

**P.R. GOVERNMENT COLLEGE (A), KAKINADA**  
**DEPARTMENT OF ZOOLOGY**  
**Bachelor of Vocational Course (Commercial Aquaculture)**  
**SYLLABUS AND NAME OF THE PAPERS**  
**NSDC, NSQF & ASCI - LEVELS OF ASSESSMENT (4, 5.6 & 7)**

S.No	CORE SUBJECTS		NON-CORE SUBJECTS	Credits	Credits total	NSQF & NSDC Levels of Assessment (UGC)
1.	<b>I Year</b>	<b>First Semester</b>				
	Core I	Biology of fishes	Zoology			4 (Certificate)
	Core II	Principles and Aquatic Ecology	Chemistry			
	Core III	Fresh water Aquaculture	General English			
			Introduction to computer			
		<b>Second Semester</b>				
	Core IV	Brackishwater Aquaculture & Mariculture	Zoology			5 (Diploma)
	Core V	Hatchery Management and Aquatic organisms	Chemistry			
	Core VI	Fishing Methods	General English			
			Introduction to computer			

**P.R. Govt. College (A), Kakinada**  
**DEPARTMENT OF ZOOLOGY**  
**Bachelor of Vocational Course (Commercial Aquaculture)**  
**Semester-I**  
**Core-I TITLE: BIOLOGY OF FISHES**  
**Credits 4**  
**Syllabus**

OBJECTIVES:	LEARNING OUTCOMES
<ul style="list-style-type: none"> <li>➤ To introduce the learner to general morphology and taxonomy of fin &amp; Shell fishes.</li> <li>➤ To study the Biological, Morphological and physiological characteristics of fin &amp; shell fishes</li> <li>➤ To provide the knowledge on the taxonomic characteristics of the fin &amp; Shell fishes</li> </ul>	<ul style="list-style-type: none"> <li>➤ By the end of the course the student will be equipped with the knowledge of taxonomy, morphology &amp; physiology of fin &amp; Shell fishes.</li> <li>➤ Knowledge on the basic taxonomic tools for the identification of fin &amp; shell fishes will be learnt by the student.</li> </ul>

**Module 1: General Characteristics and Taxonomy of Fishes**

**Hrs.14**

- 1.1. General characters and Classification of fishes.
- 1.2. Sense organs in fishes (Neuromast organs) – lateral line system. Ampullae of Lorenzini.
- 1.3. Specialized organs in fishes – electric organs, Sound producing organs, Poison glands in fishes and Bioluminescence in fishes.
- 1.4. Air Bladder and Weberian Apparatus-Location of air bladder, Functions of air bladder, Location and Functions of weberian apparatus.

**Module 2: Food and Feeding - Growth**

**Hrs.14**

- 2.1. Food and feeding habits – structural adaptations, classification based on food and feeding habits.
- 2.2. Types of fishes on the basis of the manner of capture and ingestion, Gastrosomatic index.
- 2.3. Scales in fishes-Placoid, Ganoid, Cycloid and Ctenoid

**Module 3: Digestion, Respiration and Circulation**

**Hrs.14**

- 3.1. Digestive system – General morphological feature of digestive system in fishes, Digestive system and process of digestion.
- 3.2. Respiratory system – Types of gills, Structure of gill, mechanism of gill respiration.
- 3.3. Cardiovascular system – General features of heart and physiology of circulation, Significance of circulation.

**Module 4: Reproduction, Excretion, Migration & Endocrine glands in fishes**

**Hrs.14**

- 4.1. Reproduction – ovary and testes, structure, development of primary and secondary sexual & Sexual dimorphism in fishes. Hormonal regulation of fish reproduction.
- 4.2. Excretion and osmoregulation-freshwater and marine fishes.
- 4.4. Parental care in fishes, Migration in fishes –anadromous and catadromous.
- 4.5. Endocrine organs in fishes-Pituitary gland, thyroid gland, adrenal gland, Urohypophysis, pancreatic islets and pineal organs.

