



**ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION**  
(A Statutory body of the Government of Andhra Pradesh)

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**SYLLABUS FOR B.Sc (Aquaculture)**  
**UNDER CBCS FRAME WORK WITH EFFECT FROM 2020-21**

**PROGRAMME: THREE-YEAR B.Sc.**  
(Aquaculture)  
*(With Learning Objectives, Unit-wise Syllabus, References & Model papers)*  
*For Fifteen Courses of 1, 2, 3 & 4 Semesters)*  
**(To be Implemented from 2020-21 Academic Year)**

**Structure of AQUACULTURE Syllabus**

**(Under CBCS pattern for 3-years B.Sc Programme)**

**(With domain subject covered during the first 4 Semesters with 5 Courses)**

YEAR	SEMESTER	PAPER NO	TITLE OF THE PAPER	MARKS (100)		CREDITS
				MID SEMESTER	END SEMESTER	
I	I	I	Principles of Aquaculture	25	75	04
			Practical- I	15	35	01
	II	II	Biology of Fish and Shellfish	25	75	04
			Practical- II	15	35	01
II	III	III	Freshwater & brackishwater aquaculture	25	75	04
			Practical- III	15	35	01
	IV	IV	Fish nutrition & Feed technology	25	75	04
			Practical- VI	15	35	01
		V	Fish Health Management	25	75	04
			Practical- V	15	35	01

The syllabus for Aquaculture is framed at undergraduate level under the revised Choice Based Credit system. The main objective of framing this syllabus is to give the students a

holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Aquaculture. The syllabus has also been framed in such a way that the basic skills of subject are taught to the students and may continue higher studies in post graduation and/or secure a job after graduation.

## **PROGRAMME OUTCOMES**

On completion of their degree, students will have developed a comprehensive and well-founded knowledge in aquaculture and a range of transferable professional skills. Graduates of the course are expected to be able to:

- 1 Demonstrate a sound understanding of the biology of aquaculture organisms and of breeding, genetics, nutrition and water quality issues relevant to aquaculture
- 2 Design aquaculture systems and solve engineering issues in aquaculture
- 3 Employ knowledge of health and safety issues in aquaculture ventures
- 4 Employ scientific techniques, practical skills and business management strategies to improve aquatic resource management
- 5 Understand and interpret critical scientific and ethical issues in aquaculture
- 6 Employ scientific methodologies such as experimental design, quantitative skills, and the critical analysis of data
- 7 Communicate and present information clearly and fluently in both written and spoken forms
- 8 Interact effectively as part of a team in order to work towards a common outcome
- 9 Reason critically and logically and make independent judgements
- 10 Engage effectively with information and communication technologies
- 11 Demonstrate research skills appropriate for further study and employment
- 12 Appreciate the need for continuing professional development.

### **LEARNING OUTCOMES:**

1. Students will be able to understand types of culture system and economics of different kinds of aquaculture and productivity of culture ponds.
2. Students will be able to understand the transport of fin fish and shell fish and transport of eggs fry, fingerlings and adults.
3. Students will be able to understand the pond preparation and management, pre stocking and post stocking.
4. Students will be able to understand the major carp culture like cat fishes murrels and prawn culture, ornamental fish culture.
5. Students will be able to understand the nutritional requirements of commercially important fin fish and shell fish feed types, feeding techniques and feed management and role of probiotics in nutrition.
6. Students will be able to understand role of genetics in aquaculture like gynogenesis and androgenesis, triploidy, tetraploidy, hybridization, sex reversal breeding, production of transgenic fishes.
7. Students will be able to understand general principles of molluscan culture, pearl oyster culture, seaweeds.
8. Students will be able to understand environmental impact aquaculture for waste and future development in waste minimization environmental consequences of hyper nitrification.

### **❖ Important days for Aquaculture at National/International level Importance**

1. **November 21<sup>th</sup>**- World Fisheries Day
2. **July 10<sup>th</sup>** - India celebrates as the National Fish Farmers day.

**AP STATE COUNCIL OF HIGHER EDUCATION**  
**w.e.f. 2020-21 (Revised in April, 2020)**

**I B.Sc Aquaculture**  
**SEMESTER – I**  
**PAPER – I**  
**PRINCIPLES OF AQUACULTURE**

**HOURS : 60 (5X12)**

**Max.Marks: 100**

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**Learning Objectives:**

1. To know the present status of aquaculture and its role in world economy and food production.
2. To understand the pond ecosystems and natural food production.
3. To improve the technical knowledge on preparation and management of fish and shrimp ponds.
4. To gain knowledge on the estimation of different parameters in culture ponds for better aquaculture practices.
5. To gain knowledge on harmful algal blooms and their control.
6. To improve the technical skills in soil and water analysis for better aquaculture practice.

