introductory knowledge of fish classification and taxonomy skills
3. To provide knowledge about finfish and shellfish classification
4. To study the systematic position and general morphology of finfishes and shellfishes

Course outcomes:

1. The learner will be able to identify and classify different finfish and shell fish species
2. The learner will gain synoptic idea about fisheries with respect to resources, production, scope and prospectus.
3. The learner will be able to identify common species available in and around the region using morphological keys

CURRICULUM DETAILS

Module No	Unit No	Topics	Hrs required to cover the content
1		**Fisheries**	**15**
	1.1	Introduction to fisheries	
	1.2	Fishery resources of India: Inland and Marine	
	1.3	Fishery Production in India	
	1.4	Scope and prospectus of fisheries in India	
2		**Taxonomy**	**15**
	2.1	Principles of taxonomy.	
	2.2	Nomenclature, types.	
	2.3	Classification and interrelationships,	
	2.4	Criteria for generic and specific identification.	
	2.5	Introduction to modern taxonomic tools: DNA polymorphism, protein polymorphism & chromosome morphology.	
3		**Taxonomy of Finfish**	**15**
	3.1	Basics of sample collection and preservation for taxonomic study: Sampling for taxonomic study, fish collection methods, fish preservation techniques, Fixation, sampling for genetic studies, labelling maintenance.	

	3.2	Morphological, morphometric and meristic characteristics of taxonomic significance.	
	3.3	Study of commercially important finfish species (classification, identification keys, biology and important traits) ➢ Freshwater: Carps, Catfishes, Murrel, Tilapia, Trout, Mahseer ➢ Brackish water: Asian sea bass, Milk fish, Pearlspot, Mullet, Grouper ➢ Marine: Mackerel, Sardine, Seerfish, Tuna, Bombay duck, Flatfishes,	
4		**Taxonomy of Shellfish**	**15**
	4.1	Study of external morphology of crustacea.	
	4.2	Study of external morphology of molluscs.	
	4.3	Study of commercially important shellfish species (classification, identification keys, biology and important traits) ➢ Crustaceans: Prawns, Shrimps, Crabs, Lobsters ➢ Molluscs: Bivalves (clams, mussels, oysters), Gastropods (snails) and Cephalopods (squids, cuttlefish, octopus)	

Reference:

1. Bal, D. V. and K. V. Rao, 1990. Marine fisheries of India. Tata McGraw-Hill Publishing Company Ltd, New delhi, Pp. 472.
2. Biswas, S. P. Fundamental of Ichthyology, Narendra Publishing House, Delhi, 392 p.
3. Day, F. 1981. Fishes of India Vol. I and II; William Sason and sons Ltd., London.
4. FAO volumes for fish identification.
5. J.R. Norman, A history of Fishes, Hill and Wang Publishers
6. Jayaram, K. C., 2002. Fundamentals of fish taxonomy. Narendra Publishing House, Delhi, 172 p.
7. Jhingran, V.C. 1991. Fish and Fisheries in India. Hindustan Publishing Company, New Delhi, India.
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10. Santanam, R. 1980. Fisheries Science, Daya Publishing House, New Delhi, India.
11. Srivastava C.B.L., 2008, Fish Biology, Narendra Publishing House, Delhi
12. Talwar, P. K. and A. G. Jingaran. 1991. Inland fishes of India and adjuscent countries. Volume I, IBH Publishing, New Delhi.
13. Yadav, B.N. 1997. Fish and fisheries, Daya Publishing House, New Delhi, India.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-I

Discipline Specific Core Course

SFISCP401: Lab course 1

(Based on SFISCT401: Fishery and Taxonomy of fishes)

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Basics of sample collection and preservation for taxonomic study of fishes.
2. Study of general morphology of finfishes
3. Study of general morphology of shellfishes
4. Identification techniques for fishes (Morphometric characters)
5. Identification techniques for fishes (Meristic characters)
6. Study of modern taxonomic tools (DNA polymorphism, protein polymorphism & chromosome morphology)
7. Identification of commercially important finfishes (Carps, Catfishes, Murrel, Tilapia, Trout, Mahseer, Asian sea bass, Milk fish, Pearlspot, Mullet, Mackerel, Sardine, Seerfish, Tuna, Bombay duck, Flatfishes)
8. Identification of commercially important crustacean (Prawns, shrimps, crabs).
9. Identification of commercially important Molluscs (Mussel, clams, oysters, Cuttle fish, squid).
10. Field visits to fish landing center / waterbody.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-I

Subject: Fishery Science

Discipline Specific Core Course Practical

SFISCP401: Lab course 1

(Based on SFISCT401: Fishery and Taxonomy of fishes)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1	Preserve the given fish specimen for taxonomic study	05
Q. 2	Identify, classify and comment on given specimen (Any 04 commercially important finfish and shellfish species)	08
Q. 3	Define and measure morphometric and meristic characters from the given fish specimen (05 each)	05
Q. 4	Viva-voce	02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-I

Discipline Specific Core Course

SFISCT402: Aquaculture: Principles and practices

Periods: 60	**No. of Credits: 04**	**Marks: 100**

Course pre-requisite:

- Basic information about fish and general culture practices

Course objectives:

1. To impart knowledge about aquaculture scope and prospectus
2. To study different types of aquaculture systems
3. To study candidate species of aquaculture and their important traits
4. To study steps in aquaculture practice

Course outcomes:

1. The student will have thorough knowledge about different aquaculture, its scope and prospectus.
2. The learner will have technical knowhow in different steps of aquaculture farm management
3. The learner will acquire thorough knowledge about different aquaculture system.

CURRICULUM DETAILS

Module No	Unit No	Topics	Hrs required to cover the content
1		**Introduction to aquaculture**	**15**
	1.1	Basics of Aquaculture - Definition and scope.	
	1.2	History of Aquaculture	
	1.3	Present scenario: global and national	
	1.4	Aquaculture and Agriculture	
2		**Aquaculture systems**	**15**
	2.1	Types of aquaculture based on economic considerations: Extensive, semi-intensive, intensive and supra intensive aquaculture	
	2.2	Types of aquaculture based on species: Monoculture, polyculture and integrated culture	
	2.3	Culture systems: 1. Pond culture 2. Fish Culture in reservoirs, 3. Fish culture in paddy fields 4. Raceway culture,	
	2.4	Culture systems: 1. Cage culture 2. Pen culture 3. Biofloc culture 4. Recirculating Aquaculture System	
3		**Candidate species for aquaculture**	**15**
	3.1	Criteria for selection of candidate species for aquaculture.	
	3.2	Commercially important candidate species for Freshwater aquaculture:	