## **Internal Evaluation**

- Assignments
- Seminars
- Quiz
- Field Trips

## **Suggested reading**

### **Core reading**

1. Moyle,P.B. and Cech,J.J. Fishes – An Introduction to Ichthyology Norman,J.R. A History of Fishes.
2. Bagenal. Methods of Fish Production in Freshwaters Nicholski, G.V. Ecology of Fishes.
3. Lagler. Ichthyology.
4. Matty. Fish Physiology.
5. Francis Day. Fishes of India.
6. Munro,I.S.R. The Marine and Freshwater Fishes of Ceylon.
7. CMFRI. The Commercial Molluscs of India.

### **Supplementary Reading**

1. Purchon,R.D. The Biology of Mollusca.
2. Dorothy E Bliss. The Biology of Crustacea.
3. Nelson,J.S. Fishes of the World Berg,L.S. Classification of Fish Both Recent and Fossil.

### **Advanced Reading**

1. Wootton, R.J. Fish Ecology.
2. FAO Identification Sheets for Fishery Purposes.

### **Other Reference Books:**

1. Marshall & Williams. Textbook of Zoology. Vol.I.
2. Parker and Hasswell. Textbook of zoology, Vertebrates. Vol.II.
3. Barnes. General Zoology
4. Day, F. The fishes of India.
5. S.S. Khanna. An introduction to fishes.
6. K.G. Lagler. Ichthyology.
7. Rath,A.K. Freshwater Aquaculture,
8. Santhanam, et.al. a Manual of Freshwater Aquaculture
9. Pillay,T.V.R. Aquaculture – Principles and Practices
10. Jhingran,V.G. Fish and Fisheries of India
11. Jhingran,V.G and Sehgal,K.L. Coldwater Fisheries of India.
12. Bardach, Rhyther and McLarney. Aquaculture
13. Huet, M. Textbook of Aquaculture.
14. Rogen, Pallin and Shehadeh. Integrated Agriculture and Aquafarming Farming system.
15. Boyd,C.E. Qater Quality in Warmwater Fish Ponds
16. Moyle,P.B. and Cech,J.J. Fishes – An Introduction to Ichthyology

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**I B.Voc., (COMMERCIAL AQUACULTURE), SEMESTER-I,**  
**CORE-I TITLE: BIOLOGY OF FISHES**

**BLUE PRINT FOR QUESTION PAPER SETTER**

<b>MODULE NO.</b>	<b>ESSAY QUESTIONS  10 MARKS</b>	<b>SHORT ANSWER QUESTIONS  5 MARKS</b>	<b>VERY SHORT ANSWER QUESTIONS  2 MARKS</b>	<b>MARKS ALLOTTED TO THE UNIT</b>
<b>MODULE – I</b>	02	01	02	29
<b>MODULE – II</b>	01	01	02	19
<b>MODULE – III</b>	01	02	02	24
<b>MODULE – IV</b>	01	02	02	24
<b>Total no.of Questions</b>	<b>05</b>	<b>06</b>	<b>08</b>	
<b>Total Marks including choice</b>				<b>96</b>

**NOTE:** The question paper setters are requested to kindly adhere to the format given in the above table.

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**CHOICE BASED CREDIT SYSTEM**  
**IB.Voc., COMMERCIAL AQUACULTRE SEMESTER-I, 2019-20**  
**MODEL QUESTION PAPER**

**Time: 3 hrs.**

**TITLE: BIOLOGY OF FISHES, CORE-I**

**Marks: 60**

**PART – 1**

**Note: Answer any THREE questions**

**10 x 3 = 30**

1. Write an essay on General characters of Fishes.
2. Describe various sense organs in Fishes.
3. Give an account on food and feeding habits of fish.
4. Explain the General morphological features of Digestive system and process of digestion.
5. Describe the process of Respiration and Respiratory gases exchange in Fish.