**Unit - I: Introduction**

- 1.1. Definition, Significance and History of Aquaculture; Concept of Blue Revolution; Present status of aquaculture in the world, India and AP state.
- 1.2. Types of Aquaculture: Freshwater, Brackishwater and Mariculture; Monoculture, Polyculture, Composite culture, Monosex culture and Integrated fish farming.
- 1.3. Culture systems: Ponds, Raceways, Cages, Pens, Rafts and water recirculating systems; Culture practices: Traditional, extensive, modified extensive, semi-intensive and intensive culture of fish and shrimp.
- 1.4. Major cultivable species for aquaculture and their commercial importance: freshwater, brackishwater and marine.
- 1.5. Criteria for the selection of species for culture

**Unit - II: Pond ecosystem**

- 2.1. General concepts of Ecology, Carrying capacity and Food chains
- 2.2. Nutrient cycles in culture ponds – Phosphorus, Carbon and Nitrogen
- 2.3. Importance of Plankton and Benthos in culture ponds, nutrient dynamics and algal blooms
- 2.4. Concepts of Productivity, estimation and improvement of productivity in ponds.

**Unit - III: Design and construction of aquafarms**

- 3.1. Criteria for the selection of site for freshwater and brackish water pond farms
- 3.2. Design and construction of a freshwater fish farm and hatchery.
- 3.3. Design and construction of a shrimp farm and hatchery.
- 3.4. Functional classification of ponds – head pond, hatchery, nursery, rearing, production, stocking and quarantine ponds

#### **Unit - IV: Pond culture management**

- 4.1. Water quality and Soil characteristics in aquaculture: Significance of physico-chemical and biological parameters and their management at optimal levels in ponds.
- 4.2. Organic manures and Chemical fertilizers -Types and need of their application in ponds.
- 4.3. Eradication of aquatic weeds, insects and unwanted fishes: Common aquatic weeds-advantages and disadvantages and their control; Common aquatic insects – disadvantages and their control; Common weed and predatory fishes - disadvantages and their control.
- 4.4. Factors affecting fish health; Integrated health management.

#### **Unit - V: Economics and Fish processing**

- 5.1. Aquaculture economics – Capital costs, variable costs, cost-benefit analysis
- 5.2. Fish marketing methods in India
- 5.3. Harvesting of ponds; handling, packaging and transport of fish and shrimp.
- 5.4. Methods of preservation and processing of fish and shrimp

#### **Reference 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
3. Pillay TVR & M.A.Dill, 1979. Advances in Aquaculture. Fishing News Books Ltd., London
4. Stickney RR 1979. Principles of Warm Water Aquaculture. John Wiley & Sons Inc. 1981
5. Boyd CE 1982. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing
6. Bose AN et.al., 1991. Coastal Aquaculture Engineering. Oxford & IBH Publishing Company
7. Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR.
8. Govindan, TK. 1985. *Fish Processing Technology*, Oxford-IBH.
9. Ivar LO. 2007. *Aquaculture Engineering*. Daya Publ. House.
10. Shang, Y.C. 1990. *Aquaculture Economic Analysis – An Introduction*.

**I B.Sc Aquaculture**  
**SEMESTER – I**  
**PAPER – I**  
**PRINCIPLES OF AQUACULTURE**

**Time :3hrsMax.Marks:75**

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**THEORY MODEL PAPER**

**I. Answer any FIVE of the following**

**Draw labeled diagram wherever necessary**

**5x5=25**

1. Monoculture
2. Brackish water culture
3. Lotic system
4. Phosphorus cycle
5. Nursery pond
6. Blue Revolution
7. Capital Cots
8. Topography

**II. Answer any FIVE of the following**

**Draw labeled diagram wherever necessary**

**5x10=50**

9. a. Explain Freshwater aquaculture  
(or)  
b. Explain Intensive and Semi-Intensive aquaculture.
10. a. Explain Carbon cycle  
(or)  
b. Describe the importance of plankton and Benthos in culture ponds.
11. a. Explain different types of ponds in aquaculture.  
(or)  
b. Describe how to design Hatchery.
12. a. Which important factors are involved to construct an ideal fish pond  
(or)  
b. Explain the components of barrage pond.
13. a. Explain chemical factors effect in aquaculture.  
(or)  
b. write about weed control in aquaculture.

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**I B.Sc AQUACULTURE PRACTICAL SYLLABUS FOR SEMESTER-I**  
**PAPER - I**  
**PRINCIPLES OF AQUACULTURE**

**Periods: 24**

**Max. Marks: 50**

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**PRACTICALS: (Any 8 as per the local Industry needs and Requirement)**

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



**I B.Sc Aquaculture**  
**SEMESTER –I**  
**PAPER – I**  
**PRINCIPLES OF AQUACULTURE**

**Time : 2hrs**

**Max.Marks:50**

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**PRACTICAL MODEL PAPER**

I. Estimate Dissolved oxygen/ Total alkalinity, carbonates and Bicarbonates/chlorides/ Total hardness/ Phosphates/ Ammonia in a given water sample and write the principle and procedure .