		Carps, Catfishes, Murrel, Tilapia, Trout, Prawn	
	3.3	Commercially important candidate species for Brackishwater aquaculture: Asian sea bass, Milk fish, Pearlspot, Mullet, Shrimp, Crab, Mussels	
	3.4	Commercially important candidate species for Mariculture: Grouper Pompano, Cobia, Snapper	
4		**Steps in aquaculture management**	**15**
	4.1	Pre stocking management: Drying, Ploughing, repairs, eradication of weeds, eradication of weed and predatory fishes, Manuring, Soil correction, watering, etc.	
	4.2	Stocking management: Seed selection, acclimatization and stocking	
	4.3	Post stocking management: Water quality management, food and feeding management, Health management,	
	4.4	Harvesting and Marketing	

Reference:

1. Balugut, E.A.1989. Aquaculture system and practices. A selected review publishing House, New Delhi.
2. Bardach J.E. and J.H. Rhyther, 2013. Aquaculture: The Farming and Husbandary of Freshwater and Marine organisms, John Wiley & Sons.
3. D. Allen Davis, 2015. Feed and Feeding Practices in Aquaculture, Woodhead Publishing
4. Jhingran, V.C. 1991. Fish and Fisheries in India. Hindustan Publishing Company, New Delhi, India.
5. Khanna, S.S. and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing house
6. Pillai, TVR. and M. N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
7. Pillay, T.V.R. 1993. Aquaculture: Principles and Practices, Fishing New Books, Blackwell Scientific Publications
8. Rath, P. K., 2000. Freshwater Aquaculture, Scientific Publishers, Jodhpur
9. Robert R. Stickney., 2009. Aquaculture: An Introductory Text, CAB International Publishers.
10. Santanam, R. 1980. Fisheries Science, Daya Publishing House, New Delhi, India.
11. Srivastava C.B.L., 2008, Fish Biology, Narendra Publishing House, Delhi
12. Yadav, B.N. 1997. Fish and fisheries, Daya Publishing House, New Delhi, India.

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Layout, design and components of Aquaculture farm
2. Study of commercially important candidate species for freshwater aquaculture (Carps, Catfishes, Murrel, Tilapia, Trout, Prawn)
3. Study of commercially important candidate species for brackish aquaculture (Asian sea bass, Milk fish, Pearlspot, Mullet, Shrimp, Crab, Mussels)
4. Study of commercially important candidate species for mariculture (Grouper Pompano, Cobia, Snapper)
5. Estimation of Lime/Manure requirement in aquaculture pond
6. Estimation of feed ration in aquaculture.
7. Study of Planktons from aquaculture: Phytoplankton and zooplankton
8. Study of aquaculture feed ingredients: Groundnut oil cake, Cotton seed cake, Rice bran, fish meal, soyabean
9. Study of fertilizers used in aquaculture: Organic and inorganic
10. Study of aquatic weeds
11. Estimation of water quality parameters: Dissolved oxygen, Free Carbon dioxide, pH
12. Preparation of layout plan of aquaculture farm.
13. Field visit to aquaculture farm/fish culture farm

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-I

Subject: Fishery Science

Discipline Specific Core Course Practical

SFISCP402: Lab course 2

(Based on SFISCT402: Aquaculture- Principles and practices)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1	Estimate the requirement of ……for given aquaculture pond (Lime/Manure/Feed ration)	05
Q. 2	Identify, classify and comment on fish species (Any 02)	04
Q. 3	Identify and comment of given specimen (Any 02) (Planton, Fish feed ingradient, Aquatic weed)	04
Q. 4	Analys given water sample for estimation of …….. (Dissolved oxygen/ Free Carbon dioxide)	05
Q. 5	Viva-voce	02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-I

Discipline Specific Core Course

SFISCT403: Anatomy & Physiology of fishes

Periods: 60	**No. of Credits: 04**	**Marks: 100**

Course pre-requisite:

- General structure of fishes, anatomy and physiology in general.

Course objectives:

1. To impart knowledge about anatomy of commercially important species.
2. To study the physiology of different body systems in fishes as well as finfishes
3. To study the food and feeding habbit as well as gut content analysis of aquatics species.

Course outcomes:

1. The student will have thorough knowledge about different systems in fishes.
2. The students will be well aware about requirements as well as life processes of important fish species.
3. Students will be able to analysis food and feeding habits, breeding performance, defence mechanisms, etc in fishes.

CURRICULUM DETAILS

Module No	Unit No	Topics	Hrs required to cover the content
1		**General anatomy and physiology of finfishes**	**15**
	1.1	Skeletal systems: Exoskeleton & endoskeleton	
	1.2	Skin: structure, function	
	1.3	Scales: types, structure	
	1.4	Comparative study of bony and cartilaginous fishes	
	1.5	Food and feeding habits of fishes: 1. Qualitative methods for analysis of gut contents 2. Quantitative methods for analysis of gut contents	
2		**Anatomy and physiology of finfishes**	**15**
	2.1	Digestive System: Structure & physiology (Alimentary canal, Associated glands, Physiology of digestion)	
	2.2	Circulatory system: Structure and Physiology (Heart, Arterial system, Venous system, Blood, Physiology of circulation)	
	2.3	Respiratory system: Structure and Physiology	
	2.4	**Urino-genital system: Structure and Physiology** 1. Excretory system: Kidney, urinary bladder, physiology of excretion, Osmoregulation	

		2. Reproductive system: male reproductive system, female reproductive system	
3		**Anatomy and physiology of Shrimp**	**15**
	3.1	General morphology of Shrimp	
	3.2	Digestive system of Shrimp	
	3.3	Circulatory system of Shrimp	
	3.4	Respiratory system of Shrimp	
	3.5	Reproductive system of Shrimp	
	3.6	Excretory system of Shrimp	
4		**Anatomy and Physiology of Mussel**	**15**
	4.1	General morphology of Mussel	
	4.2	Digestive system of Mussel	
	4.3	Circulatory system of Mussel	
	4.4	Respiratory system of Mussel	
	4.5	Reproductive system of Mussel	
	4.6	Excretory system of Mussel	

Reference:

1. Jayaram, K. C. (2002). Fundamentals of fish taxonomy. Narendra Publishing House, Delhi, 172 p.
2. Khanna, S. S. and H. R. Singh (2003). Fish Biology and fisheries, Narenrdra Publishing House, New Delhi, India.
3. Khanna, S. S. and H. R. Singh (2014). A text book of Fish Biology and Fisheries, Narendra Publishing house
4. Kumar, A. (2005). Fish Biology, APH Publishing Corporation.
5. Pillai, TVR. and M. N. Kutty (2005). Aquaculture: Principles and Practices, Wiley-Blackwell.
6. Santanam, R. (1980). Fisheries Science, Daya Publishing House, New Delhi, India.
7. Srivastava C.B.L. (2008). Fish Biology, Narendra Publishing House, Delhi
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9. Bardach EJ, Rhyther JH & Mc Larney WO. 1972. *Aquaculture the Farming and Husbandry of freshwater and Marine Organisms*. John Wiley & Sons.
10. FAO. 2001. *Planning and Management for Sustainable Coastal AquacultureDevelopment*. FAO Publ.
11. Gilbert B. 1990. *Aquaculture*. Vol. II. Ellis Horwood.
12. ICAR. 2006. *Handbook of Fisheries and Aquaculture*. ICAR.
13. Pillay TVR. 1990. *Aquaculture, Principles and Practices*. Fishing News Books.
14. Shepherd J &Bromage N. 1990. *Intensive Fish Farming*. B.S.P. Professional Books.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-I

Discipline Specific Core Course

SFISCP403: Lab course 3

(Based on SFISCT403: Anatomy & Physiology of fishes)

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Study of fish scales
2. Study of digestive system of fishes
3. Analysis of gut content of fishes
4. Study of circulatory system of fishes
5. Study of reproductive system of fishes
6. Study of morphology of Mussel
7. Study of Digestive system of Prawn /Shrimps
8. Study of Reproductive system of Prawn /Shrimps
9. Study of Skeleton in fishes
10. Histological study:
    a. T.S. of Oesophagus, Stomach, Intestine
    b. T.S. of Liver, Pancreas, Ovaries, Testis, Pituitary gland

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-I

Subject: Fishery Science

Discipline Specific Core Course Practical

SFISCP403: Lab course 3

(Based on SFISCT403: Anatomy & Physiology of fishes)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1	Dissect given fish specimen to expose …… (Digestive System/Reproductive system)	06
Q. 2	Permanent Mounting and identification of scale OR Analyse the gut content of given specimen	06
Q. 3	Identify and comment of given specimen/Spot (Any 03) (Bones: Vertebrae, Girdle; T.S. of tissues, glands, gonads)	06
Q. 4	Viva-voce	02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-I

Discipline Specific Elective Course

SFISET401: A. Fish Breeding & Seed Production Technology

Periods: 45	**No. of Credits: 03**	**Marks: 75**

Course pre-requisite:

- General biology and breeding behavior of fishes.

Course objectives:

1. To cater thorough knowledge about breeding and seed production systems in fishes.
2. The study natural fish seed resources and collection of fish seed.
3. To study different methods of induces breeding and seed production methods of commercially important species
4. To study principle, structure and working of different hatchery designs used in fish seed production.

Course outcomes:

1. The learners will be well worse with different fish seed resources, collection methods and handling of fish seed.
2. The students will have thorough knowledge about breeding and seed production of commercially important species.
3. The students will be able to operate hatchery unit.

CURRICULUM DETAILS

Module No	**Unit No**	**Topics**	**Hrs required to cover the content**
1		**Natural fish seed resources**	**11**
	1.1	**Introduction**	
	1.2	Natural breeding of fishes	
	1.3	Spawn resources investigation technique	
	1.4	Selection of spawn collection site	
	1.5	Gears used for collection of spawn	
	1.6	Methods of collection of spawn	
	1.7	Spawn quality and quantity indices, advantages and disadvantages of riverine seed collection.	
2		**Breeding techniques**	**11**
	2.1	Bundh breeding: Introduction, Types of bundhs, operation of bundhs	
	2.2	Artificial fertilization by stripping: Introduction, types, operation	
		Induced breeding	
	2.3	Introduction, Hormones responsible for induced breeding	
	2.4	Hypophysation: Introduction, collection of Pituitary gland (PG),	

		preservation and storage of PG, preparation of PG suspension for injection, dosage	
	2.5	Induced breeding by synthetic hormones: Introduction, different synthetic hormones used in fish breeding, dosage	
	2.6	Other methods used in induced breeding of fishes	
3		**Breeding, hatchery design and management**	**12**
	3.1	Carps: 1. Chinese circular hatchery 2. Glass jar hatchery	
	3.2	Milk fish hatchery	
	3.3	Asian Sea bass hatchery	
	3.4	Fresh water prawn (*Macrobrachium rosenbergi)* hatchery	
	3.5	Tiger shrimp *(Penaeus monodon)* hatchery	
4		**Fish seed trade and transport**	**11**
	4.1	Qualities of fish seed	
	4.2	Different stages of seeds in finfish and shellfish	
	4.3	Conditioning of fish seed	
	4.4	Methods and units of fish seed counting	
	4.5	Fish seed transportation	

Reference:

1. Thomas P. C. *et al*., 2003. Breeding and seed production of finfish and shellfish, Daya Publishing House, New Delhi.
2. Rath, P. K., 2000. Freshwater Aquaculture, Scientific Publishers, Jodhpur.
3. FAO, 1992. Manual of seed production of carps.
4. Pillay, T.V.R. and M. N. Kutty, 2005. Aquaculture Principles and Practices, Blackwaell Scientific Publishers, UK.
5. Jingran, V. G. and Pullin, R. S.V., 1985. Hatchery Manual for the common, Chinese and Indian Major Carps, ICLARM.
6. James, P. M., 1983. Handbook of Mariculture, CRC Press, Florida.
7. Bardach EJ, Rhyther JH & Mc Larney WO. 1972. *Aquaculture the Farming and Husbandry of freshwater and Marine Organisms*. John Wiley & Sons.
8. FAO. 2001. *Planning and Management for Sustainable Coastal AquacultureDevelopment*. FAO Publ.
9. Gilbert B. 1990. *Aquaculture*. Vol. II. Ellis Horwood.
10. ICAR. 2006. *Handbook of Fisheries and Aquaculture*. ICAR.
11. Pillay TVR. 1990. *Aquaculture, Principles and Practices*. Fishing News Books.
12. Shepherd J &Bromage N. 1990. *Intensive Fish Farming*. B.S.P. Professional Books.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-I

Discipline Specific Elective Course

SFISEP401: Lab course 4-A

(Based on SFISET401: A. Fish Breeding & Seed Production Technology)

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Gears used for collection of fish seed from natural resources.
2. Study of developmental stages of finfish
3. Study of developmental stages of shrimp
4. Study of developmental stages of freshwater prawn
5. Study of stripping methods for Artificial fertilization
6. Collection, preservation and storage of pituitary gland
7. Preparation of suspension/extract of pituitary gland
8. Study of eye-stalk ablation in shrimp for induced breeding
9. Study of fish seed quality
10. Study on counting of fish seed
11. Study of fish seed packaging and transportation
12. Visit to fish seed production centre/hatchery

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-I

Subject: Fishery Science

Discipline Specific Elective Course Practical

SFISEP401: Lab course 4-A

(Based on SFISET401: A. Fish Breeding & Seed Production Technology)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1	Dissect given fish specimen to expose.....	06
	OR	
	Prepare the extract of given pituitary glands	
Q. 2	Identify the developmental stage of given specimen (Any 03)	06
Q. 3	Count the given fish seed and pack using given packaging material	06
	OR	
	Carryout the eye-ablation of given specimen	
Q. 4	Viva-voce	02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature

SFISET401: B. Soil & water quality in aquaculture

Periods: 45	**No. of Credits: 03**	**Marks: 75**

Course pre-requisite:

- General information regarding soil and water.