**Part – II**

Answer any **FOUR** Questions

**4x5=20**

6. Types of scales in Fish
7. Types of Fish based on food
8. Bioluminescence in Fishes
9. Electric organs
10. Migration in Fishes
11. Maturation and Spawning in Fish

**Part – III**

Answer any **FIVE** Questions

**5x2=10**

12. Buoyancy
13. Ampullae of Lorenzini
14. Biological clocks
15. Pseudobranch
16. Plankton feeders
17. Column feeders
18. Chromatophores
19. Adrenal gland

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**P.R. Govt. College (A), Kakinada**  
**Bachelor of Vocational course (Commercial Aquaculture)**  
**Semester-I,**  
**Core-II:TITLE: PRINCIPLES AND METHODS IN AQUACULTURE**  
**Syllabus**  
**Credits 3**

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OBJECTIVES	LEARNING OUTCOMES
<ul style="list-style-type: none"> <li>➤ To study the aquatic environment their components.</li> <li>➤ To study the pond ecosystem</li> <li>➤ To study the cultivable fresh water fishes</li> </ul>	<ul style="list-style-type: none"> <li>➤ By the end of the course the student will be equipped with the aquatic ecosystem</li> <li>➤ Knowledge on the pond ecosystem will be learnt by the student.</li> <li>➤ Knowledge on the cultivable fishes will be learnt by the student.</li> </ul>

**Module 1 Introduction**

**Hrs.14**

1. History, definition, scope and significance of aquaculture, Blue Revolution, concepts of Blue Revolution.
- 1.1. Different aquaculture systems, classification of Aquaculture.
- 1.2. Based on organisms and based on levels of management intensity of culture systems

**Module 2: Pond Ecology**

**Hrs.14**

- 2.1. General concepts of ecology-Ecological factors, productivity of culture pond, carrying capacity, food chain and food web.
- 2.2. Nutrient cycles (Biogeochemical cycles) – Nitrogen, Phosphorous and Carbon.
- 2.4. Significance and important groups of phytoplankton, zooplankton and benthos in culture ponds.
- 2.5. Management of water and soil quality parameters.

**Module 3: Types of ponds & Cultivable Freshwater fishes**

**Hrs.14**

- 3.1. Type of ponds – nursery, rearing and stocking.
- 3.2. Design and construction of fish farms
- 3.3. Criteria for the selection of species.
- 3.4. Cultivable freshwater fishes- carps, airbreathing fishes, tilapia, freshwater prawn.

**Module 4: Brackishwater culture and mariculture**

**Hrs.14**

- 4.1. Brackishwater resources and fishes of commercial importance – Milk fish, mullet, seabass, shrimps, crabs.
- 4.2. Major brackish water culture systems in India.
- 4.3. Different organisms in Mariculture –Edible oyster, pearl oyster and sea weeds.

## **Internal Evaluation**

- Assignments
- Seminars
- Quiz
- Field Trips

## **Suggested reading**

### **Core reading**

1. Rath,A.K. Freshwater Aquaculture,
2. Santhanam, et.al. a Manual of Freshwater Aquaculture
3. Pillay,T.V.R. Aquaculture – Principles and Practices
4. Jhingran,V.G. Fish and Fisheries of India
5. Jhingran,V.G and Sehgal,K.L. Coldwater Fisheries of India.
6. Bardach, Rhyther and McLarney. Aquaculture
7. Huet, M. Textbook of Aquaculture.
8. Rogen, Pallin and Shehadeh. Integrated Agriculture and Aquafarming Farming system.
9. Boyd,C.E. Qater Quality in Warmwater Fish Ponds
10. Moyle,P.B. and Cech,J.J. Fishes – An Introduction to Ichthyology

