



ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM
B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

UG PROGRAM (4 Years Honors)
CBCS - 2020-21

SUBJECT
AQUACULTURE TECHNOLOGY



Syllabus and Model Question Papers



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Note: BOS is to provide final soft copy in PDF and word formats and four copies of hard copies in bounded form to the office of Dean Academic affairs.



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1. Resolutions of the Board of Studies

Meeting held on

Time:

At:

Adikavi Nannaya University, Rajamahendravaram

Agenda:

1. Adoption of revised-common program structure and revising/updating course-wise syllabi (in the prescribed format) as per the guidelines issued by APSCHE
2. Adoption of regulations on scheme of examination and marks/grading system of the UG program
3. Preparation of Model question papers in prescribed format
4. List of equipment / software requirement for each lab/practical
5. Eligibility of student for joining the course
6. Eligibility of faculty for teaching the course
7. Any specific instructions to the teacher/paper-setter/student/ chief-superintendent/ paper-evaluator
8. List of paper-setters/paper evaluator with phone, email-id in the prescribed format

Members present:

1. Dr.K. Ramaneswari
2. Dr. N. Sreenivas
- 3.

Resolutions:

Recommended Combination: Zoology, Chemistry & Aquaculture Technology

“The domain subject “**AQUACULTURE TECHNOLOGY**”, embracing the fields of biology of commercial aquatic organisms like fish. Prawn, seaweed, pearl oysters, hatchery technology, culture practices, disease management, food and feeding habits, feed manufacturing, marketing, economics etc, is very much market-oriented course as the state of Andhra Pradesh is having longest coastal belt providing greater employment opportunities to the community.



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UG Program (4 years Honors) Structure (CBCS)

2020-21 A. Y., onwards
BACHLOR OF SCIENCE

(3rd and 4th year detailed design will be followed as per APSCHE GUIDELINES)

Subjects/ Semesters		I		II		III		IV		V		VI			
		H/W	C	H/W	C	H/W	C	H/W	C	H/W	C	H/W	C		
Languages															
English		4	3	4	3	4	3								
Language (H/T/S)		4	3	4	3	4	3								
Life Skill Courses		2	2	2	2	2+2	2+2								
Skill Development Courses		2	2	2+2	2+2	2	2								
Core Papers															
M-1	C1 to C5	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1						
M-2	C1 to C5	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1						
M-3	C1 to C5	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1						
M-1	SEC (C6,C7)											4+2	4+1		
M-2	SEC (C6,C7)											4+2	4+1		
M-3	SEC (C6,C7)											4+2	4+1		
Hrs/ W (Academic Credits)		30	25	32	27	32	27	36	30	36	30	0	12	4	4
Project Work															
Extension Activities (Non Academic Credits)															
NCC/NSS/Sports/Extra Curricular										2					
Yoga							1		1						
Extra Credits															
Hrs/W (Total Credits)		30	25	32	27	32	28	36	33	36	30	0	12	4	4

M= Major; C= Core; SEC: Skill Enhancement Courses



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Marks & Credits distribution: UG-Sciences

Sl. No	Course type	No. of courses	Each course teaching Hrs/wk	Credit for each course	Total credits	Each course evaluation			Total marks
						Conti-Assess	Univ-exam	Total	
1	English	3	4	3	9	25	75	100	300
2	S.Lang	3	4	3	9	25	75	100	300
3	LS	4	2	2	8	0	50	50	200
4	SD	4	2	2	8	0	50	50	200
5	Core/SE -I	5+2	4+2	4+1	35	25	75+50	150	1050
	Core/SE -II	5+2	4+2	4+1	35	25	75+50	150	1050
	Core/SE -III	5+2	4+2	4+1	35	25	75+50	150	1050
6	Summer-Intern	2		4	8		100	200	200
7	Internship/ Apprentice/ on the job training	1		12	12		200	200	200
		38			159				4550
8	Extension Activities (Non Academic Credits)								
	NCC/NSS/Sports/ Extra Curricular			2	2				
	Yoga			2	1	2			
	Extra Credits								
	Total	40			142				



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DETAILS OF COURSES AND CREDITS

Sem	Course No.	Course Title	Course Type (T/P/L)	Teaching Hrs./Week	Credits	Max. Marks	Max. Marks	
				Science :4+2	Science :4+1	Internal/Conti./Mid Assessment	Sem-End Exam	
I	1	Basic Principles of Aquaculture	T	4	04	25	75	
		Basic Principles of Aquaculture -I Lab	L	2	01	-	50	
II	2	Biology of Fin Fish & Shell Fish	T	4	04	25	75	
		Biology of Fin Fish & Shell Fish - II Lab	L	2	01	-	50	
III	3	Fish Nutrition & FeedTechnology	T	4	04	25	75	
		Fish Nutrition & Feed Technology - III Lab	L	2	01	-	50	
IV	4	Freshwater & Brackish water Aquaculture	T	4	04	25	75	
		Practical - IV	L	2	01	-	50	
	5	Fish Health Mangement & Fisheries Economics	T	4	04	25	75	
		Practical - V	L	2	01	-	50	
V	6A	Soil and Water Quality Management	T	4	04	25	75	
		Soil and Water Quality Management Lab	L	2	01	-	50	
	7A	Ornamental Fish Culture	T	4	04	25	75	
		Ornamental Fish Culture Lab	L	2	01	-	50	
	OR							
	6B	Techniques for Aqualab	T	4	04	25	75	
		Techniques for Aqua Lab (p)	L	2	01	-	50	
	7B	Fish Processing Technology	T	4	04	25	75	
		Fish Processing Technology Lab	L	2	01	-	50	
	OR							
	6C	Aquaculture Economics	T	4	04	25	75	
		Aquaculture Economics Lab	L	2	01	-	50	
	7C	Fish Microbiology and Quality Assurance	T	4	04	25	75	
		Fish Microbiology and Quality assurance Lab	L	2	01	-	50	

Note: * Course Type Code : T-Theory, L - Lab, P: Problem solving

Note 1: For Semester–V, for the domain subject **Aquaculture Technology**, any one of the three pairs of SECs shall be chosen as courses 6 and 7, i.e., 6A & 7A or 6B & 7B or 6C & 7C. The pair shall not be broken (ABC allotment is random, not on any priority basis).

Note 2: One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate field skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the field skills embedded in the syllabus citing related real field situations.



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Note 3: To insert assessment methodology for Internship/ on the Job Training/Apprenticeship under the revised CBCS as per APSICHE Guidelines.

- **First internship (After 1st Year Examinations):** Community Service Project. To inculcate social responsibility and compassionate commitment among the students, the summer vacation in the intervening 1st and 2nd years of study shall be for Community Service Project (the detailed guidelines are enclosed).
- **Credit For Course: 04**

- **Second Internship (After 2nd Year Examinations):** Apprenticeship / Internship / on the job training / In-house Project / Off-site Project. To make the students employable, this shall be undertaken by the students in the intervening summer vacation between the 2nd and 3rd years (the detailed guidelines are enclosed).
- **Credit For Course: 04**

- **Third internship/Project work (6th Semester Period):**
During the entire 6th Semester, the student shall undergo Apprenticeship / Internship / On the Job Training. This is to ensure that the students develop hands on technical skills which will be of great help in facing the world of work (the detailed guidelines are enclosed).
- **Credit For Course:12**



GENERAL CURRICULAR ACTIVITIES :

❖ **Lecturer-based:**

1) **Class-room activities:** Organization of Group discussions, question-answer sessions, scientific observations, use of audio-visual aids, guidance programmes, examination and evaluation work (scheduled and surprise tests), quizzes, preparation of question banks, student study material, material for PG entrance examinations etc.

2) **Library activities:** Reading books and magazines taking notes from prescribed and reference books and preparation of notes on lessons as per the syllabus; Reading journals and periodicals pertaining to different subjects of study; Making files of news-paper cuttings etc.

3) **Lab activities:** Organization of practicals use of virtual laboratory , maintenance of lab attendance registers/log registers, maintenance of glassware and chemicals

4) **Activities in the Seminars, workshops and conferences:** Organization of at least one seminar/workshop/conference per academic year either on academic/research aspects and inculcate research spirit among students

5) **Research activities:** Student study projects (General / RBPT model), Minor or Major research projects, Research guidance to research scholars, Publication of research articles/papers (at least one in 2 years) in UGC-recognized journals, Registration in Vidwan/Orcid/Scopus/Web of Science

6) **Smart Classroom Activities:** Organization of Departmental WhatsApp groups, Ed Modo groups/Google Class Rooms/Adobe Spark groups for quick delivery of the subject; Preparation of Moocs content & presentation tube lessons by trained lecturers; Using smart/digital/e- class rooms (mandarory) wherever present; Utilization of YouTube videos (subject to copy rights) etc.

❖ **Student-based:**

1) **Class-room activities:** Power point presentations, seminars, assignments

2) **Library activities:** Visit to library during library hour and preparation of notes

3) **Lab activities:** Maintenance of observation note book and record, keeping lab clean and tidy

4) **Activities in the Seminars, workshops and conferences:** Participation/presentation in seminar/workshop/conference

CO-CURRICULAR ACTIVITES:

❖ **OBJECTIVES:**

The co-curricular activities are aimed at strengthening the theoretical knowledge with an activity related to the content taught in the class room. The aesthetic development, character building, spiritual growth, physical growth, moral values, creativity of the student.

The different types of co-curricular activities relevant to Sericulture domain are listed below:



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❖ **Academic – based**

- Preparation of Charts/Clay or Thermocol Models
- Debates, Essay Writing Competitions
- Group Discussions
- Departmental (Sericulture) magazine
- Formation of Book clubs
- Animal album-making
- Viva-Voce

❖ **Lab/Research –based**

- Documentaries
- Field Visit/Excursions/to sericulture research stations- sericulture units
- Training at research centres (sericulture etc.)
- Exposure to scientific instruments and hands-on experience
-

❖ **Value - based**

- Organization of works shop with the aqua farmers like lab to pod activity annually with the students and stake holders
- **Observation of Days of National/International Importance**

World Cancer Day (February 4th)	International Biological Diversity Day (May 22nd)
Darwin Day (February 12th)	World Turtle Day (May 23rd)
National Science Day (Feb 28th)	World blood Donor Day (June 14th)
World Wildlife day (March 3rd)	World Zoonoses Day (July 6th)
National Vaccination Day (March 16th)	World Mosquito Day (August 20th)
World Health Day (April 7th)	World Turtle Day (May 23rd)
Earth Day (April 22nd)	World Mosquito Day (August 20th)
Malaria Day (April 25th)	World Animal day (October 4th)
World Hepatitis Day (May 19th)	World Fisheries Day (November 21)



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B Sc	Semester: I	Credits: 4
Course: 1	BASIC PRINCIPLES OF AQUACULTURE	Hrs/Wk:4

Course Outcomes: By the completion of the course the graduate should able to –

- Describe the concept of blue revolution and different aqua culture systems
- Explain the pond ecosystem
- Describe the different types of fish ponds
- Explain the steps of pond preparation
- Describe the pond management practices

Learning objectives:

- To understand the concept of blue revolution and different aqua culture systems.
- To understand the pond ecosystem .
- To understand the different types of fish ponds.
- To understand steps of pond preparation.
- To understand the pond management practices

UNIT I: INTRODUCTION:

- 1.1. Concept of Blue Revolution - History and definition of Aquaculture. Scope of Aquaculture at global Level, India and AndhraPrades
- 1.2. Different Aquaculture systems – Pond, Cage, Pen, Running water, Extensive, Intensive and & Semi-Intensive Systems and their significance.
- 1.3. Monoculture, Polyculture and Monosex culture systems

UNIT II: POND ECOSYSTEM

- 2.1 General Concepts of Ecology, Carrying Capacity and Food Chains
- 2.2 Lotic and lentic systems, streams and spring
- 2.3 Nutrient Cycles in Culture Ponds – Phosphorus, Carbon and Nitrogen Importance of Plankton and Benthos in culture ponds, nutrient dynamics and algal blooms
- 2.4 Concepts of Productivity, estimation and improvement of productivity

UNIT III: TYPES OF FISH PONDS

- 3.1 Classification of ponds based on water resources – spring, rain water, flood water, well water and water course ponds
- 3.2 Functional classification of ponds – head pond, hatchery, nursery ponds
- 3.3 Functional classification of ponds -rearing, production, stocking and quarantine ponds
- 3.4 Fish Hatchery design

UNIT IV: POND PREPARATION

- 4.1 Important factors in the construction of an ideal fish pond – site selection, topography
- 4.2 Important factors in the construction of an ideal fish pond- nature of the soil, water resources
- 4.3 Lay out and arrangements of ponds in a fish farm
- 4.4 Construction of an ideal fish pond – space allocation, structure and components of barrage pond



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UNIT V: POND MANAGEMENT FACTORS

- 5.1 Need of fertilizer and manure application in culture ponds
- 5.2 Role of nutrients; NPK contents of different fertilizers and manures used in aquaculture; and precautions in their application
- 5.3 Physico-chemical conditions of soil and water optimum for culture –temperature, depth, turbidity, light, water and shore currents, PH, DOD, CO₂ and nutrients; measures to increase oxygen and reduce ammonia & hydrogen sulphide in culture ponds; correction of PH
- 5.4 Eradication of predators and weed control – advantages and disadvantages of weed, weed plants in culture ponds, aquatic weeds, weed fish, toxins used for weed control and control of predators

PRESCRIBED BOOKS:

1. Jhingran VG 1998. Fish and Fisheries of India. Hindusthan Publishing Corporation, New Delhi
2. Pillay TVR, 1996. Aquaculture Principles and Practices, Fishing News Books Ltd., London

REFERENCES BOOKS:

1. Pillay TVR & M.A.Dill, 1979. Advances in Aquaculture. Fishing News Books Ltd., London
2. Stickney RR 1979. Principles of Warm Water Aquaculture. John Wiley & Sons Inc. 1981
3. Boyd CE 1982. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Company.
4. Bose AN et.al., 1991. Coastal Aquaculture Engineering. Oxford & IBH Publishing Company Pvt.Ltd.



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B Sc	Semester: I	Credits: 1
Course: 1	BASIC PRINCIPLES OF AQUACULTURE LAB	Hrs/Wk:2

PRACTICALS:

1. Estimation of Carbonates, Bicarbonates in water samples
2. Estimation of Chlorides in water samples
3. Estimation of dissolved oxygen
4. Estimation of ammonia in water
5. Field visit to nursery, rearing and stocking ponds of aqua farms
6. Field visit to hatchery
7. Study of algal blooms and their control
8. Collection & identification of zooplankton and phytoplankton
9. Study of aeration devices
10. Determination of soil nitrogen and phosphorus
11. Collection and study of aquatic weeds
12. Field survey of nearby habitat for dietary dependency on and requirement of aqua-products



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MODEL QUESTION PAPER(Semester-End)
B.Sc Degree Examinations
SEMESTER - I
Course 1:BASIC PRINCIPLES OF AQUACULTURE

Time : 3 hrs

Max. Marks : 75

SECTION –A

Answer any FIVE of the following

5x5 = 25 Marks

(Draw labelled diagrams wherever necessary)

1. Write a note on Pen culture
2. Illustrate the importance of Poly culture
3. Why plankton is important in culture
4. Discuss the management of Nursery pond
5. Quarantine plays an important role in ponds- discuss
6. What are the ideal soil characters for the construction of fish pond
7. Discuss the weed control in culture ponds
8. What measures you suggest for the pH correction in the culture ponds

SECTION –B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

(Draw diagrams wherever necessary)

9. a). Explain in detail the scope of aquaculture in Andhra Pradesh
(or)
b) Write an essay on the Intensive system of Aquaculture and its merits and demerits.
10. a). Write an essay on the Nitrogen Cycle in pond ecosystem
(or)
b). What measures are to be taken for the improvement of Pond Productivity.
11. a). Describe in detail the fish hatchery design.
(or)
b). what is head pond ? Describe the preparation and management of head pond
12. a). Describe in detail the Layout and arrangement of ponds in an ideal fish farm
(or)
b). Explain in detail the nature water resources required for the construction of fish pond.
13. a). Write an essay on the need of Pond fertilization in aquaculture
(or)
b). Explain in detail the optimum physicochemical conditions for water in culture ponds



B Sc	Semester: II	Credits: 4
Course: 2	BIOLOGY OF FIN FISH & SHELL FISH	Hrs/Wk:4

Course Outcomes: By the completion of the course the graduate should able to –

- Describe the general characters and classification of cultivable fishes.
- Explain the food, feeding and growth of fish.
- Describe the reproductive biology of fishes.
- Explain the parental care and development of fishes.
- Describe the parental care and development of fishes

Learning objectives:

- To understand the general characters and classification of cultivable fishes .
- To understand the food, feeding and growth of fish.
- To understand the reproductive biology of fishes.
- To understand the parental care and development of fishes.
- To understand the parental care and development of fishes

UNIT I: General Characters & Classification of Cultivable Fin & Shell Fish:

- 1.1 General Characters and classification of fishes, crustaceans and molluscs up to the level of Class.
- 1.2 Fish, Crustaceans and Molluscs of commercial importance
- 1.3 Sense organs of fishes, crustaceans and molluscs
- 1.4 Buoyancy in fishes- swim bladder and mechanism of gas secretion

UNIT II: Food, Feeding and Growth:

- 2.1 Natural fish food, feeding habits, feeding intensity, stimuli for feeding, utilization of food gut content analysis, structural modifications in relation to feeding habits, forage ratio and food selectivity index
- 2.2 Principles of Age and growth determination; growth regulation, Growth rate measurement – scale method, otolith method, skeletal parts as age indicators
- 2.3 Genetic, biotic & ecological factors in determining the longevity of fishes, length-frequency method, age composition, age-length keys, absolute and specific growth, back calculation of length and growth, annual survival rate, asymptomatic length, fitting of growth curve
- 2.4 Length-weight relationship, condition factor/Ponderal index, relative condition factor

UNIT III: Reproductive Biology:

- 3.1 Breeding in fishes, breeding places, breeding habits & places
- 3.2 Breeding in natural environment and in artificial ponds, courtship and reproductive cycles
- 3.3 Induced breeding in fishes
- 3-4 Breeding in shrimp, pearl oyster, pila, and cephalopods

UNIT IV: Development:

- 4.1 Parental care in fishes, ovo-viviparity, oviparity, viviparity, nest building and brooding
- 4.2 Embryonic and larval development of fishes
- 4.3 Embryonic and larval development of shrimp, crabs and molluscs of commercial importance
- 4.4 Environmental factors affecting reproduction and development of cultivable aquatic fin & shell fish



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UNIT V: Hormones & Growth

- 5.1 Endocrine system in fishes
- 5.2 Neurosecretary cells, androgenic gland, ovary,
- 5.3 Y-organ, chromatophores, pericardial glands and cuticle.
- 5.4 Molting, molting stages, metamorphosis in crustacean shell fish

PRESCRIBED BOOKS:

- 1. Bone Q et al., 1995. Biology of fishes, Blackie academic & professional, LONDON
- 2. Saxena AB 1996. Life of Crustaceans. Anmol Publications Pvt.Ltd., New Delhi

REFERENCES BOOKS:

- 1. Tandon KK & Johal MS 1996. Age and Growth in Indian Fresh Water Fishes. Narendra Publishing House, New Delhi.
- 2. Raymond T et al., 1990. Crustacean Sexual Biology, Columbia University Press, New York
- 3. Guiland J.A (ed) 1984. Penaeid shrimps- Their Biology and Management.
- 4. Barrington FJW 1971. Invertebrates: Structure and Function.ELBS
- 5. Parker F & Haswell 1992. The text book of Zoology, VolII. Invertebrates (eds. Marshal AJ & Williams). ELBS & Mc Millan & Co.



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B Sc	Semester: II	Credits: 1
Course: 2(L)	BIOLOGY OF FIN FISH & SHELL FISH - II LAB	Hrs/Wk:2

PRACTICALS:

1. Study of mouth parts in herbivorous and carnivorous fishes
2. Comparative study of digestive system of herbivorous and carnivorous fishes
3. Length-weight relationship of fishes
4. Gut content analysis in fishes and shrimp
5. Mouth parts and appendages of cultivable prawns, shrimps and other crustaceans
6. Study of eggs of fishes, shrimps, prawns and other crustaceans
7. Study of oyster eggs
8. Embryonic and larval development of fish
9. Study of gonadal maturity and fecundity in fishes and shellfish
10. Observation of crustacean larvae
11. Observation of molluscan larvae
12. Study of nest building and brooding of fishes



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MODEL QUESTION PAPER(Semester-End)

B.Sc Degree Examinations

SEMESTER - II

Course 2: BIOLOGY OF FIN FISH & SHELL FISH

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25 Marks

(Draw labelled diagrams wherever necessary)

1. Write General characters of Crustaceans
2. Discuss the commercial importance of Molluscs with examples
3. Natural fish feed
4. Natural breeding places of fish
5. Breeding in shrimp
6. Nest building in fishes
7. Androgenic gland
8. Y -organ

SECTION –B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

(Draw diagrams wherever necessary)

9. a).Write an essay on the general characters and classification of fishes
(or)
b).Explain in detail the sense organs of fishes and their importance
10. a). Describe structural modifications seen in fish in relation to feeding habits
(or)
b). Discuss in detail the Scale and otolith methods of growth rate measurement in fish.
11. a).Write an essay on the breeding of fish in artificial fish ponds
(or)
b). Write an essay on the induced breeding in fish.
12. a).Describe in detail the embryonic and larval development of shrimp
(or)
b).Discuss in detail various environmental factors affecting the reproduction and development of cultivable aquatic fish.
13. a). Write an essay on the endocrine system of fish
(or)
b). Describe in detail the molting and metamorphosis in a crustacean shell fish



B Sc	Semester: III	Credits: 4
Course: 3	FISH NUTRITION & FEED TECHNOLOGY	Hrs/Wk:4

Course Outcomes: By the completion of the course the graduate should able to –

- Describe the nutritional requirements of cultivable fishes
- Explain the different types of feed and feeding methods of fish
- Describe the techniques of fish feed manufacturing and storage methods
- Explain the concept of fish feed additives, non nutrient ingredients.
- Describe the different nutritional deficiency symptoms of fish

Learning objectives

- To understand the nutritional requirements of cultivable fishes.
- To understand the different types of feed and feeding methods of fish.
- To understand the techniques of fish feed manufacturing and storage methods.
- To understand the concept of fish feed additives, non nutrient ingredients.
- To understand the different nutritional deficiency symptoms of fish.