Course objectives:

1. To study various water quality parameters
2. To study collection of water as well as soil samples for analysis
3. To study different types of soils and associate properties
4. To study Soil and water amendments in aquaculture.

Course outcomes:

1. The learner will be equipped with thorough knowledge regarding soil and water requirements for aquaculture.
2. The students will be able to analysis different water and soil quality parameters.
3. The learner will be well worse with collection of water as well as soil samples.
4. The students will possess sound knowledge with respect to water and soil requirements as well as amendments in aquaculture.

CURRICULUM DETAILS

Module No	**Unit No**	**Topics**	**Hrs required to cover the content**
1		**Resources and properties of water**	**11**
	1.1	Water resources	
	1.2	Physical properties of water: Water depth Transparency, Temperature Electrical conductivity	
	1.3	Chemical properties of water: Dissolved oxygen, carbon dioxide, pH, Alkalinity, Salinity	
	1.4	Biological properties of water: Plankton, Algae, Macrophytes, Pathogens	
	1.5	Collection and preservation of water samples for analysis	
2		**Water quality Management**	**12**
	2.1	Water quality criteria for Aquaculture	
	2.2	Management of physical water quality parameters	
	2.3	Management of chemical water quality parameters	
	2.4	Management of biological water quality parameters	
	2.5	Accessories used for water quality management in aquaculture	

		a. Aerators b. Filters	
3		**Resources and properties of soil**	**11**
	3.1	Soil: origin and nature of soils	
	3.2	Soil types and their distribution	
	3.3	Physical properties of soil: soil colour, texture, structure, pore size, bulk density, water holding capacity, etc.	
	3.4	Chemical properties of soil: Cation Exchange Capacity, pH, Organic Carbon, Carbon - Nitrogen ratio, etc.	
	3.5	Biological properties of soil: soil fertility, Microbes, etc.	
	3.6	Soil analysis: collection and preparation of soil samples	
4		**Soil quality management**	**11**
	4.1	Soil quality criteria for aquaculture	
	4.2	Soil quality management in aquaculture: Lime, Manures, Fertilizers, Micronutrients, Alum, Gypsum	
	4.3	Environmental ameliorative: Chlorination, Deodorizers, Bacterial Formulation	

Reference:

1. Adhikari S & Chatterjee DK. 2008. *Management of Tropical Freshwater Ponds*. Daya Publ.
2. APHA, AWWA, WPCF. 1998. Standard Methods for the Examination of Water and Wastewater, 20th Ed.
3. Claude E. Boyd (1990). Water Quality in Ponds for Aquaculture, Auburn University, Alabama Agricultural Experiment Station.
4. Claude E. Boyd, C.S. Tucker (2012). Pond Aquaculture Water Quality Management, Springer Science & Business Media.
5. Jhingran, V. G. (1975). Fish & Fisheries of India. Hindustan Publishing Corporation (India). 954p.
6. Kodarkar, M. S. (1992). Methodology for water analysis, physico-chemical, Biological and Microbiological Indian Association of Aquatic Biologists Hyderabad.
7. Pillai, TVR. and M. N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell
8. Ratan Kumar Saha, Dibyendu Kamilya, Himadri Saha (January, 2015). Handbook on Soil and Water Quality Management Techniques in Aquaculture, Edition: 1st, Publisher: Dean, College of Fisheries, CAU, Lembucherra

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-I

Discipline Specific Elective Course

SFISEP401: Lab course 4-B

(Based on SFISET401: B. Soil & water quality in aquaculture)

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Equipment used in soil and water analysis (pH Meter, Thermometer, Salinity refractometer, Secchi disc, water sampler, soil sampler etc.)
2. Collection and storage of water and soil samples

Water analysis

3. Estimation of dissolved oxygen.
4. Estimation of free carbon dioxide
5. Estimation of pH,
6. Estimation of turbidity
7. Estimation of total alkalinity
8. Estimation of hardness
9. Estimation of transparency (Light penetration)

Soil analysis

10. Estimation of water retention capacity
11. Estimation of soil texture,
12. Estimation of pH,
13. Estimation of conductivity

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-I

Subject: Fishery Science

Discipline Specific Elective Course Practical

SFISEP401: Lab course 4-B

(Based on SFISET401: B. Soil & water quality in aquaculture)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1	Analys the given water sample for estimation of …….	06
	(Dissolved oxygen/ Free Carbin dioxide/Alkalinity)	
Q. 2	Estimate the turbidity/Hardness/ Transparency of water.	06
Q. 3	Determine the texture of given soil sample	06
	OR	
	Determine the water holding capacity of given soil sample	
Q. 4	Viva-voce	02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-I

SFISRM401: Research Methodology

Periods: 45	No. of Credits: 03	Marks: 75

Course pre-requisite:

Students should have minimum, expected background of knowledge in Biology, Mathematics, Statistics and computer Science

Course objectives:

1. The students will know how to access new facts using systematic thinking, analyzing phenomena, problems and seeking solutions based on reliable facts. The analysis of a phenomenon and trace its basics and refute its cause.
2. The prediction based on scientific evidence, documented methodology and consecutive logical steps. Provide logical solution to the problem. To reach new and innovative results based on the latest facts and research.