### **Supplementary Reading**

1. Shepherd,J and Bromage, N. Intensive Fish Farming
2. Pillay,T.V.R. Advances in Aquaculture
3. Beveridge. Cage Culture

### **Advanced Reading**

Stickney,R.R. Principles of Warmwater Aquaculture

### **Web resources**

FAO <http://www.fao.org/fishery/topic/4340/en>

NACA <http://www.enaca.org/>

VUAT <http://www.vuatkerala.org/static/eng/advisory/fisheries/index.htm>

Aquaculture/Pond Dynamics <http://pdacrsp.oregonstate.edu/pubs/>

Wikipedia <http://en.wikipedia.org/wiki/Aquaculture>

Fish farming <http://www.fishfarming.com/>

ICAR <http://www.icar.org.in/indiafishvoice/intro.html>

CIFA <http://www.cifa.in/tech.htm>

Aquaculture articles: <http://aquafind.com/articles/aquaculture.php>

Aquaculture Artices <http://www.aquarticles.com/>

### **Other Reference Books:**

1. Friedrich, H.: Marine Biology
2. Raymont, J.E.C.: Plankton and productivity in the Oceans, Volume 1.
3. Balakrishna Nair. N. and D.M. Thampy: A text book of Marine ecology
4. Broecker, W.S.: Chemical Oceanography
5. Sverdrup, H.V., M.W., Johnson and R.H. Fleming.: The Oceans - Their physics, chemistry and general biology. Prentice-Hall Inc. 1942.

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**I B.Voc., (COMMERCIAL AQUACULTURE), SEMESTER-I,**  
**CORE-II, : PRINCIPLES AND METHODS IN AQUACULTURE**

**BLUE PRINT FOR QUESTION PAPER SETTER**

<b>MODULE NO.</b>	<b>ESSAY QUESTIONS 10 MARKS</b>	<b>SHORT ANSWER QUESTIONS 5 MARKS</b>	<b>VERY SHORT ANSWER QUESTIONS 2 MARKS</b>	<b>MARKS ALLOTTED TO THE UNIT</b>
<b>MODULE – I</b>	02	01	02	29
<b>MODULE – II</b>	01	01	02	19
<b>MODULE – III</b>	01	02	02	24
<b>MODULE – IV</b>	01	02	02	24
<b>Total no.of Questions</b>	<b>05</b>	<b>06</b>	<b>08</b>	
<b>Total Marks including choice</b>				<b>96</b>

**NOTE:** The question paper setters are requested to kindly adhere to the format given in the above table.



**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**CHOICE BASED CREDIT SYSTEM**  
**IB.Voc., COMMERCIAL AQUACULTRE SEMESTER-I, 2019-20**  
**MODEL QUESTION PAPER**

**TITLE: CORE-II : PRINCIPAL AND METHODS IN AQUACULTURE,**

**Time: 3 hrs.**

**Marks: 60**

**PART – 1**

**Note: Answer any THREE questions**

**10 x 3 = 30**

1. Write an essay on concepts of Blue revolution.
2. Describe the culture systems used for Aquaculture practices
3. Describe various concepts of Pond Ecology.
4. Give an account of the criteria for the selection of a species for culture.
5. Write an essay any four commercially important Brackish water Fishes.

**Part – II**

Answer any **FOUR** Questions

**4x5=20**

6. Integrated Fish Farm
7. Carrying capacity
8. Nursery Ponds
9. Biology of Common Carp
10. Shell Fishery in India
11. Air Breathing fishes

**Part – III**

Answer any **FIVE** Questions

**5x2=10**

12. Cage Culture
13. Polyculture
14. Primary Productivity
15. Food Web
16. Brood Stocks
17. Tilapia
18. *Penaeus monodon*
19. Sea weeds

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**P.R. Govt. College (A), Kakinada**  
**Bachelor of Vocational course (Commercial Aquaculture)**  
**Semester-I, Core-III Freshwater Aquaculture**  
**Syllabus**  
**Credits 4**

OBJECTIVES	LEARNING OUT COME
<ul style="list-style-type: none"> <li>➤ To give an introduction to Fresh water aquaculture practices.</li> <li>➤ To develop the basic knowledge of Fin fish and shellfish culture systems.</li> </ul>	<ul style="list-style-type: none"> <li>➤ At the end of the course student can able to gain the knowledge on the fresh water aquaculture practices.</li> <li>➤ Knowledge on the culture systems be learnt by the student.</li> </ul>

**Module 1: Freshwater Fish Culture**

**Hrs.14**

- 1.1 Various freshwater organisms used for aquaculture in India.
- 1.2 Management of carp culture ponds- Nursery rearing and stocking ponds –Preparation of ponds– different methods for the eradication of weed fishes, predators, aquatic insects and aquatic weeds, stocking and post stocking management, harvesting.
- 1.3 Culture of air breathing fishes- Channa, Heteropneustes, Clarius, Anabas.