**10marks**

II. Identify the following spotters

**20 marks**

- a. Phytoplankton
- b. Phytoplankton
- c. Zooplankton
- d. Aquatic insect or molluscan shell
- e. Aquatic Weed

III. Record

**05 marks**

IV. Internal assessment

**15 marks**

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**w.e.f. 2020-21 (Revised in April, 2020)**

**I B.Sc Aquaculture**  
**SEMESTER – II**  
**PAPER – II**

**BIOLOGY OF FISH AND SHELLFISH**

**HOURS: 60 (5X12)**

**Max.Marks: 100**

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**Learning Objectives:**

- 1 To gain knowledge on classification of fish, crustacean and molluscs.
- 2 To understand the feed and feed management in fish culture.
- 3 To improve the knowledge on the determination of age and growth in fish.
- 4 To understand the reproductive biology of fish, shrimp and mollusks
- 5 To understand the embryonic and larval development of fish and shell fish.
- 6 To understand the hormonal influences in finfish and shell fish.

**UNIT – I: Classification, External and Internal anatomy and Digestive system)**

- 1.1. General characters and Classification of fishes, crustaceans and molluscs up to Class.
- 1.2. Gross external morphology of a typical teleost fish, prawn, shrimp, crab and oyster.
- 1.3. Internal anatomy of a teleost fish, shrimp, crab and oyster.
- 1.4. Digestive system and associated glands in fish and shrimp. Process of digestion and assimilation.

**UNIT – II: Respiratory, Circulatory and Excretory systems**

- 2.1. Structure of gills; Mechanism of respiration and gaseous exchange in fish, shrimp and oyster.
- 2.2. Structure of heart and physiology of circulation in fish and shrimp.
- 2.3. Structure and function of kidneys in fishes; Osmotic and ionic regulation in fishes.
- 2.4. Structure and function of excretory organs in shrimp, crab and oyster.

**UNIT – III : Endocrine, sensory and reproductive systems**

- 3.1. Structure and function of endocrine organs in fish and shrimp.
- 3.2. Hormonal regulation of fish reproduction; Endocrine regulation of reproduction in crustaceans.
- 3.3. Sensory organs in fish and shrimp.
- 3.4. Reproductive structures in teleosts, crustaceans and oysters.

**UNIT – IV: Feeding and Growth**

- 4.1. Natural food and feeding habits of commercially important fishes, shrimp, crab and oysters.
- 4.2. Methods of determination of age and growth in fishes. Length-weight relationship.
- 4.3. Factors affecting growth in fish and shrimp. Absolute and Specific growth in fishes.
- 4.4. Molting, molting stages and metamorphosis in crustaceans.

**UNIT – V: Reproductive and Developmental biology**

- 5.1. Maturity stages of gonads, Gonado-somatic index

- 5.2. Fecundity of fish, prawn and shrimp.
  - 5.3. Life cycle of carp, prawn, shrimp, crab and oyster.
  - 5.4. Larval forms of commercially important prawn, shrimp, crab and oysters.
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**Reference 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
3. Tandon KK & Johal MS 1996. Age and Growth in Indian Freshwater Fishes. Narendra Publishing Raymond T et al., 1990. Crustacean Sexual Biology, Columbia University Press, New York
4. Guiland J.A (ed) 1984. Penaeid shrimps- Their Biology and Management.
5. Lagler KF, Bardach, JE, Miller, RR, Passino DRM. 1977. Ichthyology, 2nd Ed. John Wiley & Sons, New York.
6. Lovell J. 1989. Nutrition and Feeding of Fish. Van Nostrand Reinhold, New York.
7. Moyle PB and Joseph J. Cech Jr. 2004. Fishes: An Introduction to Ichthyology. 5th Ed. Prentice Hall.
8. Nikolsky GV. 1963. Ecology of Fishes, Academic Press.
9. Norman JR and Greenwood PH. 1975. A History of Fishes, Halsted Press.
10. Kurian CV & Sabastian VO. 1976. Prawns and Prawn Fisheries of India. Hindustan Publ.Co.

**I B.Sc Aquaculture  
SEMESTER – II  
PAPER – II  
BIOLOGY OF FISH AND SHELL FISH**

**Time :3hrs**

**Max.Marks:75**

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**THEORY MODEL PAPER**

**I. Answer any FIVE of the following**

**Draw labeled diagrams wherever necessary**

**5x5=25**

1. Electric organs.
2. Swim bladder in fishes
3. Natural fish food
4. Length-weight relationship
5. Breeding places
6. Induced breeding
7. Nest building
8. Ovo-viviparity

**II. Answer any FIVE of the following:**

**5x10=50**

**Draw labeled diagrams wherever necessary**

9. a. Describe general characters of fishes and classify up to class level.  
(or)  
b. Explain fin fish and shell fish of commercial importance.
10. a. Explain different methods to estimate fish age and growth  
(or)  
b. Explain different factors in fish longevity
11. a. Write an essay on different breeding habitats.  
(or)  
b. Explain Breeding in shrimp
12. a. Describe embryonic and larval development in fishes.  
(or)  
b. Explain environmental factors effecting on fin fish in reproduction and development.
13. a. Role of Endocrine hormones in fishes.  
(or)  
b. Describe metamorphosis in crustaceans.