Course outcomes: The students will get following ideas, skills and techniques-

1. Understand basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Present a research report and paper
5. Write a research proposal for grant

CURRICULUM DETAILS

Module No	Unit No	Topics	Hours required to cover the content
1		**Research Methodology**	**10**
	1.1	Meaning of research, Objectives of research, Types of research,	
	1.2	Research approaches, Significance of research, Research methods versus methodology, Research and scientific methods,	
	1.3	Research processes, Criteria for good research	
	1.4	Research problem, Selecting the problem, Necessity of defining the problem, Techniques involved in defining a problem	
2		**Research Design and Sample Surveys**	**12**
	2.1	Meaning and need for research design, features of a good design.	
	2.2	Important concepts relating to research design: Dependent and independent variables, Extraneous variables, Control, Research hypothesis, Experimental and non-experimental hypothesis – Testing research, Experimental and control group	
	2.3	Different research designs: Research design in case of exploratory research studies, Research design in case of hypothesis- testing research studies, basic principles of experimental designs, Important Experimental Designs	
	2.4	Sampling Design, steps in sample design, criteria of selecting a sampling procedure, characteristics of a good sample design, different types of sample design	
3		**Data Collection and Data Processing**	**12**

	3.1	Measurements in Research, Measurement Scales, Sources of errors in measurement	
	3.2	Collection of primary data: Observation Method, Interview Method, through questionnaires, through schedules, difference between questionnaire and schedule	
	3.3	Collection of secondary data, Selection of appropriate methods for data collection, Case study method	
	3.4	Data processing, processing operations: editing, coding, classification, tabulation, graphical representation, types of analysis, Statistics in research, Dispersion and Asymmetry, Measures of Relationship, Regression Analysis	
4		**Testing of Hypothesis and Chi-Square Test**	**11**
	4.1	Basic Concepts Concerning Testing of Hypotheses, Procedure and Flow diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Tests of Hypotheses , Hypothesis Testing of Correlation Coefficients and Limitations of the Tests of Hypotheses	
	4.2	Chi-Square Test: Chi-Square Test for Comparing Variance, Chi-square as a Non-parametric Test, Conditions for the Application of Chi-Square Test, Steps Involved in Applying Chi-square Test, Important Characteristics of Chi-Square Test and caution in using Chi-Square test. Relationship between Spearman's r's and Kendall's, Characteristics of	
	4.3	Distribution-free or Non-parametric Tests Analysis of Variance (ANOVA), Analysis of Co-Variance (ANOCOVA), Distribution-free Tests, its importance	
	4.4	Multivariate Analysis Techniques, Characteristics and Applications, Classification of Multivariate Techniques, Variables in Multivariate Analysis, Important Multivariate Techniques.	

References:

1. Biradar R. S., 2002 . Course Manual Fisheries Statistics, CIFE, Mumbai**.**
2. C. R. Kothari, (2004) Research Methodology, Published by New Age International (P) Ltd., Publishers New Delhi.
3. Jason Puckett (2011) Zotero: a guide for librarians, researchers and educators, published by American Library Association.
4. Michael Alley, The Craft of Scientific Writing (3rdEdition),Springer, New York,1996
5. Philip Reubens (General editor), Science and Technical Writing– A Manual of Style (2ndEdition), Routledge, New York,2001
6. R. Panneerselvam (2014) Research Methodology, PHI Learning publisher.
7. Ranjit Kumar (2014) Research Methodology A Step-by-Step Guide for Beginners, SAGE Publications.
8. Snedecor, G. W., and W. G. Cochran. 1989. Statistical methods, 8th edition. Iowa State University Press, Ames.
9. Uwe Flick (2014) Introducing Research Methodology, A Beginner's Guide to Doing a Research Project, SAGE Publications.
10. Zar, J. H. 1984. Biostatistical analysis. Prentice Hall, Englewood Cliffs, New Jersey

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-II

Discipline Specific Core Course

SFISCT451 Fish biochemistry and microbiology

Periods: 60	**No. of Credits: 04**	**Marks: 100**

Course pre-requisite:

- Basic knowledge about biochemistry and microbiology.

Course objectives:

1. To study biochemical composition and nutritive values of fish and fishery products
2. To study role of different microorganisms in in food
3. To isolate and study different microbes from fish and fishery products
4. To study standard operating procedures in fish processing and handling

Course outcomes:

1. The learner will have thorough knowledge about nutritive value as well as biochemical composition of fish and fishery products
2. The students will have expertise in isolation and analysis of microorganism from fish and fishery products
3. The student will be able to set and follow standard operating procedures for maintaining hygiene and sanitation.

CURRICULUM DETAILS

Module No	**Unit No**	**Topics**	**Hrs required to cover the content**
1		**Major biomolecules in foods and their important functions.**	**15**
	1.1	Biochemical composition of fish and nutritive value	
	1.2	Carbohydrates: classification, functions and properties	
	1.3	Proteins: classification, functions and properties	
	1.4	Lipids: Structures, classification, functions and properties	
	1.5	Vitamins: Classification, functions and properties	
2		**Microorganisms in food**	**15**
	2.1	Introduction and history of microorganisms in foods;	
	2.2	Role and significance of microorganisms in nature and in foods	
	2.3	Types of microorganisms in fish and fishery products	
	2.4	Factors affecting growth and survival of microorganisms in food	
3		**Microbial analysis**	
	3.1	Enumeration of microorganisms in food by conventional and rapid techniques	
	3.2	Microbial principles of fish preservation and processing	
	3.3	Microbial spoilage of fresh & processed fish and fishery products	
	3.4	Indicators of microbial qualities of fish and fishery products	
	3.5	Food borne pathogens involved in infections, intoxication and other	**15**

		biological hazards	
	3.6	Microbial poisoning in food	
4		**Hygiene and sanitation**	**15**
	4.1	Indices of fish sanitary quality,	
	4.2	Concept of quality management, Standard Operating Procedures (SOP), Good Manufacturing Practices (GMP)	
	4.3	Hazard Analysis Critical Control Point (HACCP), Microbiological standards and criteria, Quality Standards for fish and fishery products.	
	4.4	Fish plant sanitation, Disinfectants and detergents and cleaning	

References:

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2. Alasalvar C, Miyashita K, Shahidi F and Wanasundara U. 2011. *Handbook of Seafood Quality, Safety and Health Applications*, Wiley-Blackwell (Oxford)
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5. Balachandran KK. 2001. *Post Harvest Technology of Fish and Fish Products*. Daya Publ. House.
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18. Michael J, Pelizar JR and Chan ECS. 1998. *Microbiology*. McGraw Hill.
19. Rita Narayanan 2013. *Food Microbiology: basic and applied with laboratory exercises*, New India Publishing Agency (New Delhi)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-II

Discipline Specific Core Course

SFISCP451: Lab course 1

(Based on **SFISCT451 Fish biochemistry and microbiology**)

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Study of biochemical composition and Proximate composition of fish
2. Estimation of protein from fish sample
3. Estimation of lipids from fish sample
4. Estimation of carbohydrate from fish sample
5. Sensory evaluation of fishes
6. Isolation and characterization of spoilage and pathogenic microorganisms,
7. Sampling for TPC from fish
8. Isolation and enumeration of bacteria from fish
9. Microbial composition of fermented fish
10. Conventional and molecular methods of detection of pathogens

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-II

Subject: Fishery Science

Discipline Specific Core Course Practical

SFISCP451: Lab course 1

(Based on **SFISCT451 Fish biochemistry and microbiology**)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1 Estimate …….. from the given fish sample. 07

(Protein/Lipid/Carbohydrate)

Q. 2 Identify and comment on given specimen (Any two microorganisms from fish and fishery Products) 04

Q. 3 Prepare media/agar plates for incubation using Spread/Streak/Pour plate methods using given fish sample to estimate Total Plate Count (TPC) 07

OR

Enumerated the microbial count (CFU/mL) from given specimen plate and details .