UNIT I: Nutritional Requirements of Cultivable Fish:

- 1.1 Requirements for energy, proteins, carbohydrates, lipids, fiber, micronutrients for different stages of cultivable fish and prawns
- 1.2 Essential aminoacids and fatty acids, protein to energy ratio, nutrient interactions and protein sparing effect
- 1.3 Dietary sources of energy, effect of ration on growth, determination of feeding rate, check tray
- 1.4 Factors affecting energy partitioning and feeding

UNIT II: Forms Of Feeds & Feeding Methods:

- 2.1 Feed conversion efficiency, feed conversion ratio and protein efficiency ratio
- 2.2 Wet feeds, moist feeds, dry feeds, mashes, pelleted feeds, floating and sinking pellets, advantages of pelletization
- 2.3 Manual feeding, demand feeders, automatic feeders, surface spraying, bag feeding and tray feeding
- 2.4 Frequency of feeding

UNIT III: Feed Manufacture & Storage:

- 3.1 Feed ingredients and their selection, nutrient composition and nutrient availability of feed ingredients
- 3.2 Feed formulation – extrusion processing and steam pelleting, grinding, mixing and drying, pelletization, and packing
- 3.3 Water stability of feeds, farm made aqua feeds, micro-coated feeds, micro-encapsulated feeds and micro-bound diets
- 3.4 .Microbial, insect and rodent damage of feed, chemical spoilage during storage period and proper storage methods

UNIT IV: Feed Additives & Non-Nutrient Ingredients:

- 4.1 Binders, anti-oxidants, probiotics
- 4.2 Feed attractants and feed stimulants
- 4.3 Enzymes, hormones, growth promoters and pigments
- 4.4 Anti-metabolites, aflatoxins and fiber



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UNIT V: Nutritional Deficiency In Cultivable Fish:

- 5.1 Protein deficiency, vitamin and mineral deficiency symptoms
- 5.2 Nutritional pathology and ant-nutrients
- 5.3 Importance of natural and supplementary feeds,
- 5.4 Importance of balanced diet

PRESCRIBED BOOKS:

- 1. HALVER JE 1989. Fish nutrition. Academic press, San diego

REFERENCES:

- 1. Lovell rt 1998. Nutrition and feeding of fishes, Chapmann & Hall, New York
- 2. Sena de silva, trevor a anderson 1995. Fish nutrition in aquaculture. Chapmann & Hall, New York



B Sc	SEMESTER: III	Credits: 1
Course: 3(L)	FISH NUTRITION & FEED TECHNOLOGY - III LAB	Hrs/Wk:2

PRACTICALS:

1. Estimation of protein content in aquaculture feeds
2. Estimation of carbohydrate content in aquaculture feeds
3. Estimation of lipid content in aquaculture feeds
4. Estimation of ash in aquaculture feed
5. Study of water stability of pellet feeds
6. Feed formulation and preparation in the lab
7. Study of binders used in aquaculture feeds
8. Study of feed packing materials
9. Study of physical and chemical change during storage
10. Study on physical characteristics of floating and sinking feeds
11. Visit to a aqua-feed production unit
12. Visit to a farm for studying feeding practices



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MODEL QUESTION PAPER(Semester-End)

B.Sc Degree Examinations

SEMESTER - III

Course 3: FISH NUTRITION & FEED TECHNOLOGY

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25 Marks

(Draw labelled diagrams wherever necessary)

1. Check tray
2. Micronutrients required for the prawn at Mysis stage
3. Protein efficiency ratio.
4. Principle feed ingredients
5. Chemical Spoilage during feed storage
- 6 Probiotics
7. Vitamin deficiency symptoms in cultivable fish
8. Balanced diet for cultivable fish

SECTION –B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

(Draw diagrams wherever necessary)

9. a) Explain the requirements for Energy, Fiber , Protein in the fingerling stages of fish
(or)
b) Explain in details the essential amino acids and fatty acids required for the cultivable fish
10. a) Describe in detail wet and dry feed used in aquaculture
(or)
b) Describe the mechanism of bag feeding and tray feeding add a note on the merits and demerits of the same
11. a) Describe in detail feed formulation and processing
(or)
b) Write an essay on the proper storage methods to be adopted for aquafeed storage.
12. a) write an essay on the different types of feed binders used in aqua feeds
(or)
b) Discuss in detail the role of enzymes and growth promoters in aquafeed
13. a) Write an essay on the protein and mineral deficiency symptoms of cultivable fish
(or)
b) Write the importance of Natural and supplementary feeds used for the cultivable fish.



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B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

B Sc	SEMESTER: IV	Credits: 4
Course: 4	FRESH WATER & BRACKISHWATER AQUACULTURE	Hrs/Wk:4

Course Outcomes: By the completion of the course the graduate should able to –

- Describe the prospects and scope of fresh water aquaculture at various levels
- Explain the practices involved in carp culture
- Describe the culture of cold water and air breathing fish
- Explain the culture practices of prawn.
- Describe the culture of different brackish water species

Learning objectives :

- To understand the prospects and scope of fresh water aquaculture at various levels.
- To understand the practices involved in carp culture.
- To understand the culture of cold water and air breathing fish.
- To understand the culture practices of prawn.
- To understand the culture of different brackish water species

UNIT I: Introduction to Freshwater Aquaculture

- 1.1 Status, scope and prospects of fresh water aquaculture in the world, India and AP
- 1.2 Different fresh water aquaculture systems

UNIT II: CARP Culture:

- 2.1 Major cultivable Indian carps – *Labeo*, *Catla* and *Cirrhinus* & Minor carps
- 2.2 Exotic fish species introduced to India – *Tilapia*, *Pangassius* and *Clarius* sp.
- 2.3 Composite fish culture system of Indian and exotic carps
- 2.4 Impact of exotic fish, Compatibility of Indian and exotic carps and competition among them

UNIT III: Culture of Air-Breathing and Cold Water Fish

- 3.1 Recent developments in the culture of *Clarius*, *Anabas*, *Murrels*,
- 3.2 Advantages and constraints in the culture of air-breathing and cold water fishes- seed resources, feeding, management and production
- 3.3 Special systems of Aquaculture- brief study of culture in running water, re-circulatory systems, cages and pens, sewage-fed fish culture

UNIT IV: Culture of Prawn

- 4.1 Fresh water prawns of India - commercial value
- 4.2 *Macrobrachium rosenbergii* and *M. Malcomsonii* – biology, seed production,
- 4.3 Pond preparation, stocking, management of nursery and grow-out ponds, feeding, and harvesting

UNIT V: Culture of Brackishwater Species

- 5.1 Culture of *P. mondon* – Hatchery technology and Culture practices including feed and disease management
- 5.2 Culture of *L. vannamei* – hatchery technology and culture practices including feed and disease management.
- 5.3 Mixed culture of fish and prawns



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PRESCRIBED BOOKS:

1. Jhingran VG 1998. Fish and Fisheries of India. Hindusthan Publishing Corporation, New Delhi

REFERENCES BOOKS:

1. Santharam R, N Sukumaran and P Natarajan 1987. A manual of aquaculture, Oxford-IBH, New Delhi
2. Srivatsava 1993. Fresh water aquaculture in India, Oxford-IBH, New Delhi
3. Marcel H 1972. Text book of fish culture. Oxford fishing news books



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B Sc	SEMESTER: IV	Credits: 1
Course: 4(L)	Practical - IV LAB	Hrs/Wk:2

PRACTICALS:

1. Identification of important cultivable carps
2. Identification of important cultivable air-breathing fishes
3. Identification of important cultivable fresh water prawns
4. Identification of different life history stages of fish
5. Identification of different life history stages of fresh water prawn
6. Collection and study of weed fish
7. Identification of commercially viable crabs – *Scylla cerrata*, *Portunus pelagicus*, *P.sanguinolentus*, *Neptunus pelagicus*, *N. Sanguinolentus*
8. Identification of lobsters – *Panulirus polyphagus*, *P.ornatus*, *P.homarus*, *P.sewelli*, *P.penicillatus*
9. Identification of oysters of nutritional significance *Crossostrea madrasensis*, *C.gryphoides*, *C. cucullata*, *C.rivularis* , *Picnodanta*
10. Identification of mussels and clams
11. Identification of developmental stages of oysters
12. Field visit to aqua farm and study of different components like dykes etc.



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MODEL QUESTION PAPER(Semester-End)

B.Sc Degree Examinations

SEMESTER - IV

Course 4: FRESH WATER & BRACKISHWATER AQUACULTURE

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25 Marks

(Draw labelled diagrams wherever necessary)

1. Types of fresh water culture
2. Mixed culture
3. *Pangassius*
4. Murrel culture
5. Cage culture
6. Commercial value of fresh water prawn
7. MBV
8. Mixed culture

SECTION –B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

(Draw diagrams wherever necessary)

9. a). Write an essay on the status of freshwater aquaculture in India
(or)
b) Describe different types of freshwater culture systems in aquaculture
10. a) Write an essay on the Biology of *Catla Catla*
(or)
b) Describe the Composite fish culture system with the exotic carps.
11. a) Describe in detail the recent developments cold water fish culture
(or)
b) Explain in detail RAS system of aquaculture
12. a) Write an essay on the seed Production Technology of *M. rosenbergii*
(or)
b) Write an essay on the management of Nursery ponds in prawn culture
13. a) Describe the culture practice of *P.monodon*
(or)
b) Explain the feed and disease management in *L vannamei culture*



B Sc	SEMESTER: IV	Credits: 4
Course: 5	FISH HEALTH MANGEMENT & FISHERIES ECONOMICS	Hrs/Wk:4

Course Outcomes: By the completion of the course the graduate should able to –

- Describe the diseases of fin fish
- Explain the diseases of shell fish
- Describe the fish health management strategies
- Explain different fisheries economic policies
- Describe the various schemes for the welfare of fishermen community

Learning objectives :

- To understand the diseases of fin fish
- To understand the the diseases of shell fish.
- To understand the fish health management strategies.
- 4. To understand the different fisheries economic policies .
- To understand the various schemes for the welfare of fishermen community

UNIT I: Diseases of Fin Fish

- 1.1 Fungal diseases– Saprolegniosis, brachiomycosis, ichthyophorus diseases – Lagenidium diseases – Fusarium disease, prevention and therapy
- 1.2 Viral diseases – Emerging viral diseases in fish, haemorrhagic septicemia, spring viremia of carps, infectious hematopoietic necrosis in trout, infectious pancreatic necrosis in salmonids, swim-bladder inflammation in cyprinids, channel cat fish viral disease, prevention and therapy
- 1.3 Baterial diseases – Emerging bacterial diseases, Aermonas, Pseudomonas and vibrio infections, columnaris, furunculosis, epizootic ulcerative syndrome, infectious abdominal dropsy, bacterial gill disease, enteric red mouth, bacterial kidney disease, proliferative kidney disease, prevention and therapy

UNIT II: Diseases of Shell Fish

- 2.1 Major shrimp viral diseases – Bacculovirus penaeii, Monodon Bacculovirus, Bacculoviral midgut necrosis, Infectious hypodermal and haematopoietic necrosis virus, Hepatopancreatic parvo like virus, Yellow head bacculovirus, white spot bacculovirus.
- 2.2 Bacterial diseases of shell fish – aeromonas, pseudomonas and vibrio infections, luminous bacterial disease, filamentous bacterial disease. Prevention and therapy
- 2.3 Protozoan diseases- Ichthyophthiriasis, Costiasis, whirling diseases, trypanosomiasis. Prevention and therapy

UNIT III : Fish Health Management

- 3.1 Diagnostic tools – immune detection- DNA/RNA techniques, General preventive methods and prophylaxis. Application and development of vaccines.
- 3.2 Quarantine – Significance, methods and regulations for transplants.
- 3.3 Good Feed management for healthy organisms, Zero water exchange, Probiotics in health management, Issues of biosecurity.