**Module 2: Culture of Prawns and Molluscs**

**Hrs.14**

- 2.1 Cultivable species of freshwater prawns and their biology
- 2.2 Essentials of prawn hatchery; Management techniques of nursery and Grow-out ponds.
- 2.3 Freshwater pearl culture – Present status of freshwater pearl culture and production in India.

**Module 3 Reservoir fisheries & Integrated Farming**

**Hrs.14**

- 3.1. Major reservoirs in India, measures for increasing production from reservoirs in India
- 3.2. Recent development in integrated farming – Rice cum fish culture, Duck cum fish culture, Poultry cum fish culture and Pig cum fish culture.
- 3.3. Organic aqua farming.
- 3.4. Fish culture in cages and pens.

**Module 4: Aquaculture for stable environment**

**Hrs.14**

- 4.1. Sewage fed fish culture, sewage treatment,– Sewage cum fish culture in India.
- 4.2. Larvivorous fishes in relation to public health-Essential characters of larvivorous Fish; Larvicidal Fishes in India; Classification Fishes based on mosquitocidal activity.

## **Internal Evaluation**

- Assignments
- Seminars
- Quiz
- Field Trips

## **Suggested reading**

### **Core reading**

1. Jhingran, V.G. Fish and fisheries of India. Hindustan Publ. Corporation (India), 1982.
2. Santhanam, R. et. Al. A Manual of Freshwater Aquaculture. Oxford & IBH Publishing Co. Pvt. Ltd., 1987.
3. Pilley, T.V.R. Aquaculture – Principles and Practices. Fishing News (Books) Ltd., London, 1990.
4. Pandey, A.C. Air Breathing Fishes. Reliance Publishing House, New Delhi, 1990.

### **Supplementary Reading**

1. Welch, P.S. Limnology. McGrawHill, NY, 1952.
2. Hutchinson, G.E. A Treatise on Limnology, Vols. I & II. John Wiley & Sons, 1957.
3. Ruttner, F. Fundamentals of Limnology. Translated by D.G. Frey and F.E.Fry. University of Toronto Press, 1968.
4. Wetzel, R.G. Limnology. W.B. Saunders Co., 1975.
5. Reid, G.K. & R.D. wood. Ecology of inland waters and Estuaries. Van Nostrand Company, 1976.

### **Other Reference Books:**

1. Cole, C.A. Textbook of Limnology. The C.V. Mosby Co., 1983.
2. Bardach, et. Al. Aquaculture – The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, NY, 1972.
3. Stickney, R.R. Principles of Water Aquaculture. John Wiley & Sons, NY, 1979.
4. Chondar, C.L. Hypophysation of Indian major carps. Satish Book Enterprise, Agra, 1980.
5. Janardhana Rao, K. & S.D. Tripathi. A Manual of Giant Freshwater Prawn Hatchery. CIFA, Kausalyaganga, Orissa, India, 1993.
6. Iso Matsui. Theory and Practice of Eel Culture. American Publishing Co. Pvt. Ltd., 1980.

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**I B.Voc., (COMMERCIA AQUACULTURE), SEMESTER-I,**  
**CORE-III Freshwater Aquaculture**

**BLUE PRINT FOR QUESTION PAPER SETTER**

<b>MODULE NO.</b>	<b>ESSAY QUESTIONS 10 MARKS</b>	<b>SHORT ANSWER QUESTIONS 5 MARKS</b>	<b>VERY SHORT ANSWER QUESTIONS 2 MARKS</b>	<b>MARKS ALLOTTED TO THE UNIT</b>
<b>MODULE – I</b>	02	01	02	29
<b>MODULE – II</b>	01	01	02	19
<b>MODULE – III</b>	01	02	02	24
<b>MODULE – IV</b>	01	02	02	24
<b>Total no.of Questions</b>	<b>05</b>	<b>06</b>	<b>08</b>	
<b>Total Marks including choice</b>				<b>96</b>