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**I B.Sc AQUACULTURE PRACTICAL SYLLABUS FOR SEMESTER-II**  
**PAPER - II**  
**BIOLOGY OF FISH AND SHELL FISH**

**Periods: 24**

**Max. Marks: 50**

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**PRACTICALS: (Any 8 as per the local Industry needs and Requirement)**

1. Length-weight relationship offishes
2. Study of gonadal maturity and fecundity in fishes and shellfish
3. Gross External morphology of Fish (catla, catfish and channa), Prawn, Shrimp and Oyster
4. Observation of internal anatomy by autopsy of fish and shrimp.
5. Mounting of cycloid and ctenoid scales of fish.
6. Mount the appendages of cultivable prawns, shrimps and other crustaceans
7. Dissection of the digestive system of Fish (herbivorous and carnivorous) and shrimp.
8. Gut content analysis of herbivorous and carnivorous fish.
9. Mounting of the pituitary gland of fish.
10. Larval forms of Prawn, Shrimp, Crab and Oyster.

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**I B.Sc Aquaculture**  
**SEMESTER – II**  
**PAPER – II**  
**BIOLOGY OF FISH AND SHELLFISH**

**Time :2hrs**

**Max.Marks:50**

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**PRACTICAL MODEL PAPER**

- |      |   |                     |
|------|---|---------------------|
| I.   | Enumerate Length Weight relationship of the given fishes.<br>Write procedure and Draw Graphs as required. | <b>10marks</b>      |
| II.  | Identify the following spotters   | <b>4x5=20 marks</b> |
| A.   | Mouth Parts   |                     |
| B.   | Type of Eggs  |                     |
| C.   | Larval Forms  |                     |
| D.   | Larval Forms  |                     |
| III. | Record  | <b>05 marks</b>     |
| IV.  | Internal assessment   | <b>15 marks</b>     |

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**w.e.f. 2020-21 (Revised in April, 2020)**

**II B.Sc Aquaculture**  
**SEMESTER – III**  
**PAPER – III**  
**FRESHWATER & BRACKISHWATER AQUACULTURE**

**HOURS : 60 (5X12)**

**Max.Marks: 100**

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**Learning Objectives:** To know the present status of freshwater and brackishwater aquaculture and their role in world economy and food production.

- 1 To gain knowledge on carp, prawn, shrimp and crab culture and composite fish culture systems.
- 2 To improve the technical knowledge on fish and shrimp hatchery technology and culture practices.
- 3 To improve the knowledge and technical skills for the identification of cultivable finfish and shellfish.

**UNIT- I: Introduction**

- 1.1. Status, scope and prospects of freshwater aquaculture in the world, India and AP
- 1.2. Status, scope and prospects of brackish water aquaculture in the world, India and AP
- 1.3. Freshwater and brackish water resources in India.
- 1.4. Special culture systems - brief study of culture in running water, re-circulatory systems, cages and pens, sewage-fed fish culture.

**UNIT-II: Culture of carp, air-breathing, and exotic fishes**

- 2.1. Bundh breeding and Induced breeding of Indian major carp by hypophysation technique. Synthetic hormones used for induced breeding of carps. Types of fish hatcheries- traditional, Chinese and jar hatcheries.
- 2.2. Preparation and Management of Indian major carp culture ponds – nursery, rearing and grow-out ponds.
- 2.3. Culture of air-breathing fishes in India; *Pangasius* fish farming
- 2.4. Exotic fishes introduced to India and their impact on indigenous species. Composite fish culture of Indian and exotic carps – compatibility and competition.

**UNIT-III: Culture of prawn and ornamental fishes**

- 3.1. Breeding and hatchery management of freshwater prawn, *Macrobrachium rosenbergii*.
- 3.2. Culture of *Macrobrachium rosenbergii* and *M. malcolmsonii* – biology, seed production, pond preparation, stocking, management of nursery and grow-out ponds, feeding, morphotypes and harvesting.
- 3.3. Ornamental fish culture– Common freshwater and marine ornamental fishes; Fabrication, setting up and maintenance of freshwater and marine aquarium.
- 3.4. Breeding and rearing of freshwater ornamental fishes.

#### **UNIT-IV: Culture of shrimp and crab**

- 4.1. Breeding and Hatchery management of a typical penaeid shrimp (*Penaeus monodon* or *Litopenaeus vannamei*).
- 4.2. Transportation of shrimp seed and nursery management.
- 4.3. Culture of *P. monodon* or *L. vannamei* –pond preparation, stocking, management of water, feed and diseases, and harvesting.
- 4.4. Culture of mud crab, *Scylla serrata*.