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UNIT IV: Fisheries Economics- I

- 4.1 Methods of economic analysis of business organizations
- 4.2 Aquaculture economics- application of economics principles to aquaculture operations
Various inputs and production function laws of variable proportions
- 4.3 Cost and earnings of aquaculture systems – carp culture, shrimp farming systems,

UNIT V: Fisheries Economics- II

- 5.1 Socio-economic conditions of fishermen in Andhra Pradesh
- 5.2 Role of Matsyafed and NABARD in uplifting fishermen's conditions, fishermen cooperatives
Contribution of fisheries to the national economy
- 5.3 Economic analysis preparation of project and project appraisal

PRESCRIBED BOOKS:

1. Shaperclaus W. 1991 Fish Diseases- Vol.I & II. Oxonian Press Pvt.ltd
2. Roberts RJ 1989. Fish pathology. Bailliere Tindall, New York
3. Lydia Brown 1993. Aquaculture for veterinarians- fish husbandry and medicine. Pergamon Press. Oxford
4. Jayaraman R 1996. Fisheries Economics. Tamilnadu Veterinary and Animal Science University. Tuticorn
5. Subba Rao N 1986. Economics of Fisheries. Daya publishing house, Delhi

REFERENCES BOOKS:.

1. Shankar KM & Mohan CV. 2002. Fish and Shellfish Health Management. UNESCO Publ. Sindermann CJ. 1990
2. Walker P & Subasinghe RP. (Eds.). 2005 Principal Diseases of Marine Fish and Shellfish. Vols. I, II. 2nd Ed. Academic Press
3. DNA Based Molecular Diagnostic Techniques: Research Needs for Standardization and Validation of the Detection of Aquatic Animal Pathogens and Diseases. FAO Publ. Wedmeyer G, Meyer FP & Smith L. 1999.
4. Bullock G et.al., 1972 Bacterial diseases of fishes. TFH publications, New Jersey
5. Post G 1987. Text book of Fish Health. TFH publications, New Jersey
6. Johnson SK 1995. Handbook of shrimp diseases. Texas A & M University, Texas
7. Dewwett KK and Varma JD 1993. Elementary economic theory. S.chand, New Delhi
8. Korakandy R 1996. Economics of Fisheries Mangement. Daya Publishing House, Delhi
9. Tripathi SD 1992. Aquaculture Economics. Asian Fisheries Society, Mangalore



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B Sc	SEMESTER: IV	Credits: 1
Course: 5(L)	FISH HEALTH MANGEMENT & FISHERIES ECONOMICS	Hrs/Wk:2

PRACTICALS:

1. Enumeration of Bacteria by TPC Method
2. Enumeration of total Coliforms
3. Observation of gross pathology and external lesions of fish and prawn with reference to the common diseases in aquaculture
4. Examination of pathological changes in gills and gut lumen, lymphoid organ, muscles and nerves of fish
5. Examination of pathological changes in gut lumen, hepatopncreas, lymphoid organ, muscles and nerves of prawn and shrimp
6. Collection, processing and analysis of data for epedemeiological investigations of viral diseases
7. Bacterial pathogens – isolation, culture and characterization
8. Identification of parasites in fishes: Protozoan, Helmiths, Crustaceans
9. Antibioigrams – preparation and evaluation
10. Molecular and immunological techniques; Biochemical tests; PCR; ELISA; Agglutination test; Challenge tests; Purification of virus for development of vaccines (Demonstration at institutes/labs)
11. Estimation of dose, calculation of concentration, methods of administration of various chemotherapeutics to fish and shell fish
12. Estimation of antibiotics used in aquaculture practices
13. Estimation of probiotics used in aquaculture
14. Field visit to farm for health monitoring and disease diagnosis
15. Cost benefit analysis calculations



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B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

MODEL QUESTION PAPER(Semester-End)

B.Sc Degree

Examinations

SEMESTER - IV

Course 5: FISH HEALTH MANGEMENT & FISHERIES ECONOMICS

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25

Marks(Draw labelled diagrams wherever necessary) z

1. *Fusarium disease*
2. Black gill disease
3. MBV
4. Biosecurity in aquatic health management
5. vaccines in aquaculture
6. Need of economic analysis in aquaculture
7. Matyafed
8. Project appraisal

SECTION – B

Answer ALL the questions each question carries 10 marks

5x10=50

Marks(Draw diagrams wherever necessary)

9. a) Write an essay on emerging viral diseases symptoms – treatment - therapy in fin fish
(or)
b) Describe in detail any 3 Bacterial diseases of finfish.
10. a) Explain in detail the bacterial diseases of shell fish
(or)
b) Describe the protozoan diseases of shell fish with a note on their prevention andtherapy.
11. a) Describe the role of quarantine in fish health management
(or)
b) Describe the Good feed management practices
12. a) Describe the laws of variable proportions in relation to aquaculture
(or)
b) Describe the Cost earnings for Carp culture
13. a) Write an essay on the socio economic conditions of fishermen in Andhra Pradesh
(or)
b) write an essay on the fishermen cooperative societies in Andhra Pradesh



B Sc	SEMESTER: V (Skill Enhancement Course - Elective)	Credits: 4
Course: 6A	SOIL AND WATER QUALITY MANAGEMENT	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Know various types of soil and their properties
2. Monitor and manage optimum water quality parameters in fish/shrimp culture ponds
3. Maintain the soil and water quality by using required dose of lime, manures and fertilizers for optimum yields in culture ponds
4. Acquire knowledge on advanced technologies for improving water quality
5. Demonstrate skills related to chemical treatments for combating soil and water quality problems in aquaculture farms.

Syllabus: (Total Hours: 90 including Teaching, Lab, Field Training and Unit tests, etc.)

UNIT I: Soil quality (10h)

1. Soil types and their distribution. Physical and chemical properties of soil: Soil colour, texture, structure, pore space, bulk density, and water holding capacity; Conductivity, pH, redox potential, soil salinity, calcium carbonate, organic carbon, available nitrogen, available phosphorus, Carbon-Nitrogen ratio, organic matter and soil fertility.
2. Properties of water logged soils, methane and hydrogen sulphide formation. Problem soils: Saline soils, Alkali soils, Acid sulphate soils (ASS), and their reclamation.
3. Pond Seepage and its control. Soil quality criteria/requirements for aquaculture.

UNIT II: Water quality (10h)

1. Water quality parameters: Temperature, transparency, salinity, dissolved oxygen, carbon dioxide, pH, alkalinity, hardness, conductivity, ammonia, nitrites, nitrates, orthophosphates and hydrogen sulphide; phytoplankton, zooplankton and benthos.
2. Role of aquatic microorganisms in carbon, nitrogen, phosphorus and sulphur cycles.
3. Water quality criteria for freshwater and brackish water aquaculture.

UNIT III: Soil and Water amendments (10h)

1. Liming: Liming materials, effects of liming on pond ecosystem, liming rates for ponds, calculation of lime requirements and application of liming materials to ponds.
2. Manures and Fertilizers: Types of manures and fertilizers, primary nutrients, micronutrients, fertilizer grades, quantity and method of application; Bio fertilizers.
3. Pond fertilization: Role of organic and inorganic fertilizers in aquaculture; Problems in ponds with indiscriminate fertilization.

UNIT IV: Pond water management (10h)

1. Dial changes in dissolved oxygen concentration, oxygen depletion in ponds, Aeration, Water exchange, Bio-floc technology.
2. Water treatment, Water filtration devices, Waste water treatment practices, Waste discharge standards, Re circulatory aquaculture system (RAS).
3. Water quality management in freshwater carp culture; brackish water shrimp culture; and hatcheries.



UNIT V: Pond treatments

(10h)

1. Pond conditioners and Chemical treatments: Potassium permanganate, Hydrogen peroxide, Calcium hydroxide, Rotenone, Formalin and Malachite green. Methods of applying chemicals.
2. Reduction of pH; Control of turbidity, salinity, hardness and chlorides; Chlorine removal; Removal of toxic gases.
3. Control of algal blooms and aquatic weeds. Bioremediation: Soil and water probiotics for aquaculture ponds.

REFERENCES:

1. Boyd, C.E. (1982). Water Quality Management for Pond Fish Culture. Elsevier Sci. Publishing Co.
2. Boyd, C.E. and Tucker, C.S. (1992). Water Quality and Pond Soil Analyses for Aquaculture. Alabama Agricultural Experimental Station, Auburn University, USA.
3. Boyd, C.E. and Tucker, C.S. (2012). Pond aquaculture water quality management. Springer Science & Business Media.
4. ICAR. (2006). Hand Book of Fisheries and Aquaculture. ICAR.
5. MPEDA: Handbooks on culture of carp, shrimp, etc.
6. Training Manual on Recent advances in soil and water management in brackishwater aquaculture (2018). Saraswathy, R., Kumararaja, P., Lalitha, N., Suvana, S., SatheeshaAvunje, Muralidhar, M. (Eds.), CIBA-TM Series –No.8 (2nd Ed), ICAR–Central Institute of Brackishwater Aquaculture, Chennai, India pp.137.
7. Boyd, C.E. (1995). Soil and water quality management in aquaculture ponds. INFOFISH international, 5(95), 29-36.
8. Boyd, C.E. (1995). Bottom soils, sediment, and pond aquaculture. Springer Science & Business Media.
9. Pillay, T.V.R. and Kutty, M.N. (2005). Aquaculture- Principles and Practices. 2nd Ed. Blackwell
10. Dhevendaran, K. (2008). *Aquatic Microbiology*, Daya Publ. House.
11. 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.
12. Chattopadhyay, G.N. (1998). Chemical analysis of Fish Pond Soil and Water. Daya Publishing House, Delhi.
13. Ramadhas, V. and R. Santhanam (1996). A Manual of Methods of Seawater and Sediment analysis. Fisheries College & Research Institute, Tuticorin.
14. Adhikari, S and Chatterjee, D.K. (2008). Management of Tropical Freshwater Ponds. Daya Publication.
15. Boyd, C.E. (2003). Guidelines for aquaculture effluent management at the farm-level. Aquaculture, 226(1-4), 101-112.
16. Harry, O. Buckman and Nyle, C. Brady. (1963). The Nature and Properties of Soils. The Macmillan Company, New York.
17. Rajagopalsamy, C.B.T. and Ramadhas, V. 2002. Nutrient Dynamics in Freshwater Fish Culture System. Daya Publication.
18. Stickney, R.R. (1979). Principles of Warm water Aquaculture. John-Wiley & sons Inc.
19. Sverdrup, H.V., Johnson, M.W. and Fleming, R.H. (1942). The Oceans: their physics, chemistry and general biology. Prentice Hall, Inc. New York.
20. *Web resources suggested by the teacher concerned and the college librarian including reading material.*



B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 1
Course: 6A	SOIL AND WATER QUALITY MANAGEMENT Lab	Hrs/Wk:2

Practical Syllabus: Course 6A: Soil and Water Quality Management

Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Identify and handle various glassware, equipment and analytical instruments used for soil and water analyses.
2. Exhibit skills for preparing standard and working solutions for soil & water analyses.
3. Collect and analyze the physico-chemical and biological parameters of soil & water.
4. Calculate the dosages of lime and fertilizers required in ponds.
5. Apply the advanced techniques for quality improvement in ponds for better yields.