**NOTE:** The question paper setters are requested to kindly adhere to the format given in the above table.

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**CHOICE BASED CREDIT SYSTEM**  
**IB.Voc., COMMERCIAL AQUACULTRE SEMESTER-I, 2019-20**  
**MODEL QUESTION PAPER**

**Time: 3 hrs.**

**TITLE: FRESH WATER AQUACULTURE, CORE-III**

**Marks: 70**

**PART – 1**

**Note: Answer any THREE questions**

**10 x 3 = 30**

1. Give an account of methods for eradication of weed fishes, predators, aquatic weeds.
2. Write an essay on Biology of Common Carp and breeding techniques in India.
3. Write about the essentials for the establishment of Prawn Hatchery.
4. What is Sewage, describe its water quality and different methods of treatment of Sewage.
5. Write an essay on major Reservoirs of Fishery resources in India.

**Part – II**

Answer any **FOUR** Questions

**4x5=20**

6. Morphology of *Channa* species
7. Fresh water pearl culture
8. Rice cum fish culture
9. Pen culture
10. Larvivorous Fishes
11. Organic aqua farming

**Part – III**

Answer any **FIVE** Questions

**5x2=10**

12. Major carps
13. BOD
14. Algal Blooms
15. Pearl culture
16. Zooplankton
17. Pen culture
18. Cat Fishes
19. Raft culture

**P.R. Govt. College (A), Kakinada**  
**Bachelor of Vocational course (Commercial Aquaculture)**  
**Semester-II, Core-IV Brackishwater Aquaculture and Mari culture**  
**Syllabus**  
**Credits 4**

OBJECTIVES:	LEARNING OUT COME
<ul style="list-style-type: none"> <li>➤ To provide basic biology of the species used for brackish water aquaculture and mariculture.</li> <li>➤ To give an introduction to brackish water aquaculture practices.</li> <li>➤ To provide a basic idea about various Mari culture practices.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Knowledge on the biology and biological cycle of the brackish water &amp; marine cultivable species will be learnt.</li> <li>➤ .Knowledge on the brackish water culture practices will be learnt by the student.</li> <li>➤ Knowledge on the Mari culture will be learnt by the student.</li> </ul>

**Module 1: Introduction**

**Hrs. 14**

- 1.1. Introduction, history, development and present status of brackishwater farming in India.
- 1.2. Brackishwater as a medium for aquaculture, ecological factors – abiotic and biotic factors.
- 1.3. Selection of site, general planning and design of brackish water farms.

**Module 2: Brackishwater Finfish Culture**

**Hrs. 14**

- 2.1. Selection of cultivable species in brackish water systems, their biology and culture practices – monoculture and polyculture of – *Chanos chanos*, *Mugil cephalus*, *Lates calcarifer*.
- 2.2. Nursery, rearing and grow out in ponds, cages and pens.

**Module 3: Crustacean Culture**

**Hrs. 14**

- 3.1. Species of shrimps cultured in brackishwater and their biology – *Penaeus monodon*, *Penaeus indicus*, *Litopenaeus vannamei*.
- 3.2. Extensive, semi-intensive and intensive shrimp farming practices.
- 3.3. Crab culture (*Scylla serrata*, *Scylla oceanica* and *Charybdis* sp.): Pond design, management of crab farm, fattening process of crab, economics-cage culture and pen culture

**Module 4: Mariculture**

**Hrs. 14**

- 4.1. Ecological subdivisions of the sea. Selection of site and selection of materials for sea farming.
- 4.2. Different designs of open sea farming structures – construction of cages – bioengineering problems and solutions – scope of open sea farming in India.
- 4.3. Present status and recent developments in mariculture.