#### **UNIT-V: Culture of brackish water fishes**

- 5.1. Breeding and Culture of milk fish, *Chanos chanos*.
- 5.2. Breeding and Culture of Asian sea bass, *Lates calcarifer*.
- 5.3. Breeding and Culture of grey mullet, *Mugil cephalus*.
- 5.4. Fish and shellfish culture in cages and pens.

#### **Reference Books:**

1. Bardach, JE *et al.* 1972. *Aquaculture – The farming and husbandry of freshwater and marine organisms*, John Wiley & Sons, New York.
2. Boyd, CE. 1982. *Water Quality Management for Pond Fish Culture*. Elsevier Sci. Publ. Co.
3. Chakraborty C & Sadhu AK. 2000. *Biology Hatchery and Culture Technology of Tiger Prawn and Giant Freshwater Prawn*. Daya Publ. House.
4. CIFE. 1993. *Training Manual on Culture of Live Food Organisms for Aqua Hatcheries*. CIFE, Versova, Mumbai
5. De Silva SS & Anderson TA. 1995. *Fish Nutrition in Aquaculture*. Chapman & Hall Aquaculture Series.
6. FAO. 2007. *Manual on Freshwater Prawn Farming*.
7. Huet J. 1986. *A text Book of Fish Culture*. Fishing News Books Ltd.
8. ICAR. 2006. *Hand Book of Fisheries and Aquaculture*. ICAR.
9. Jhingran V.G. 1998. *Fish and Fisheries of India*. Hindustan Publ. Corporation, India.
10. Landau M. 1992. *Introduction to Aquaculture*. John Wiley & Sons.
11. Mcvey JP. 1983. *Handbook of Mariculture*. CRC Press.
12. MPEDA: *Handbooks on culture of carp, shrimp, etc.*
13. New MB. 2000. *Freshwater Prawn Farming*. CRC Publ.
14. Pillay TVR. 1990. *Aquaculture- Principles and Practices*, Fishing News Books Ltd., London.
15. Pillay TVR & Kutty MN. 2005. *Aquaculture- Principles and Practices*. 2<sup>nd</sup> Ed. Blackwell
16. Rath RK. 2000. *Freshwater Aquaculture*. Scientific Publ.
17. Stickney RR. 1979. *Principles of Warmwater Fish Culture*, John Wiley & Sons.

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**II B.Sc Aquaculture**  
**SEMESTER – III**  
**PAPER – III**  
**FRESH WATER & BRACKISHWATER AQUACULTURE**

Time :3hrs

Max.Marks:75

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**THEORY MODEL PAPER**

**I. Answer any FIVE of the following**

**Draw labeled diagrams wherever necessary**

**5x5=25**

1. Freshwater culture systems
2. Aquaculture status in India
3. Exotic fishes
4. Minor carps
5. Re-circulatory system
6. Sewage-fed fish culture
7. Seed production
8. Grow-out ponds

**II. Answer any FIVE of the following:**

**5x10=50**

**Draw labeled diagrams wherever necessary**

9. a. Describe the status and prospects of freshwater aquaculture in A.P.  
(or)  
b. Explain freshwater aquaculture system.
10. a. Write an essay on major cultivable Indian carps  
(or)  
b. Describe composite fish culture system of Indian and exotic carps.
11. a. Explain recent culture trends in murrels  
(or)  
b. Explain advantages in the culture of air-breathing fishes.
12. a. Write an essay on the commercial value of Indian freshwater prawn.  
(or)  
b. Describe *Macrobrachium rosenbergii* culture .
13. a. Explain feed and disease management in *P.monodon* culture.  
(or)  
b. Describe hatchery technology and culture practices of *L. vannamei*.

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**II B.Sc AQUACULTURE PRACTICAL SYLLABUS FOR SEMESTER-III  
PAPER - III**

**FRESHWATER & BRACKISHWATER AQUACULTURE**

**Periods: 24**

**Max. Marks: 50**

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**PRACTICALS: (Any 8 as per the local Industry needs and Requirement)**

1. Identification of important cultivable carps
2. Identification of important cultivable air-breathing fishes
3. Identification of important cultivable freshwater prawns
4. Identification of different life history stages of fish
5. Identification of different life history stages of freshwater prawn
6. Collection and study of weed and predatory fishes.
7. Identification of commercially viable crabs – *Scylla serrata*, *Portunus pelagicus*, *P.sanguinolentus*, *Neptunus pelagicus*, *N.Sanguinolentus*
8. Identification of mussels and clams
9. Identification of developmental stages of oysters
10. Field visit to aqua farm and study of different components like dykes, water pumps, inlets and outlets, aerators, feeding devices, etc.