Practical Syllabus:

1. Demonstration of laboratory glassware and equipment used in water and soil analysis.
2. Principles of Titrimetry, Gravimetry, Potentiometry, Conductometry, Refractometry, Colorimetry, Turbidimetry, Spectrophotometry (Vis, UV-Vis, Flame, Atomic Absorption Spectrophotometer (AAS)).
3. Solutions: Standard, and dilute solutions; units of concentration; standard curve.

Soil Analysis:

4. Collection and Processing of soil samples
5. Determination of Soil texture, pH, Redox potential and Conductivity.
6. Determination of Organic carbon, available nitrogen and available phosphorus.

Water Analysis:

7. Measurement of Temperature, Transparency, Turbidity, and Salinity of water.
8. Estimation of Dissolved oxygen, Free carbon dioxide, Total alkalinity and Total hardness in water.
9. Estimation of ammonia, nitrites, nitrates, and orthophosphates.
10. Collection and identification of phytoplankton, zooplankton and benthos
11. Calculation of doses of lime and fertilizers for ponds
12. Design and fabrication of different filters.

Co-Curricular Activities:

a) Mandatory: *(Training of students by teacher on field related skills: 15 hours)*

1. **For Teacher:** Training of students by teacher in laboratory and field for a total of 15 hours on handling and operation of glassware, equipment and instruments; preparation of standard and working solutions, and standard curves; collection and processing of soil and water samples in the field; estimation of physico-chemical parameters of soil and water; collection and identification of plankton and benthos; calculation of doses for pond liming and fertilization; and design and fabrication of water filtering devices.
2. **For Student:** Individual visit to a local fish/ shrimp farms and hatcheries or to a laboratory in college/university/research organization/private sector and study the soil and water quality. Submission of a hand-written Fieldwork Report not exceeding 10 pages in the given format.
3. Max marks for Field Work Report: 05.
4. Suggested Format for Field work: *Title page, student details, content page, introduction, work done, findings, conclusions and acknowledgements.*
5. Unit tests (IE).



b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying tools /kits used for soil and water analyses and their handling, operational techniques with safety and security, IPR)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in soil and water analyses.
5. Collection of material/figures/photos related to the topic, writing and organizing them in a systematic way in a file.
6. Visits to fish and shellfish culture farms, hatcheries, research organizations, etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

VII.Suggested Question Paper Pattern:

Max. Marks: 75 Time: 3 hours



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B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

MODEL QUESTION PAPER(Semester-End)
B.Sc Degree Examinations
SEMESTER - V (Skill Enhancement Course - Elective)
Course 6A: SOIL AND WATER QUALITY MANAGEMENT

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25 Marks

1. Types of soils
2. Pond seepage
3. Phytoplankton
4. Phosphorus
5. Types of manures
6. Biofertilizers.
7. Recirculatory aquaculture system (RAS)
8. Bioremediation

SECTION – B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

9. a) what is soil? Write about Physical and chemical properties of soil?
(OR)
b) Explain in detail about Soil quality criteria and requirements for aquaculture?
10. a) Describe the Water quality parameters in culture ponds?
(OR)
b) What is biogeochemical cycle? Explain role of microorganisms in Nitrogen cycle?
11. a) What is liming ? Explain liming process in culture ponds?
(OR)
b) What is fertilizer? Explain the Role of organic and inorganic fertilizers in aquaculture?
12. a) Explain in detail about Bio-floc technology
(OR)
b) Describe the Water quality management in shrimp hatcheries?
13. a) What is the chemicals used in pond treatment ? Which Methods follow to applying chemicals in pond treatment?
(OR)
b) What is probiotic ? Soil and water probiotics for aquaculture ponds?



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Suggested Question Paper Model for Practical Examination
Semester – V/ Aquaculture Course – 6A (Skill Enhancement Course)
Soil and Water Quality Management

Max. Time : 3 Hours

Max. Marks : 50

1. Determination of a soil parameter ‘A’ 8 M
2. Estimation of a water parameter by titrimetry ‘B’ 8 M
3. Estimation of a water parameter by colorimetry/ spectrophotometry ‘C’ 12 M
4. Identification, salient features and ecological importance of the following. 4x3=12 M
 - a. Phytoplankton/ Algae
 - b. Zooplankton
 - c. Aquatic weed
 - d. Benthic organism
5. Record + Viva-voce 6+4 = 10 M



B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 4
Course: 7A	ORNAMENTAL FISH CULTURE	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Acquire knowledge on the status of world and Indian ornamental fish farming and trade
2. Identify various commercially important freshwater and marine ornamental fishes
3. Fabricate, set up and maintain the freshwater and marine aquaria
4. Demonstrate skills for breeding and larval rearing of ornamental fishes
5. Develop the commercial production units for large scale production of ornamental fishes and aquarium plants and their trade.

Syllabus: (Total Hours: 90 including Teaching, Lab, Field Training and Unit tests, etc.)

UNIT I: Status of Ornamental fish farming and trade (10h)

1. Global status of ornamental fish trade and export potential.
2. Present status and prospects of ornamental fish farming and trade in India. Indian ornamental fish diversity and its status. Major marine ornamental fish resources of India. Method of collection of live fish.
3. Types of aquaria – Home and Public aquaria (freshwater and marine), Oceanarium.

UNIT II: Ornamental fishes (10h)

1. Origin and Benefits of ornamental fish keeping as a hobby.
2. Freshwater ornamental fishes – their taxonomy and biology - varieties of Gold fish Koi, Barbs, Danios (cyprinids); Gourami, Betta (anabantids); Tetras (characins), Live bearers (Guppy, molly, sword tail, platy); Angel fish and other Cichlids, Catfishes, Loaches.
3. Marine ornamental fishes– varieties and their habitats. Other ornamental organisms– anemones, worms, lobsters, shrimps, octopus, starfish.

UNIT III: Aquarium Management (10h)

1. Fabrication, setting up and maintenance of freshwater and marine aquarium - Lighting and aeration - Aquarium plants and their propagation methods - Aquarium accessories and decoratives. Selection of fishes and Species compatibility for aquarium keeping.
2. Water quality management for freshwater and marine aquariums. Water filtration systems – biological, mechanical and chemical. Types of filters.
3. Aquarium fish feeds – Live feeds, Dry and wet feeds. Pigmented feeds for color enhancement, larval feeds and feeding.
4. Common diseases of aquarium fish - diagnosis and treatment. Control of snail and algal growth. Medicines and chemicals used in aquaria.

UNIT IV: Breeding and Rearing of ornamental fishes (10h)

1. Breeding of Live bearers and Egg layers – sex identification, conditioning of parent fish, stimulating spawning, parental care, hatching, and fry rearing.
2. Breeding of marine ornamental fishes (clown and damsel fishes) and larval rearing.
3. Application of genetics and biotechnology for quality strain production.

UNIT V: Commercial Production of Aquarium fish and Plants (10h)

1. Commercial production units of ornamental fish - requirements and design
2. Commercial production of live bearers, goldfishes, gouramies, barbs, angels and tetras.
3. Mass production of aquarium plants.
4. Fish conditioning, packing, transport and quarantine methods. Retail marketing and export of ornamental fish.



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ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM

B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 1
Course: 7A	ORNAMENTAL FISH CULTURE Lab	Hrs/Wk:2

Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Identify the common ornamental fishes and aquarium plants.
2. Fabricate a glass aquarium and set up with equipment and accessories
3. Maintain the fishes in aquarium with proper water quality, feeding and disease management.
4. Exhibit skills for breeding egg-layers and live-bearers and fry rearing.
5. Condition the fish for packing and transport.

Practical Syllabus:

1. Identification of common freshwater and marine aquarium fishes
2. Construction of a glass aquarium
3. Setting up and maintenance of aquarium (maintained by students can be evaluated after one month)
4. Water quality management in freshwater and marine aquariums
5. Identification of Aquarium plants and live food organisms, and decoratives
6. Aerators and Types of Filters
7. Breeding of egg layers (Gold fish), live bearers (Guppy) and bubble nest builder (Gourami)
8. Ornamental fish diseases and their diagnosis and treatment. Calculation of medicine/ chemical treatment dosages.
9. Conditioning and packing of ornamental fishes.

Co-Curricular Activities:

a) Mandatory: (*Training of students by teacher on field related skills: 15 hours*)

1. **For Teacher:** Training of students by teacher in laboratory and field for a total of 15 hours on the biology of freshwater and marine ornamental fishes, setting up and maintenance of aquarium, breeding and commercial production of aquarium fishes and plants, and packing and transport of ornamental fishes.
2. **For Student:** Individual visit to public aquaria, oceanarium, and commercial ornamental fish production farms, or to a university/research organization with ornamental fish production units and study the breeding, culture, marketing and export of ornamental fish. Submission of a hand written Field work Report not exceeding 10 pages in the given format.
3. Max marks for Field Work Report: 05
4. Suggested Format for Field Report: *Title page, student details, content page, introduction, work done, findings, conclusions and acknowledgements.*
5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying biofilters, aerators, accessories and their maintenance).
3. Seminars, Group discussions, Quiz, Debates, etc. (on related topics).
4. Preparation of videos on aquarium keeping, breeding and larval rearing of ornamental fishes
5. Collection of material/figures/photos related to the topic, writing and organizing them in a systematic way in a file.
6. Visits to ornamental fish farms, public aquaria, oceanarium and aquarium fish production facilities in research organizations, etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

Suggested Question Paper Pattern:

Max. Marks: 75 Time: 3 hours



ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM
B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

MODEL QUESTION PAPER(Semester-End)
B.Sc Degree Examinations
SEMESTER - V (Skill Enhancement Course - Elective)
Course 7A: ORNAMENTAL FISH CULTURE

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25 Marks

1. Method of collection of live fish
2. Types of aquaria
3. Gold fish
4. Starfish
5. Aquarium plants
6. Control of snail
7. Damsel fishes larval rearing
8. Fish conditioning

SECTION – B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

9. a) Explain the Global status of ornamental fish trade and export potential?
(OR)
b) Give a detail account on Indian ornamental fish diversity and its status?
10. a) write the taxonomy of Freshwater ornamental fishes?
(OR)
b) Explain in detail about Marine ornamental fishes?
11. a) Write an essay on Aquarium fish feed?
(OR)
b) Explain the biological, mechanical and chemical water filtration systems?
12. a) Explain in detail about Breeding of Live bearers and Egg layers
(OR)
b) Describe the Application of genetics and biotechnology for quality strain production?
13. a) Write the notes on Mass production of aquarium plants?
(OR)
b) Describe the Retail marketing and export of ornamental fish?



ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM

B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

Suggested Question Paper Model for Practical Examination

Semester – V/ Aquaculture Course – 7A (Skill Enhancement Course)

Ornamental Fish Culture

Max. Time : 3 Hours

Max. Marks : 50

1. Identification of two freshwater aquarium fishes ‘A’ 8 M
2. Identification of two marine aquarium fishes ‘B’ 8 M
3. Demonstration of breeding technique of egg layers/live bearers ‘C’ 12 M
4. Write about the following. 4 x 3 = 12 M
 - a. Aerators
 - b. Biofilters
 - c. Aquatic plant
 - d. Live feed / Fish disease and its treatment
5. Record + Viva-voce 6+4 = 10 M



B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 4
Course: 6B	TECHNIQUES FORAQUALAB	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the basic concepts in laboratory techniques.
2. Analyze and assess the soil and water quality in culture ponds.
3. Familiarize with the biochemical techniques used in aqua labs
4. Know the microbial techniques for disease diagnosis
5. Diagnose the diseases of fish and shrimp and suggest the remedial measures.

Syllabus: (Total Hours:90 including Teaching, Lab, Field Training and Unit tests etc.)

UNIT I: Basic concepts in Laboratory Techniques (10h)

1. Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumettes; washing, drying and sterilization of glassware.
2. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different chemical doses in field applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values.
3. Use and handling of microscope, laminar flow, autoclave, vacuum pumps, balances, thermometer, centrifuge, magnetic stirrer, desiccators, muffle furnace, ovens, incubators, waterbath; Electric wiring and earthing.

UNIT II: Soil and Water Testing (10h)

1. Analytical methods: Principle and applications of titrimetry, gravimetry, potentiometry, conductometry, refractometry, colorimetry, turbidimetry, spectroscopy (UV- Vis, Flame, AAS); Computerized instrument systems.
2. Water analysis: Collection and preservation of water samples; Measurement of temperature, transparency. Estimation of dissolved oxygen, pH, free carbon dioxide, total alkalinity, total hardness, turbidity, conductivity, salinity, chlorinity, total solids, ammonia, nitrites, nitrates, phosphates, BOD. Analysis of pollutants and toxic gases. Plankton analysis: Collection, identification, enumeration and biomass estimation of phytoplankton and zooplankton, and benthos.
3. Soil testing: Soil Texture and Structure, pH, Available Nitrogen, Available Phosphorus, Organic Carbon.

UNIT III: Biochemical Techniques (10h)

1. Basic principles and applications of chromatographic techniques: Paper, TLC, GC, LC, HPLC, affinity chromatography and ion exchange chromatography. Types and applications of centrifuges.
2. Feed analysis: Preliminary examination-history, colour, odour, texture, water solubility. Proximate analysis—Estimation of crude protein, crude lipid, moisture, ash, fibre, NFE (nitrogen free extracts).
3. Analysis of glucose, proteins, lipids, RNA and DNA in fish tissues by spectrophotometry.



UNIT IV: Microbiological Techniques

(10h)

1. Techniques in Sterilization, Preparation of media, Inoculation, Enumeration of bacteria; staining techniques; Safety in microbiology laboratory; bio-safety levels.
2. Isolation, culture and identification of bacteria and virus. Basics of mycological and virological techniques.
3. Working principles and applications of bright field microscopy, PCR and ELISA. Applications of diagnostic techniques - Gel Electrophoresis, Agglutination test, Blotting techniques, LC-MS and GC-MS.

UNIT V: Disease diagnosis

(10h)

1. Collection and handling of fish/shellfish for disease diagnosis, Clinical and post-mortem examination (autopsy) of diseased fish and shellfish. Collection and identification of parasites from fish and shellfish.
2. Morphological and biochemical tests for bacteria and fungi; Molecular and Immunological techniques for disease diagnosis. Antibiotic sensitivity assays.
3. Assessment of seed quality - stress test. Aqua Medicines in the market and Banned Antibiotics. Disease treatment: Dose calculation, Treatment schedule and Administration of chemicals and drugs for treating common diseases. Quarantine and health certification in aquaculture.

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B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

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40. *Web resources suggested by the teacher concerned and the college librarian including reading material.*



B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 1
Course: 6B	TECHNIQUES FORAQUALAB Lab	Hrs/Wk:2

Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Acquaint with the equipment and instruments used in Aqua labs.
2. Familiarize with the techniques of soil and water testing.
3. Analyze the proximate composition of feeds and fish/shrimp tissues.
4. Develop microbial cultures to enable morphological and biochemical tests for the identification of microbes.
5. Diagnose the microbial diseases by molecular and immunological techniques.

Practical Syllabus:

1. Preparation of chemical solutions of various concentrations (Molarity, molality, normality, percent, ppm)
2. Preparation of Buffers and Reagents.
3. Estimation of soil and water quality parameters. Documentation and Analysis reports.
4. Interpretation of water quality data for evaluation of aquatic health – Case study.
5. Collection, preservation and quantitative estimation of phytoplankton and zooplankton; Identification of various phytoplankton and zooplankton
6. Feed analysis: Preliminary examination and proximate composition of feed.
7. Estimation of moisture, protein, total lipids and glucose content in fish tissue.
8. Identification of Amino acids by paper chromatography.
9. Knowledge on Proximate composition of Branded Feeds available in the market.
10. Methods to identify quality seed.
11. Collection, preservation and Identification of disease causing agents/parasites.
12. Preparation of media for culture.
13. Familiarization with techniques of bacterial culture, Identification; fungal isolation and characterization.
14. Demonstration of PCR, ELISA, Agarose gel electrophoresis, Agglutination test and blotting techniques.
15. Preparation of the list of chemicals and drugs used to control the diseases.
16. Determination of dose and mode of administration of chemicals and drugs for treating common diseases.
17. Preparation of case studies of diseased fish and shrimp.

Co-Curricular Activities:

a) Mandatory: (*Training of students by teacher on field related skills: 15 hours*)

1. **For Teacher:** Training of students by teacher in laboratory and field for a total of 15 hours on collection and preservation of water, soil and biological samples in the field; maintenance of lab and equipment; preparation of chemical solutions of various concentrations; testing of soil and water including plankton, benthos and microbial analysis; feed analysis; disease diagnosis and treatment; analysis report preparation and documentation.
2. **For Student:** Individual visit to a fish/shrimp farm or hatchery for sample collections or to a laboratory in university/research organization/private sector and study the laboratory techniques for testing soil, water, feed and diseases. Submission of a hand written Field work report not exceeding 10 pages in the given format.
3. Max marks for Field Work Report: 05.
4. Suggested Format for Field work: *Title page, student details, content page, introduction, work done, findings, conclusions and acknowledgements.*
5. Unit tests (IE).



ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM

B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying tools/kits used for sample collection and testing, and their handling and operation).
3. Seminars, Group discussions, Quiz, Debates, etc. (on related topics).
4. Preparation of videos on tools and techniques in Aqua lab operation.
5. Collection of material/figures/photos related to Aqua lab techniques, writing and organizing them in a systematic way in a file.
6. Visits to research organizations to undergo training on biochemical and microbiological techniques.
7. Invited lectures and presentations on related topics by field/industrial experts.

VII.Suggested Question Paper Pattern:

Max. Marks: 75

Time: 3 hours



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B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

MODEL QUESTION PAPER(Semester-End)

B.Sc Degree Examinations

SEMESTER - V (Skill Enhancement Course - Elective)

Course 6B: TECHNIQUES FORAQUALAB

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25 Marks

1. Use of burettes
2. Handling of chemical substances
3. Applications of titrimetry
4. BOD
5. TLC
6. bio-safety levels
7. GC-MS
8. Banned Antibiotics.

SECTION – B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

9. a) Explain the washing, drying and sterilization of glassware?
(OR)
b) Give a detail account on Use and handling of microscope?
- 10.a) write the Principle and applications spectroscopy?
(OR)
b) Write an essay on Soil testing?
11. a) Write the Types and applications of centrifuges?
(OR)
b) Write the Estimation of crude protein from fish feed?
12. a) Write the Techniques in Sterilization?
(OR)
b) Describe the Working principles and applications of PCR?
13. a)Write the notes on Collection and identification of parasites from fish and shellfish?
(OR)
b) Describe the Disease treatment in fish?



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B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

Suggested Question Paper Model for Practical Examination
Semester – V/ Aquaculture Course – 6B (Skill Enhancement Course)
Techniquesfor Aqua Lab

Max. Time : 3 Hours

Max. Marks : 50

1. Determination of a water / soil parameter 'A' 8 M
2. Feed / Fish tissue biochemical analysis (protein/ lipid/glucose, etc.) 'B' 8 M
3. Demonstration of a microbiological technique 'C' 12 M
4. Demonstration of a disease diagnostic technique 'D' 12 M
5. Record + Viva-voce 6+4 = 10 M



B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 4
Course: 7B	FISH PROCESSING TECHNOLOGY	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Acquaint with the handling of fresh fish, and principles of fish processing
2. Understand various methods of fish/shellfish preservation
3. Demonstrate skills for the processing of various fish by-products
4. Know the preparation and advantages of value added fish and shellfish products
5. Understand the quality assurance and quality control standards in fish processing plants.

Syllabus: (Total Hours: 90 including Teaching, Lab, Field Training and Unit tests, etc.)

UNIT I: Principles of Fish processing and preservation (10h)

1. Aims of fish processing. Handling, storage and transport of fresh fish, Importance of hygiene and sanitation in fish handling. Quality of water and ice in fish handling and processing.
2. Post mortem changes (rigor mortis and spoilage), Spoilage of marine and freshwater fish and shellfish. Containers for packaging and transportation of fish. Use of chemical preservatives, and Irradiation in extending shelf-life of finfish and shellfish.
3. Principles of fish preservation- Cleaning, lowering of temperature, raising of temperature, denudation, use of salt, use of fish preservatives, exposure to low radiation of gamma rays.

UNIT II: Methods of fish/shellfish Preservation (10h)

1. Traditional methods - Sun drying, Salting, Smoking and Pickling /Marinating.
2. Advanced methods – Chilling or icing, refrigerated or chilled sea water, freezing, Accelerated freeze drying and packing of freeze dried products, Canning.
3. Modern methods - Irradiation and modified atmospheric storage.