## **Internal Evaluation**

- Assignments
- Seminars
- Quiz
- Field Trips

## **Suggested reading**

### **Core reading**

1. Pillay T.V.R - Aquaculture – Principles and practices
2. Chen, L.C. – Aquaculture in Taiwan
3. Milne P H. – Fish and Shell fish farming in coastal waters
4. Iverson E.S. – Farming the edge of the sea
5. Bandach, Rhyster V McLarney – Aquaculture
6. Jhingwa V.A – Fish and Fisheries of India
7. Kurian,C.V and Sebastian V.O. – Prawn and Prawn fisheries of India

### **Supplementary Reading**

1. Pillay TVR – Advances in Aquaculture
2. Pillay TVR – Coastal Aquaculture in the Indo-Pacific

### **Advanced Reading**

1. Heut M. – Text book of fish culture
2. Sheperd and Bromage N. – Intensive Fish Farming

### **Other references:**

1. Welch, P.S. Limnology. McGrawHill, NY, 1952.
2. Hutchinson, G.E. A Treatise on Limnology, Vols. I & II. John Wiley & Sons, 1957.
3. Ruttner, F. Fundamentals of Limnology. Translated by D.G. Frey and F.E.Fry. University of Toronto Press, 1968.
4. Wetzel, R.G. Limnology. W.B. Saunders Co., 1975.
5. Reid, G.K. & R.D. wood. Ecology of inland waters and Estuaries. Van Nostrand Company, 1976.
5. Cole, C.A. Textbook of Limnology. The C.V. Mosby Co., 1983.
6. Friedrich, H.: Marine Biology
7. Raymont, J.E.C.: Plankton and productivity in the Oceans, Volume 1.
8. Balakrishna Nair. N. and D.M. Thampy: A text book of Marine ecology
9. Broecker, W.S.: Chemical Oceanography
10. Sverdrup, H.V., M.W., Johnson and R.H. Fleming.: The Oceans – Their physics, chemistry and general biology. Prentice-Hall Inc. 1942.

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**I B.Voc., (COMMERCIAL AQUACULTURE), SEMESTER-II,**  
**CORE-IV Brackishwater Aquaculture and Mari culture**

**BLUE PRINT FOR QUESTION PAPER SETTER**

	<b>ESSAY QUESTIONS</b>	<b>SHORT ANSWER QUESTIONS</b>	<b>VERY SHORT ANSWER QUESTIONS</b>
<b>MODULE-I</b>	01	02	03
<b>MODULE-II</b>	02	01	03
<b>MODULE-III</b>	02	02	03
<b>MODULE-IV</b>	01	02	03

**NOTE:** The question paper setters are requested to kindly adhere to the format given in the above table.



**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**CHOICE BASED CREDIT SYSTEM**  
**I B.Voc., COMMERCIAL AQUACULTRE SEMESTER-II, 2019-20**  
**MODEL QUESTION PAPER**

**TITLE: CORE-IV : BRACKISH WATER AQUACULTUE AND MARICULTURE,**  
**Time: 3 hrs. Marks: 70**

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**PART – 1**

**Note: Answer any THREE questions choosing at least one question from each section**

**SECTION- A**

**3 x 10 = 30**

1. Describe the general planning and design of brackishwater farms.
2. Explain the Biology and culture systems of *Lates calcarifer*.
3. Write an essay on shrimp farming culture practices.

**SECTION- B**

4. Explain the pond design, management of crab farm and culture practices.
5. Explain the ecological subdivisions of the sea.
6. Write an essay on recent developments in mariculture.

**Part – II**

Answer any **FOUR** Questions

**4x5=20**

7. Brackishwater farming
8. Ecological factors
9. *Mugil cephalus*
10. Biology of *Litopenaeus vannamei*
11. Semi-intensive culture
12. Crab fattening
13. Open sea farming

**Part – III**

Answer any **TEN** Questions

**10x2=20**

14. Backishwater
15. Abiotic
16. Primary poducers
17. Cage culture
18. Grow-out pond
19. *Mullet*
20. Nauplius
21. Zoea larvae
22. *Chanos chanos*
23. Benthic zone
24. Mariculture
25. Profundal zone