**II B.Sc Aquaculture  
SEMESTER –III  
PAPER – III**

**FRESHWATER & BRACKISHWATER AQUACULTURE**

**Time : 2hrs**

**Max.Marks:50**

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**PRACTICAL MODEL PAPER**

- I. Identify the following specimens and write notes on their commercial importance**

**6x5=30M**

- a. Carp
- b. Fresh water prawn
- c. Developmental Stages of prawn
- d. Crab
- e. Developmental stages of fish
- f. Mussel/clam

**II. Record**

**05 marks**

**III. Internal assessment**

**15 marks**

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**AP STATE COUNCIL OF HIGHER EDUCATION**  
**w.e.f. 2020-21 (Revised in April, 2020)**

**II B.Sc Aquaculture**  
**SEMESTER – IV**  
**PAPER – IV**

**FISH NUTRITION & FEED TECHNOLOGY**

**HOURS : 60 (5X12)**

**Max.Marks: 100**

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**Learning Objectives:**

- 1 To know the nutritional requirements of fish and shell fish at different stages of their life.
- 2 To understand the different types of feeds, and feed additives used in the preparation of fish and shellfish feeds.
- 3 To improve the knowledge on feed manufacture and feed storage.
- 4 To gain knowledge on feeding and feed evaluation methods.
- 5 To gain knowledge on feed manufacture and storage-
- 6 To know the nutritional pathology and remedial methods of cultivable fish and shrimp.
- 7 To improve the technical knowledge feed quality and nutritional value analysis.

**UNIT-I: Nutritional requirements of cultivable fish and shellfish**

- 1.1. Classification of nutrients; Nutritional requirements (energy, proteins, carbohydrates, lipids, fiber, micronutrients) of different stages of cultivable fish and shellfish.
- 1.2. Essential amino acids 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, factors affecting energy partitioning and feeding
- 1.4. Importance of natural and supplementary feeds, balanced diet.

**UNIT-II: Types of feeds and Feed additives**

- 2.1. Live foods: Fish food organisms – Bacterioplankton, phytoplankton, zooplankton and their role in larval nutrition.
- 2.2. Artificial feeds: Supplementary feed stuffs; Non-conventional feed ingredients; Forms of processed feeds - wet feeds, moist feeds, dry feeds, mashes, pelleted feeds - floating and sinking pellets; advantages of pelletization
- 2.3. Water stability feeds, farm made aqua feeds, micro-coated feeds, micro-encapsulated feeds and micro-bound diets
- 2.4. Feed additives: Binders, antioxidants, probiotics, enzymes, pigments, growth promoters, feed stimulants; use of preservatives.

**UNIT-III: Feed formulation, manufacture & storage**

- 3.1. Feed ingredients: selection, nutrient composition and nutrient availability.
- 3.2. Feed formulation and manufacturing – extrusion processing and steam pelleting - grinding, mixing and drying, pelletization, and packing
- 3.3. Microbial, insect and rodent damage of feed, chemical spoilage during storage period

and feed storage methods.

#### **UNIT-IV: Feeding methods**

- 4.1. Feeding devices and methods: Manual feeding, demand feeders, automatic feeders, surface spraying, bag feeding & trayfeeding
- 4.2. Feeding schedules: Frequency of feeding, feeding rates and ration size
- 4.3. Feed evaluation: feed conversion ratio, feed conversion efficiency and protein efficiency ratio.

#### **UNIT-V: Nutritional pathology of fish and shrimp**

- 5.1. Protein (Essential amino acid) and Lipid (Essential fatty acid) deficiency disorders; Fatty liver disease in fishes
- 5.2. Vitamin and mineral deficiency disorders
- 5.3. Anti-nutrients and aflatoxins.

#### **Reference Books:**

1. ADCP (Aquaculture Development & Co-ordination Program). 1980. *Fish Feed Technology*. ADCP/REP/80/11 FAO
2. Cyrino EP, Bureau D & Kapoor BG. 2008. *Feeding and Digestive Functions in Fishes*. Science Publ.
3. D' Abramo LR, Conklin DE & Akiyama DM. 1977. *Crustacean Nutrition: Advances in Aquaculture*. Vol. VI. World Aquaculture Society, Baton Rouge.
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6. Guillame J, Kaushik S, Bergot P & Metallier R. 2001. *Nutrition and Feeding of Fish and Crustaceans*. Springer Praxis Publ.
7. Halver J & Hardy RW. 2002. *Fish Nutrition*. Academic Press.
8. Halver JE & Tiews KT. 1979. *Finfish Nutrition and Fish feed Technology*. Vols. I, II Heenemann, Berlin.
9. Hertrampf JW & Pascual FP. 2000. *Handbook on Ingredients for Aquaculture Feeds*. Kluwer.
10. Houlihan D, Boujard T & Jobling M. 2001. *Food Intake in Fish*. Blackwell.
11. Jobling M. 1994. *Fish Bioenergetics*. Chapman & Hall.
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13. Nelson DL & Cox MM. 2005. *Lehninger Principles of Biochemistry*. WH Freeman.
14. New MB. 1987. *Feed and Feeding of Fish and Shrimp. A Manual on the Preparation and Preservation of Compound Feeds for Shrimp and Fish in Aquaculture*. FAO – ADCP/REP/87/26
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**II B.Sc Aquaculture**  
**SEMESTER – IV**  
**PAPER – IV**  
**FISH NUTRITION & FEED TECHNOLOGY**