UNIT III: Processing and preservation of fish by-products (10h)

1. Preparation and uses of fish meal, fish body oil, fish liver oil, Fish protein concentrate, Fish hydrolysates, fish meat, fish silage, fish maws, shark leather, fish manure and guano, fish glue, fish gelatin, fish factice, isinglass, fish fins, fish roe and fish cavier. Significance of biochemical and pharmaceutical products – Insulin, fish albumin, peptones, fish sutures, ambergiris, etc.
2. Production and uses of Chitin and Chitosan (shrimp wastes); Pearl essences and Beche-de-mer.
3. Utilization of sea weeds – agar-agar, alginic acid, alginate, mannitol, carrageenan, nori.

UNIT IV: Value added products (10h)

1. Status of value addition to fish and fish products in Indian seafood sector. Advantages of value addition.
2. Different types of value added products from fish and shellfish: Preparation and uses of Marinated and fermented products, Fish paste products and Diversified (battered and breaded) products - Fish and prawn pickles, fish sauce, surimi, **fish sausage, fish ham, fish cake, kamaboko, fish macaroni, fish biscuits, fish burger**, fish mince, fish finger, fish cutlet, fish wafer, fish chowder, fish soup, fish stacks, fillets, fish curry, fish papad, mussel products, etc.
3. Packing and Labelling of fish and fishery products. Cold Storages and Export of Fishery Products.



UNIT V: Quality Management and Certification

(10h)

1. Quality Assurance – Concepts of Hazard Analysis Critical Control Point (HACCP) in sea food safety; Good Manufacturing Practices (GMPs), Standard Operating Procedures (SOPs). Determining the quality assurance of sea food.
2. Sanitation and Quality control – Environmental hygiene and personal hygiene in processing plants. Good Hygienic practices (GHPs). Sanitary Standard Operating Procedures (SSOP). Basic concepts and quality control of fish processing.
3. National and International standards – ISO 9000: 2000 Series of Quality Assurance System, Codex Alimentarius.

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23. *Web resources suggested by the teacher concerned and the college librarian including reading material.*

Time: 3 hours



ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM

B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 1
Course: 7B	FISH PROCESSING TECHNOLOGY LAB	Hrs/Wk:2

Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Execute various techniques of fish preservation.
2. Assess the quality of processed fish and fish by-products.
3. Familiarize with fish packaging materials and containers.
4. Prepare common fish/shellfish by-products and value added products.
5. Assess the sanitation and quality control standards in fish processing plants.

Practical Syllabus:

1. Techniques of fish preservation: Preparation of dried fish, salted fish and smoked fish by different methods.
2. Organoleptic analysis of fish. Quality assessment of salted, dried and smoked fish
3. Types of cans, canning equipment and layout of cannery. Canning of fish/shrimp.
4. Acquaintance with various packaging materials and containers for fish products.
5. Assessment of quality of packaging materials used for packaging of fish and fish products.
6. Preparation of 10 fish/shellfish by-products
7. Preparation of 10 value added products of fish and shellfish: prawn and fish pickles, fermented fish sauce, fish paste products, diversified fish products.
8. Collection of fishery by-products
9. Quality assessment of individual by-products and value added products.
10. Assessment of sanitation in fish processing plants
11. HACCP and GMP with SSOP.

Co-Curricular Activities:

a) **Mandatory:** (*Training of students by teacher on field related skills: 15 hours*)

1. **For Teacher:** Training of students by teacher in laboratory and field for a total of 15 hours on processing and preservation of fish/shellfish and their by-products and value added products; and the quality management and certification in fish processing.
2. **For Student:** Individual visit to a fish processing plant or related field or to a laboratory in research organization/private sector and study the sanitation measures followed while handling, storage and transport of fresh fish for further processing, various methods of processing and preservation of fish/shellfish and their products, packaging and labeling, cold storage and export. Also study the sanitary procedures, HACCP and GMPs implemented for quality assurance and quality control of seafood in fish processing plants. Submission of a hand written Fieldwork Report not exceeding 10 pages in the given format.
3. Max marks for Field Work Report: 05.
4. Suggested Format for Field work: *Title page, student details, content page, introduction, work done, findings, conclusions and acknowledgements.*
5. Unit tests (IE).

b) **Suggested Co-Curricular Activities:**

1. Training of students by related industrial experts.
2. Assignments (including the preparation of novel value added products and processing of fish products)
3. Seminars, Group discussions, Quiz, Debates, etc. (on related topics).
4. Preparation of videos on fish/shellfish processing and various methods of preserving fish/fish products, preparation of value added products, packaging, labelling, etc,
5. Collection of material/figures/photos related to fish processing, preservation and value added products, writing and organizing them in a systematic way in a file.
6. Visits to fish processing plant/industry, firms, research institutes, etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

VII. Suggested Question Paper Pattern:

Max. Marks: 75



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B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

MODEL QUESTION PAPER(Semester-End)

B.Sc Degree Examinations

SEMESTER - V (Skill Enhancement Course - Elective)

Course 7B: FISH PROCESSING TECHNOLOGY

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25 Marks

1. Quality of ice in fish handling and processing
2. Use of chemical preservatives
3. Canning
4. Shark leather
5. Chitosan
6. Fish sauce
7. Prawn pickles
8. Codex Alimentarius

SECTION – B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

9. a) Explain the Aims of fish processing?
(OR)
b) Give a detail account on Principles of fish preservation?
10. a) Write in detail about the Traditional methods of fish preservation?
(OR)
b) Write in detail about advanced methods of shell fish preservation?
11. a) Explain the Significance of Insulin, fish albumin and peptones
(OR)
b) Write the Utilization of sea weeds?
12. a) Write the Status of value addition to fish and fish products in Indian seafood sector?
(OR)
b) Describe the Packing and Labeling of fish and fishery products?
13. a) Explain the Concepts of Hazard Analysis Critical Control Point (HACCP) in sea food safety?
(OR)
b) Describe the Basic concepts and quality control of fish processing?



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B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

Suggested Question Paper Model for Practical Examination

Semester – V/ Aquaculture Course – 6B (Skill Enhancement Course)

Fish Processing Technology

Max. Time : 3 Hours

Max. Marks : 50

- | | |
|--|------------|
| 1. Organoleptic analysis of fish/ Fish preservation method 'A' | 8 M |
| 2. Fish by-products 'B' | 10 M |
| 3. Value added products 'C' | 10 M |
| 4. Demonstration of HACCP/ Sanitation and Quality control 'D' | 12 M |
| 5. Record + Viva-voce | 6+4 = 10 M |



B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 4
Course: 6C	AQUACULTURE ECONOMICS	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the concept of aquaculture economics and farm planning and budgeting.
2. Know the economic principles applied to aquaculture production.
3. Familiarize with the concepts of marketing and export of fish and fishery products
4. Assess the socio-economic conditions of fishermen and fish farmers and know the financial support they are getting from central and state government agencies.
5. Understand the global trade of fish and fish products and their contribution to Indian economy.

Syllabus: (Total Hours: 90 including Teaching, Lab, Field Training and Unit tests, etc.)

UNIT I: Principles of Economics (10h)

1. Concept of Microeconomics and Macroeconomics. Law of diminishing returns, laws of increasing, constant and decreasing utility and returns.
2. Law of equi-marginal returns. Importance of economics in aquaculture development.
3. Farm planning and budgeting: Objectives, Importance, Types, project preparation, project appraisal, Record keeping. Farm financial management: Basic accounting procedures, profit and loss account.

UNIT II: Production Economics (10h)

1. Basic economic principles applied to aquaculture production: the input-output relationships, maximum level of input, least-cost combination of inputs, maximum level of output, combination of products, economies of size.
2. Cost-Return Analysis: Production costs- fixed costs and variable costs; Gross revenue, Economic analysis.
3. Partial budget analysis, Cash flow analysis and Break-even analysis of Aquaculture practices.

UNIT III: Marketing Economics (10h)

1. Basic concepts in demand and price analysis: Demand, supply and fish prices; Elasticity of demand - Price, income and cross elasticity of demand. Methods of economic feasibility analysis: Payback period, average rate of return, discounting method - Net Present Value, Benefit-cost Ratio, Internal Rate of Return.
2. Fish markets and marketing in India, demand and supply of fish, market structure and price determination in fish markets. Cold storage and other marketing infrastructure in India. Problems of Fish marketing in India.
3. Export markets and marketing of fish and fishery products, trends and problems. Role of MPEDA in export of fish and fishery products.

UNIT IV: Socio-economics (10h)

1. Socio-economic conditions of fishermen and fish farmers
2. Role of government agencies – Role of NABARD and other Central Government agencies in the upliftment of fisher folk. Role of State Government agencies in various fishery activities – Loans and credits, policies. Role of insurance in fish and shrimp farming and industry.
3. Cooperatives in Fisheries and Aquaculture: Functions, financial assistance, input supplies, marketing of fish.



UNIT V: Global trade of Fish and Fishery products (10h)

1. Introduction to GATT and WTO – IPRs, TRIPS Agreement.
2. National Income – Definitions – GDP, NDP, NNP, GNP.
3. Contribution of fisheries to Indian economy: GDP from fisheries and aquaculture sector, foreign exchange earnings and employment potential of fishery and aquaculture industry.

REFERENCES:

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Web resources suggested by the teacher concerned and the college librarian including reading material



ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM

B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 1
Course: 6C	AQUACULTURE ECONOMICS LAB	Hrs/Wk:2

Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Prepare the project proposal and project appraisal
2. Assess the cost benefit analysis of fish/shellfish production units.
3. Execute the questionnaires for market surveys and socio-economics of farmers.
4. Analyze the socio-economic conditions of fishermen and fish farmers and the role of cooperative societies.
5. Know the International trade of fish and fishery products and contribution of fisheries to Indian economy.