Q. 4 Viva-voce 02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-II

Discipline Specific Core Course

SFISCT452 Aquarium & ornamental fish management

Periods: 60	**No. of Credits: 04**	**Marks: 100**

Course pre-requisite:

- General information about aquarium and aquatic ornamental species.

Course objectives:

1. To provide knowledge about ornamental fish industry.
2. To impart knowledge & technical knowhow regarding design and fabrication of aquarium tanks
3. Study of different aquatic ornamental species.
4. To study breeding and propagation of different aquatic ornamental species.
5. To cater detailed knowledge about setting, care and maintenance of aquarium tanks.

Course outcomes:

1. The students will be thoroughly informed about the aquarium and ornamental industry.
2. Learners will gain detailed knowledge and hands on regarding design and fabrication of aquarium tanks.
3. The student will be able to propagate different aquarium species.
4. The student will have expertise in setting as well maintenance of aquarium tanks.

CURRICULUM DETAILS

Module No	**Unit No**	**Topics**	**Hrs required to cover the content**
1		**Aquarium**	**15**
	1.1	Introduction to ornamental fish industry	
	1.2	Benefits of ornamental fish keeping	
	1.3	Importance of aquarium	
	1.4	Types of aquarium	
	1.5	Aquarium fabrication	
	1.6	Accessories of aquarium	
2		**Study of important aquarium species**	**15**
	2.1	**Biology of Indigenous ornamental fishes:** i) *Brachydanio rerio* (Zebra fish), ii) *Chanda nama* (Glass fish), iii) *Botia lohachata* (Reticulated loach)	
	2.2	**Biology of Exotic ornamental fishes:** i) *Carassius auratus* (Goldfish), ii) *Betta splendens* (Siamese fighting fish), iii) *Poecillia reticulate* (Guppy), iv) *Xiphophorus helleri* (Sword tail fish)	
	2.3	**Biology of Other aquatic Ornamental organisms:** i) Octopus ii) Haddons carpet anemone iii) Red lobster	
	2.4	**Aquarium plants:** i) Hydrilla, ii) Amazon Sword, iii) Vallisneria, iv)	

		Cabomba	
3		**Breeding of ornamental fishes and plants**	**15**
	3.1	Identification of male and female brooders	
	3.2	Breeding technique of ornamental fishes a) Egg layers: i) Gold fish, ii) Fighting fish b) Live Bearers: i) Guppy, ii) Mollies, iii) Sword tail	
	3.3	Transportation of live aquarium fishes	
	3.4	Propagation of Aquarium plant	
4		**Management of aquarium**	**15**
	4.1	Setting of aquarium	
	4.2	Care and maintenance of aquarium	
	4.3	Aquarium water quality and management	
	4.4	Food for Aquarium fishes: fish feeds, and live fish food organism	
	4.5	Disease management of ornamental fishes	

References:

1. Axelrod HR &Sweenen ME. 1992. *The Fascination of Breeding Aquarium Fishes*. TFH.
2. Axelrod HR &Vorderwinkler W. 1978. *Encyclopaedia of Tropical Fishes*. TFH Publ.
3. B. Ahilan N Flex and R. Santhanan, 2013. The text book of aquariculture, Daya Publishing House, New Delhi.
4. B. K. Mahapatra, S. Datta, G. H. Pailan, P. SardarA. R. Sen and S. Dasgupta, 2015. Ornamental Fish Breeding, Culture and Trade. Director, ICAR-CIFE, Mumbai.
5. C. W. Emmens, Keeping and Breeding Aquarium Fishes, 1953. Academic press, INC publishers, New York.
6. *Handbook of Fisheries and Aquaculture*. 2006. ICAR.
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8. Helen E. Roberts, DVM, 2010. Fundamentals of ornamental fish health, Edition first, Blackwell Publishing.
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10. N. Arumugam, K.V. Jayashree, C.S. Tharadevi, 2015. Home Aquarium and Ornamental Fish Culture, Pages-508.
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Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-II

Discipline Specific Core Course

SFISCP452: Lab course 2

(Based on **SFISCT452 Aquarium & ornamental fish management**)

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Design and fabrication of glass aquarium tank
2. Study of different accessories used in aquarium
3. Study of common indigenous fishes: Egg layers and Live Bearers fishes
4. Study of common exotic aquarium fishes: Egg layers and Live Bearers fishes
5. Study of common aquarium ornamental plants: Hydrilla, Amazon Sword, Vallisneria, Cabomba
6. Setting-up of aquarium tank
7. Maintenance of an aquarium tank.
8. Breeding of ornamental fishes- Egg layers (Gold fish/ Fighting fish)
9. Breeding of ornamental fishes- Live bearers: (Guppy/Sword tail)
10. Study of ornamental fish conditioning and packing
11. Identification of fish diseases and control measures

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-II

Subject: Fishery Science

Discipline Specific Core Course Practical

SFISCP452: Lab course 2

(Based on **SFISCT452 Aquarium & ornamental fish management**)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1	Prepare the aquarium tank for breeding of given aquarium fish/plant species.	04
Q. 2	Identify and comment on given specimen (Any Three from Aquarium accessories, fish species and plant species)	06
Q. 3	Fabricate the aquarium tank from given material OR Set the given aquarium tank with provided aquarium fishes, plants and accessories.	08
Q. 4	Viva-voce	02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-II

Discipline Specific Core Course

SFISCT453: Freshwater aquaculture

Periods: 60	**No. of Credits: 04**	**Marks: 100**

Course pre-requisite:

- General principles and steps in aquaculture.

Course objectives:

1. To impart detailed information and knowledge regarding freshwater resources.
2. To study qualities of cultivable freshwater aquatic species
3. To study culture practices of important freshwater fish species.
4. To study integration of aquaculture with other culture systems

Course outcomes:

1. The students will have thorough knowledge regarding different freshwater resources
2. Students will be select and identify suitable species for culture in available water resources
3. The learners will be technical sound in culture practices of different freshwater species.