**Time :3hours**

**Max.Marks:75**

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**THEORY MODEL PAPER**

**I. Answer any FIVE of the following**

**Draw labeled diagram wherever necessary**

**5x5=25**

1. Lipids
2. Check tray
3. Feed conversion efficiency
4. Bag feeding
5. Extrusion processing
6. Micro-coated feeds
7. Anti-oxidants
8. Aflatoxins

**II. Answer any FIVE of the following**

**Draw labeled diagram wherever necessary**

**5x5=50**

9. a. Explain essential amino acids required for cultivable fish  
(or)  
b. Describe various carbohydrates and micronutrients required for different stages of cultivable fish
  
10. a. Explain various feeds  
(or)  
b. Describe different feeding methods.
  
11. a. Explain nutrient composition and nutrient availability of feed ingredients..  
(or)  
b. Describe feed storage methods
  
12. a. Explain the role of Probiotics in fishes  
(or)  
c. Describe Enzymes and growth promoters
  
13. a. Explain Protein and Vitamin deficiency symptoms.  
(or)  
b. Describe the importance of natural and supplementary feeds.

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**II B.Sc AQUACULTURE PRACTICAL SYLLABUS FOR SEMESTER-IV**  
**PAPER - IV**  
**FISH NUTRITION & FEED TECHNOLOGY**

**Periods: 24**

**Max. Marks: 50**

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**PRACTICALS: (Any 8 as per the local Industry needs and Requirement)**

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 eeds
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 productionunit
12. Visit to a farm for studying feedingpractices

**II B.Sc Aquaculture**  
**SEMESTER –IV**  
**PAPER – IV**  
**FISH NUTRITION & FEED TECHNOLOGY**

**Time : 2hrs**

**Max.Marks:50**

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**PRACTICAL MODEL PAPER**

- |      |  |                 |
|------|--|-----------------|
| I.   | Estimate the Protein content in aquaculture feeds. Write procedure | <b>10marks</b>  |
| II.  | Estimate the Ash content in aquaculture feed. Write procedure      | <b>10marks</b>  |
| III. | Different Feed formulation identification using charts             | <b>05marks</b>  |
| IV.  | Record   | <b>05 marks</b> |
| V.   | Field Notebook   | <b>05 marks</b> |
| VI.  | Internalassessment   | <b>15 marks</b> |

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**AP STATE COUNCIL OF HIGHER EDUCATION**  
**w.e.f. 2020-21 (Revised in April, 2020)**

**II B.Sc Aquaculture**  
**SEMESTER – V**  
**PAPER – V**  
**FISH HEALTH MANGEMENT**

**HOURS : 60 (5X12)**

**Max.Marks: 100**

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**Learning Objectives:**

1. To understand the Principles of disease diagnosis and fish health management.
2. To know the prophylactic and therapeutic methods to control the diseases.
3. To understand the defense mechanism and immune system in fish and shrimp.
4. To gain detailed knowledge on the disease symptoms, causative agent, preventive measures and treatment for microbial, parasitic, nutritional and environmental disorders in fish and shrimp.
5. To understand the diagnosis tools that are followed in field of aquaculture and vaccine production for fish immunization.
6. To know the significance of Quarantine, Biosecurity and SPF seed in the health management of fish and shrimp.

**UNIT- I: Introduction**

- 1.1. Principles of disease diagnosis and fish health management.
- 1.2. Prophylaxis, Hygiene and Therapy of fish diseases.
- 1.3. Defence mechanism in finfish and shellfish – specific and non-specific immune system.
- 1.4. Role of stress and host defence mechanism in disease development - Host, pathogen and environment interaction.

**UNIT- II: Fish Diseases**

Clinical symptoms, pathology, prevention and therapy of

- 2.1. **Viral diseases:** Viral Haemorrhagic septicemia, Infectious Hematopoietic Necrosis (IHN).
- 2.2. **Bacterial diseases:** Epizootic ulcerative syndrome, Infectious abdominal dropsy, Bacterial gill disease, Columnaris disease, Tail and fin rot.
- 2.3. **Fungal diseases:** Saprolegniasis and Branchiomycosis.
- 2.4. **Protozoan diseases:** Ichthyophthiriasis, Myxoboliasis/ Whirling disease, Enterococcidiasis.
- 2.5. **Helminthic and Crustacean parasitic diseases:** Gyrodactylosis and Dactylogyrosis; Argulosis and Lernaeasis.

**UNIT III: Shrimp Diseases**

Clinical symptoms, pathology, prevention and therapy of

- 3-1 **Viral diseases:** White spot syndrome, Monodon Baculovirus, Infectious hypodermal and haematopoietic necrosis virus, Hepato Pancreatic parvo like virus, Yellow head baculovirus, Taura Syndrome.
- 3-2 **Bacterial diseases:** Vibriosis, white gut disease, loose shell syndrome, Acute Hepato-pancreatic Necrosis Disease (Early Mortality Syndrome, EMS)

- 3-3 **Fungal diseases:** Hepatopancreatic microsporidiosis (HPM) by *Enterocytozoon hepatopenaei* (EHP), *Lagenidium* and *Fusarium* disease.
- 3-4 **Protozoan diseases:** ectocommensal protozoa – *Zoothamnium* and *Acineta*.