Practical Syllabus:

1. Scope of Economics: Microeconomics and Macroeconomics - Flow charts.
2. Preparation of project proposal for loan from commercial bank or funding agencies including plan, budget and repayment schedule.
3. Farm Appraisal: A case study.
4. Study of credit schemes of banks and the government.
5. Cost benefit analysis calculations
6. Preparation of income statement
7. Costs and Returns in shrimp production unit: Case study.
8. Costs and Returns in freshwater fish production unit: Case study.
9. Costs and Returns in a freshwater fish hatchery: Case study.
10. Costs and Return in a prawn and shrimp hatchery: Cases study.
11. Developing questionnaire for conducting market surveys, and socio-economics of fishermen and fish farmers.
12. Collection and analysis of Socio-economic data of fishermen and fish farmers.
13. Fish marketing structure - Market channels – Flow chart.
14. Analysis of primary and secondary market data.
15. Case studies of Fish cooperative societies

Co-Curricular Activities:

a) **Mandatory:** (*Training of students by teacher on field related skills: 15 hours*)

1. **For Teacher:** Training of students by teacher in laboratory and field for a total of 15 hours on the principles of economics; preparation of project proposals and credit schemes; Cost-benefit analysis of fish/shellfish production farms and hatcheries; fish markets and marketing economics; organizing and conducting socio-economic surveys to study the socio-economic status of fishermen and fish farmers; and fish cooperative societies.
2. **For Student:** Individual visit to commercial fish and shellfish farms/hatcheries to study the cost-benefit analysis, commercial banks and regional rural banks for credit schemes, fish markets to study the marketing of fish and fish products, co-operative societies, government agencies and fish export organizations. Develop advertisement skills for marketing of various products used for Aquaculture. Submission of a hand written Fieldwork Report not exceeding 10 pages in the given format.
3. Max marks for Field Work Report: 05
4. Suggested Format for Field Report: *Title page, student details, content page, introduction, work done, findings, conclusions and acknowledgements.*
5. Unit tests (IE).



b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Assignments (including technical assignments on farm economics and marketing management of fish and fish products).
3. Seminars, Group discussions, Quiz, Debates, etc. (on related topics).
4. Preparation of videos on fish/shellfish markets and marketing process.
5. Collection of material/figures/photos related to the topic, writing and organizing them in a systematic way in a file.
6. Visits to fish/shellfish farms and hatcheries, fish markets, fish co-operative societies, etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

Suggested Question Paper Pattern:

Max. Marks: 75

Time: 3 hours



ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM

B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

MODEL QUESTION PAPER(Semester-End)

B.Sc Degree Examinations

SEMESTER - V (Skill Enhancement Course - Elective)

Course 6C: AQUACULTURE ECONOMICS

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25 Marks

1. Macroeconomics
2. Laws of increasing
3. Economies of size
4. Cash flow analysis
5. MPEDA
6. Role of State Government agencies in various fishery activities
7. GDP, NDP
8. NNP, GNP.

SECTION – B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

9. a) Explain the Law of equi-marginal returns? Write the Importance of economics in aquaculture development?
(OR)
b) Give a detail account on Farm planning and budgeting?
- 10.a) Write in detail about the the input-output relationships, maximum level of input, least-cost combination of inputs?
(OR)
b) Write in detail about Cost-Return Analysis?
11. a) . Explain the Methods of economic feasibility analysis?
(OR)
b) Write the Cold storage and other marketing infrastructure in India?
12. a) Write the Role of NABARD and other Central Government agencies in the upliftment of fisher folk
(OR)
b) Cooperatives in Fisheries and Aquaculture?
13. a) Explain GATT, WTO ,IPRs and TRIPS Agreement.?
(OR)
b) Explain the Contribution of fisheries to Indian economy?



ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM
B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

Suggested Question Paper Model for Practical Examination
Semester – V/ Aquaculture Course – 6C (Skill Enhancement Course)
Aquaculture Economics

Max. Time : 3 Hours

Max. Marks : 50

1. Project proposal for loan from banks or funding agencies ‘**A**’ 12 M
2. Cost-benefit analysis of fish/shellfish production farms ‘**B**’ 12 M
3. Marketing structure – Flow chart ‘**C**’ 8 M
4. Demonstration of role of fish cooperative societies/government agencies ‘**D**’ 8 M
5. Record + Viva-voce 6 + 4 = 10 M



B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 4
Course: 7C	FISH MICROBIOLOGY AND QUALITY ASSURANCE	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the history and importance of microorganisms in fish foods.
2. Know the microorganisms in fresh and processed fish foods, the factors affecting the microbial growth and their role in food spoilage.
3. Acquire knowledge on microbes involved in food borne infections and intoxications.
4. Ascertain the various ways of fish spoilage and its control.
5. Maintain the sanitary and quality standards in fish processing industries.

Syllabus: (Total Hours:90 including Teaching, Lab, Field Training and Unit tests, etc.)

UNIT I: History and Significance of microbes in foods (10h)

1. History of microorganisms in foods .Role and significance of microorganisms in foods.
2. Microbial principles of fish preservation and processing- application of low temperature, high temperature, drying, irradiation and chemicals.
3. Enumeration of microorganisms in food by conventional and rapid techniques.

UNIT II: Microorganisms in fish (10h)

1. Microorganisms in fresh and processed fish – raw fish, chilled fish, frozen fish, cured fish, canned fish, fermented, irradiated, value added and other miscellaneous fish products .Isolation and identification of common bacteria.
2. Factors (intrinsic and extrinsic) affecting the growth and survival of microorganisms in fish.
3. Psychrophiles, halophiles and the rmophiles, their role in spoilage and food poisoning.

UNIT III: Microbes of public health concern (10h)

1. Study of bacteria involved in foodborne infections and intoxications– *Vibrio parahaemolyticus*, *V. cholerae*, *Listeria monocytogenes*, *Clostridium*, *Salmonella*, *Shigella*, *Staphylococcus*, *E. coli*.
2. Biological hazards associated with fish and fishery products: Marine toxins; mycotoxins, parasites and viruses.
3. Occurrence, growth, survival, pathogenicity, prevention and risk assessment of common bacteria present in fish.

UNIT IV: Fish spoilage (10h)

1. Types of spoilage of fish and fish products. Indicators/Indices of fish spoilage.
2. Microbial spoilage of fish/shell fish and its prevention/control.
3. Assessment of quality of fish and fishery products.

UNIT V: Sanitary and Quality management (10h)

1. Bacteria of sanitary significance.Quality Indicators of fish products. Disinfectants, detergents and cleaning schedule. Process water quality in fish processing industries.
2. Concepts of Quality Management; TQM, SSOP, GHP,GMP.
3. Quality standards for fish and fishery products – BIS, FSSAI, Codex Alimentarius, ISO 9000 series and HACCP.Microbiological standards and criteria.



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4. Jeyasekharan, G., Jaya Shakila, R. and Sukumar, D. (2006). Quality and Safety of Sea foods– Text Book. Tamilnadu Veterinary and Animal Sciences University, Chennai.
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15. Balachandran, KK. (2001). Post-harvest technology of fish and fish products. Daya Publ.
16. Anthony, TT. (1988). Handbook of Natural toxins, Marine toxins and Venom. Vol.III. Marcel Dekker.
17. *Web resources suggested by the teacher concerned and the college librarian including reading material.*



B Sc	SEMESTER: V(Skill Enhancement Course - Elective)	Credits: 1
Course: 7C	FISH MICROBIOLOGY AND QUALITY ASSURANCE LAB	Hrs/Wk:2

Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Collect and process the fish/shellfish samples for microbial studies.
2. Establish the laboratory for the isolation and culture of microorganisms
3. Identify and Enumerate the microbes in water, ice, fish and fishery products
4. Characterize the bacteria by biochemical tests and detect them by molecular, conventional and rapid methods.
5. Assess the indices of freshness and quality of fresh and processed fish/shellfish.

Practical Syllabus:

1. Sampling and processing of fish/shellfish samples for microbiological investigation.
2. Sterilization techniques, Media preparation, Isolation and maintenance of bacteria, and Gram staining of bacteria.
3. Conventional and rapid methods for detection of microorganisms.
4. Enumeration of microorganisms associated with fish/shellfish and fishery products – Total plate count (TPC).
5. Enumeration of microorganisms in water and ice.
6. Isolation and identification of foodborne pathogens in fish/shellfish and fishery products.
7. Enumeration of specific spoilage microbes from fish and fishery products.
8. Biochemical tests for characterization of bacteria.
9. Molecular methods for the detection of pathogenic microorganisms.
10. Determination of MIC and MBC of chemical preservatives.
11. Assessment of freshness of fish and shrimp by using organoleptic characters.
12. Assessment of sanitation in fish processing plants.
13. Determination of available chlorine.

Co-Curricular Activities:

a) Mandatory: (*Training of students by teacher on field related skills: 15 hours*)

1. **For Teacher:** Training of students by teacher in laboratory and field for a total of 15 hours on the importance of microbes in fish and fish products, microbial principles of fish preservation and processing, microbes of public health concern, microbial fish spoilage, sanitary and quality management in fish processing industries.
2. **For Student:** Individual visit to a fish processing plant or related field or to a laboratory in research organization/private sector and study the isolation, culture and enumeration of microbes in water, ice, fish and fish products, detecting microbes by biochemical tests and molecular methods, assessment of freshness and quality of fresh and processed fish/ shellfish, quality assurance in fish processing plants. Submission of a hand written Fieldwork Report not exceeding 10 pages in the given format.
3. Max marks for Field Work Report: 05.
4. Suggested Format for Field Report:*Title page, student details, content page, introduction, work done, findings, conclusions and acknowledgements.*
5. Unit tests (IE).



b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Assignments(including technical assignments on Quality Assurance in processing plants)
3. Seminars, Group discussions, Quiz, Debates, etc. (on related topics).
4. Preparation of videos on fish/shellfish processing and various methods of preserving fish/shellfish and fish products.
5. Collection of material/figures/photos related to the topic, writing and organizing them in a systematic way in a file.
6. Visit to fish processing plant for the study of sanitary and quality standards followed, firms, research organizations, etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

Suggested Question Paper Pattern:

Max. Marks: 75

Time: 3 hours



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B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

MODEL QUESTION PAPER(Semester-End)

B.Sc Degree Examinations

SEMESTER - V (Skill Enhancement Course - Elective)

Course 7C: FISH MICROBIOLOGY AND QUALITY ASSURANCE

Time : 3 hrs

Max. Marks : 75

SECTION – A

Answer any FIVE of the following

5x5 = 25 Marks

1. Rapid techniques for Enumeration of microorganisms
2. Psychrophiles,
3. Halophiles
4. Prevention and risk assessment of common bacteria present in fish.
5. Indicators/Indices of fish spoilage.
6. TQM,
7. BIS
8. ISO 9000 series

SECTION – B

Answer ALL the questions each question carries 10 marks

5x10=50 Marks

9. a) History of microorganisms in foods. Write the Role and significance of microorganisms in foods?
(OR)
b) Give a detail account on Microbial principles of fish preservation and processing?
10. a) Write in detail about Isolation and identification of common bacteria?
(OR)
b) What are the Factors affecting the growth and survival of microorganisms in fish?
11. a) . Write note on bacteria involved in food borne infections and intoxications?
(OR)
b) Write the Biological hazards associated with fish and fishery products?
12. a) Write the Types of spoilage of fish and fish products?
(OR)
b) Assessment of quality of fish and fishery products?
13. a) Explain the Process of water quality in fish processing industries.?
(OR)
b) Explain the Microbiological standards and criteria?



ADIKAVI NANNAYA UNIVERSITY :: RAJAHMAHENDRAVARAM
B.Sc AQUACulture Technology Syllabus (w.e.f: 2020-21 A.Y)

Suggested Question Paper Model for Practical Examination
Semester – V/ Aquaculture Course – 7C (Skill Enhancement Course)

Fish Microbiology and Quality assurance

Max. Time : 3 Hours

Max. Marks : 50

- | | |
|--|--------------|
| 1. Media Preparation /Organoleptic evaluation of fish/fish products ‘A’ | 8 M |
| 2. Sterilization techniques/ Staining techniques ‘B’ | 10 M |
| 3. Isolation/ culture / characterization of bacteria from fishes and water ‘C’ | 10 M |
| 4. Demonstration of HACCP / Sanitation and Quality control ‘D’ | 12 M |
| 5. Record + Viva-voce | 6 + 4 = 10 M |