CURRICULUM DETAILS

Module No	Unit No	Topics	Hrs required to cover the content
1		**Freshwater Aquaculture Resources**	**15**
	1.1	Status and Prospects of Freshwater Aquaculture	
	1.2	Freshwater Aquaculture Resources of India	
	1.3	Traits of important cultivable fresh water species	
	1.4	Major species cultured in freshwater	
2		**Culture practices of Finfishes**	**15**
	2.1	Culture of carps (Indian major carps, minor carps and exotic carps)	
	2.2	Culture of cat fishes	
	2.3	Culture of cold water fishes	
	2.4	Culture of air breathing fishes	
3		**Culture practices of Shellfishes**	**15**
	3.1	Culture of freshwater prawns	
	3.2	Culture of mussels (Freshwater pearl culture)	
	3.3	Exotic fish species introduced in India and its impact on indigenous fish fauna	
4		**Sewage and Integrated fish culture**	**15**
	4.1	Sewage-fed fish culture	
	4.2	Integrated culture systems: Introduction, Scope, Principles	
	4.3	Culture systems with integration of Aquaculture with agriculture	

		(vegetables, paddy)	
	4.4	Culture systems with integration of Aquaculture with livestock (pig, poultry, duck,)	

Reference Books:

1. Ahilan, B. Textbook of freshwater Aquaculture, Daya Publishing House, New Delhi.
2. .Bardach J.E. and J.H. Rhyther, 2013. Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms, Wiley India Pvt Ltd
3. Daniel Merrifield and Einar Ringø, 2014. Aquaculture Nutrition: Gut Health,Probiotics and Prebiotics, John Wiley & Sons, Ltd
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5. Jhingran, V.C. 1991. Fish and Fisheries in India. Hindustan Publishing Company,New Delhi, India.
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8. Michael Bernard New, Wagner Cotroni Valenti, James H. Tidwell, Louis R.D'Abramo and Methil Narayanan Kutty, 2010. Freshwater Prawns Biology andFarming, Willy Blackwell Publishing Ltd.
9. N. Romoanowski, 2006. Sustainable Freshwater Aquacultures: The complete guidefrom backyard to investor, University of New Southwales Press.
10. Pillai, TVR. and M. N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
11. Rath, R. K., 2000. Freshwater Aquaculture, Scientific Publishers, Jodhpur.
12. Santanam, R. 1980. Fisheries Science, Daya Publishing House, New Delhi, India.
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16. Yadav, B.N. 1997. Fish and fisheries, Daya Publishing House, New Delhi, India.
17. Zade S. B., C. G. Khune, S. R. Sitare and R. V. Tijare, Principles of aquaculture, Himalaya Publishing House.

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Study of commercially important cultivable finfish species.
2. Study of commercially important cultivable shellfish species
3. Assessment of fish seed quality
4. Collection, identification and control of aquatic weeds and insects.
5. Collection, identification and control predatory and weed fishes.
6. Application of lime and fertilizers in freshwater ponds.
7. Study of natural and supplementary feed in Freshwater aquaculture.
8. Estimation of Daily Feeding Rate(DFR) & Feed Conversion Ratio (FCR) from given details
9. Estimation of growth by Length weight method
10. Estimation of biomass by using Catch per Unit Effort (CPUE)
11. Visit to freshwater fish Farm

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-II

Subject: Fishery Science

Discipline Specific Core Course Practical

SFISCP453: Lab course 3

(Based on **SFISCT453: Freshwater aquaculture**)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1	Estimate the total biomass of the pond from provided details/samples.	06
	OR	
	Estimate the growth parameters of fish from given details/samples.	
Q. 2	Calculate Daily Feeding Rate(DFR) / Feed Conversion Ratio(FCR) from given details	06
Q. 3	Identify and comment on given specimen (Any three from cultivable fish species, weed and predatory fishes, aquatic insect and weeds)	06
Q. 4	Viva-voce	02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-II

Discipline Specific Elective Course

SFISET451 A. Fish disease management

Periods: 45	**No. of Credits: 03**	**Marks: 75**

Course pre-requisite:

- General information regarding diseases, fishes and aquatic ecology.

Course objectives:

1. To provide detailed knowledge about disease development.
2. To study different factors affecting health of fishes
3. To study different types of diseases in fishes
4. To study various management practices for prevention and control fish diseases

Course outcomes:

1. The students will have thorough knowledge disease development in fishes
2. The learners will be able to analyze fishes for different diseases and infections.
3. The students will be able to undertake steps for prevention and control of diseases.

CURRICULUM DETAILS

Module No	Unit No	Topics	Hrs required to cover the content
1		**Disease and disease development**	**10**
	1.1	Disease: Introduction, process and Cause of disease development in fish	
	1.2	General etiology of fish diseases	
	1.3	Extrinsic factors affecting fish health a) Water-associated factors; b) Nutrition-associated factors	
	1.4	Common symptoms of stress	
	1.5	Effect of stress on a fish health	
2		**Infectious Fish Diseases:** (Disease causing organism, symptoms and preventives measures)	**13**
	2.1	Bacterial Diseases: Dropsy and fin rot	
	2.2	Viral Diseases: Papillomatosis, Lymphocystosis and Infectious pancreatic necrosis (IPN)	
	2.3	Fungal Diseases:-Gill rot, Branchiomycosis (Dermal Mycosis, Branchial mycosis, Systemic mycosis)	
	2.4	Epizootic Ulcerative Syndrome (EUS) in fishes.	
3		**Parasitic diseases of Fish** (Disease causing organism, symptoms and preventives measures)	**12**
	3.1	1. Protozoan Diseases:-White spot (Ichthyophthiriasis) and costiasis.	
	3.2	2. Metazoan Diseases: a) Monogenic trematode parasites (Dactylogyrus, Gyrodactylus), b) Digenic trematodes (trematode larval and Neodiplostomum),	

		c) Cestode parasites (Ligula and *Dibothriocephalus latus*), d) Nematodes and fish leeches.	
	3.3	Crustaceans diseases: Argulus and Learnia	
4		**Nutritional and environmental diseases**	**10**
	4.1	Nutrition deficiency diseases: Avitaminosis, Mineral deficiency, Starvation.	
	4.2	Environmental induced diseases of fish. a) Gas bubble disease b) Oxygen deficiency c) Thermal stress d) Stress due to pH variations	
	4.3	Management practices to control fish diseases	

References:

1. B.K. Mishra, P. Swain, P. K. Sahoo, B. K. Das, N. Sarangi. Disease management in FW Pisiculture.
2. Bose et al. Coastal Aquacultural Engineering
3. *Handbook of Fisheries and Aquaculture*. 2006. ICAR.
4. K.P. Biswas Prevention and control of fish and Prawn diseases –
5. Pillai, TVR. and M. N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
6. R. Ramachandran Nair Encyclopedia of fish disease –
7. Rath, R. K., 2000. Freshwater Aquaculture, Scientific Publishers, Jodhpur.
8. Roberts R.J., Fish Pathology.
9. Sinderman C.J. Principle diseases of Marine fish and shell fish
10. Wheaton, F. W. Aquacultural Engineering