#### **UNIT- IV: Nutritional and Environmental disorders**

Clinical symptoms, pathology, prevention and therapy of

- 4.1 **Fish:** Protein (Essential amino acid) and Lipid (Essential fatty acid) deficiency disorders; Vitamin and mineral deficiency disorders; Fatty liver disease; Gas bubble disease, Asphyxiation.
- 4.2. **Shrimp:** Soft shell syndrome, Blue disease/Pigment deficiency syndrome, Red disease, Cramp tail syndrome, Black gill disease, Muscle necrosis, Black death disease.
- 4.3. Role of gut probiotics in health management of fish and shrimp.
- 4.4. Bioremediation of soil and water as a strategy for health management in ponds.

#### **UNIT - V: Fish Health Management**

- 5.1. Diagnostic tools – immune detection- DNA/RNA technique – molecular diagnosis of viral diseases.
- 5.2. Principles and methods of vaccine production and fish immunization.
- 5.3. Quarantine and health certification in aquaculture.
- 5.4. Significance of Biosecurity and Specific pathogen free seed (SPF) in health management.

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#### **Reference 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. Shankar KM & Mohan CV. 2002. Fish and Shellfish Health Management. UNESCO Publ. Sindermann CJ. 1990
4. Walker P & Subasinghe RP. (Eds.). 2005 Principal Diseases of Marine Fish and Shellfish. Vols. I, II. 2nd Ed. Academic Press
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6. Bullock G et al., 1972 Bacterial diseases of fishes. TFH publications, New Jersey
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9. Conroy CA and Herman RL. 1968. *Text book of Fish Diseases*. TFH (Great Britain) Ltd, England.
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**II B.Sc Aquaculture**  
**SEMESTER – IV**  
**PAPER – V**  
**FISH HEALTH MANAGEMENT**

**Time :3hrs**

**Max.Marks:75**

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**THEORY MODEL PAPER**

**I. Answer any FIVE of the following**

**Draw labeled diagram wherever necessary**

**5x5=25**

1. Necrosis
2. Inflammation
3. *Aeromonas* in fish
4. *Fusarium* in shrimp
5. Essential aminoacids
6. Yellow head baculovirus in shrimp
7. Aflatoxin
8. Quarantine in aquaculture

**II. Answer any FIVE of the following**

**Draw labeled diagram wherever necessary**

**5x10=50**

9. a. Explain the defense mechanisms in fish  
(or)  
b. Write about fish health management practices.
10. a. Explain two fungal diseases in finfish with preventive and therapeutic measures.  
(or)  
b. Explain viral diseases that effect the fish culture.
11. a. Explain any three viral diseases in shellfish.  
(or)  
b. Explain preventive and therapeutic measures of protozoan diseases in shellfish.
12. a. Describe vitamin deficiency diseases in fish.  
(or)  
b. Explain Black gill disease, Muscle necrosis in shrimp.
13. a. Describe immune detection techniques used in shellfish  
(or)  
b. Write an account on Probiotics in health management of shellfish.

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**II B.Sc AQUACULTURE PRACTICAL SYLLABUS FOR SEMESTER-IV**  
**PAPER - V**  
**FISH HEALTH MANGEMENT**

**Periods: 24**

**Max. Marks: 50**

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**PRACTICALS: (Any 8 as per the local Industry needs and Requirement)**

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. Perform autopsy and Examine the pathological changes in gills and gut lumen, lymphoid organ, muscles and nerves of fish
5. Examination of pathological changes in gut lumen, hepatopancreas, lymphoid organ, muscles and nerves of prawn and shrimp
6. Collection, processing and analysis of data for epidemiological investigations of viral diseases
7. Bacterial pathogens – isolation, culture and characterization
8. Identification of parasites in fishes: Protozoan, Helminths, Crustaceans
9. Antibigrams – 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 shellfish
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

**II B.Sc Aquaculture**  
**SEMESTER –V**  
**PAPER – V**  
**FISH HEALTH MANAGEMENT**

**Time : 2hrs**

**Max.Marks:50**

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**PRACTICAL MODEL PAPER**

- |   |                 |
|---|-----------------|
| I. Enumeration of Bacteria by TPCMethod , write procedure | <b>10 marks</b> |
| II. Identification of pathological diseases(5x2)          | <b>10marks</b>  |
| III. Identification of parasites (any 2)                  | <b>05 marks</b> |
| IV. Record  | <b>05 marks</b> |
| V. Field Notebook   | <b>05 marks</b> |
| VI. Internalassessment                                    | <b>15 marks</b> |
| VII.  |                 |