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Methods of sampling fish and shellfish for disease diagnosis
2. Examination of fishes and identification of disease
3. Morphological, biochemical and biological test of bacteria and fungi.
4. Isolation of microorganisms (bacteria & fungi) from fish.
5. Staining: Monochrome stating and Gram staining
6. Collection and identification of fish parasites
7. Changes in different organs systems of fish due to diseases
8. Methods of treatment
9. Preparation and use of medicated feeds
10. Hospital tanks and management

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-II

Subject: Fishery Science

Discipline Specific Elective Course Practical

SFISEP451: Lab course 4-A

(Based on **SFISET451: A. Fish disease management**)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1	Staining of given microbial culture/ material.	06
Q. 2	Examine the given specimen for identification of disease (Any Two)	06
Q. 3	Identify and comment on given specimen (Any three Bacteria, fungi, parasite)	06
Q. 4	Viva-voce	02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Two Year PG Program, Fishery Science (w.e.f. 2024)

M.Sc. FY Semester-II

Discipline Specific Elective Course

SFISET451: B. Packaging of Fish & fishery products

Periods: 45 **No. of Credits: 03** **Marks: 75**

Course pre-requisite:

- Basic information regarding packaging of food products

Course objectives:

1. To provide detailed information regarding packaging of food products.
2. To study different packaging materials used in food packaging
3. To study canning process.
4. To study methods of food packaging.

Course outcomes:

1. The learners will have detailed knowledge of packaging of food products in order to preserve the qualities of food.
2. The students will have thorough understanding of different rules and standards of packaging
3. The students will be well worse with different material as well as methods used in packaging of fish and fisher products.

CURRICULUM DETAILS

Module No	Unit No	Topics	Hrs required to cover the content
1		**Food packaging**	**11**
	1.1	Purposes & Need for packaging of food	
	1.2	Technological aspects of packaging fishery products	
	1.3	Packaging for transport, Shipping and Institutional supplies	
	1.4	Packaging materials	
	1.5	Packaging standards for domestic and international trade	
	1.6	Labeling and printing of packaging materials	
2		**Transportation**	**10**
	2.1	Packaging requirements for transportation of live fish and shellfish	
	2.2	Methods of testing for packaging materials for their physical properties	
	2.3	Containers and their testing and evaluation	
	2.4	Package designs; Resistance of packages to hazards in handling; Transport and storage	
3		**Canning process:**	**11**
	3.1	Principles and process details	
	3.2	Canning machinery and equipment	
	3.3	Canning process for fish/shellfish	
	3.4	Value added canned products	
	3.5	Spoilage of canned food	
	3.6	Examination of cans	

	3.7	Effect of canning on nutrient profile	
4		**Advances in Packaging of Fish and fishery products**	**13**
	4.1	**VACUUM PACKAGING** a. Introduction, b. Equipments used in vacuum packaging c. Process of vacuum packaging of fish and fishery products d. Factors Affecting Vacuum Packaging e. Advantages of Vacuum Packaging	
	4.2	**MODIFIED ATMOSPHERIC PACKAGING (MAP)** a. Introduction b. Composition of gas mixture c. Equipments used in MAP d. Process of MAP for fish and fishery products e. Advantages and disadvantages of MAP	
	4.3	**CONTROLLED ATMOSPHERIC PACKAGING (CAP)** a. Introduction, b. Gases in CAP c. Advantages and disadvantages of CAP	
	4.4	**SMART & ACTIVE PACKAGING**	

References:

1. Balachandran KK. 2001. *Post-Harvest Technology of Fish and Fish Products*. Daya Publ.
2. Da-Wen Sun 2012. *Handbook of Frozen Food Processing and Packaging*, CRC Press (Boca Raton)
3. Gopakumar K. 1993. *Fish Packaging Technology - Materials and Methods*. Concept Publ.
4. Gordon L Robertson. 2005. *Food Packaging: Principles and Practices*, "Marcel Dekker, Inc."(New York)
5. Gordon L Robertson. 2010. *Food Packaging and Shelf Life: A Practical Guide*, CRC Press Inc. (Florida)
6. Gordon L Robertson. 2013. *Food Packaging: Principles and Practice*, CRC Press (Boca Raton)
7. Jerry D'Souza, Jatin Pradhan. 2010. *Handbook of Food Processing Packaging and Labeling*, SBS Publiahers and Distributors Pvt. Ltd. (New Delhi)
8. Ponnuswami V. 2012. *Nano Food Packaging: A New Post-harvest Venture*, Narendra Publishing House (Delhi)
9. S Subasinghe. 1999. *Retail Packaging of Fish and Fishery Products*, InfoFish
10. TK Srinivasa Gopal. 2007. *Seafood Packaging*, Central Institute of FIsheries Technology (Cochin)
11. W Steven Otwell, Hordur G Kristinsson, Murat O Balaban. 2006. *Modified Atmospheric Processing and Packaging of Fish: Filtered Smokes, Carbon Monoxide, and Reduced Oxygen Packaging*" "Blackwell Publishing Inc.." (Malden).

Periods: 30	**No. of Credits: 01**	**Marks: 25**

CURRICULUM DETAILS

1. Study of packaging materials
2. Study of packaging requirement of live fishes
3. Evaluation of physical properties of packaging material
4. Study of labelling and printing for packaging
5. Study of canning process
6. Study of equipments and machineries used in canning
7. Examination of cans
8. Study of Vacuum packaging
9. Study of equipments and machineries used in Vacuum packaging
10. Study of Modified Atmospheric Packaging (MAP) and Controlled Atmospheric Packaging (CAP)
11. Study of equipments and machineries used in MAP & CAP
12. Study of gas combination in MAP & CAP

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

NEP-2020 Pattern (w.e.f. 2024)

Practical Examination: M.Sc. First Year Semester-II

Subject: Fishery Science

Discipline Specific Elective Course Practical

SFISEP451: Lab course 4-B

(Based on **SFISET451: B. Packaging of Fish & fishery products**)

Centre:

Date: **Time:** **Batch No.:**

Credits: 01 **Marks: 20**

Q. 1	Estimate the GSM/thickness of given packaging material	04
Q. 2	Pack the given live/processed fish specimen using given material	06
Q. 3	Identify and comment on given specimen (Any four from packaging material, equipment, machinery, etc.)	08
Q. 4	Viva-voce	02

Examiner 1 **Examiner 2**

Name & Signature Name & Signature