**P.R. Govt. College (A), Kakinada**  
**Bachelor of Vocational course (Commercial Aquaculture)**  
**Semester-II,**  
**Core-V Hatchery Technology in Aquatic organisms**  
**Syllabus**  
**Hours 4      Credits 4**

OBJECTIVES:	LEARNING OUT COME
<ul style="list-style-type: none"> <li>➤ To understand the current methodology and various techniques of commercial seed production.</li> <li>➤ To develop basic knowledge on the spawning, larval rearing and feeding of the commercially important species.</li> <li>➤ Hatchery management strategies..</li> </ul>	<ul style="list-style-type: none"> <li>➤ Knowledge on the biology and biological cycle of the brackish water &amp; marine cultivable species will be learnt.</li> <li>➤ .Knowledge on the brackish water culture practices will be learnt by the student.</li> <li>➤ Knowledge on the Mari culture will be learnt by the student.</li> </ul>

**Module 1: Carp Hatchery**

**Hrs. 14**

- 1.1. Hatchery management-seed production of carps.
- 1.2. Hypophysation of Indian major carps and exotic carps, history of hypophysation. Pituitary gland. Collection and preservation of gland. Other ovulating agents.
- 1.3. Brood stock management, sexing, dosage for injection, mechanism of ovulation.

**Module 2: Carp Production System and Seed production of other Fishes Hrs. 14**

- 2.1. Transport of fish seed and brood fishes. Causes of mortality during transport, techniques of transport, open and closed systems, methods of transportation, use of anaesthetics.
- 2.2. Carp seed resources in major rivers India.
- 2.3. Bundh breeding, types of bundh breeding techniques. Problems of bundh breeding.

**Module 3: Seed Production of Crustaceans and Molluscs**

**Hrs. 14**

- 3.1. Seed production and nursery rearing of *Penaeus indicus*, *Penaeus monodon* and *Macrobrachium rosenbergii*.
- 3.2. Hatchery operations of pearl oysters, clams, crabs, lobster.

**Module 4: Shrimp Hatchery Establishment and Management**

**Hrs. 14**

- 4.1. Site selection; Operation and management of maturation section.
- 4.2. Operation and management of larval section; Operation and management of post larval section.
- 4.3. Live feed culture system, Hatchery seawater treatment.

## **Internal Evaluation**

- Assignments
- Seminars
- Quiz
- Field Trips

## **Suggested Reading**

### **Core reading**

1. Chodar SL Hypophysation in Indian Major Carps
2. CMFRI Spl. Bul. Hatchery Operation of Penaeid Shrimps
3. Venkataraman GS The Cultivation of Algae
4. MPEDA Sea Fishes
5. CMFRI sp Bul Artificial Reefs and Sea Farming Techniques

### **Supplementary Reading**

1. Jhingran VG Fish and Fisheries of India
2. Raymond EG Plankton and Productivity of Oceans
3. Boney AD Phytoplankton

### **Advanced Reading**

1. Pillay, TVR and Kutty MN, Principles and Practices of Aquaculture
2. Harvey BJ and Hoar WS, Principle and Practice of Induced Fish Breeding
3. Woyanarovich E and Horrath L., The Artificial Propagation of Warm, Water Fishes- Manual for Extension.

### **Other Reference Books:**

1. Pillay, T.V.R. & M.A. Dill. Advances in Aquaculture. Fishing News (Books) Ltd., England, 1979.
2. Stickney, R.R. Principles of Warm water Aquaculture. John Wiley & Sons Inc.,1979.
3. Hopher, B. & Y. Prugim. Commercial Fish Farming. John Wiley & Sons Inc.,1981.
4. Boyd, C.E. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Company, 1982.
5. Jhingran, V.G. Fish and Fisheries of India. Hindustan Publishing Corporation India, 1982
6. Turcker, C.S. (ed.). Channel Catfish Culture. Elsevier, 1985.
7. Bose, A.N. et. Al. Coastal Aquaculture Engineering. Oxford & IBH Publishing Company Pvt. Ltd., 1991.

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**I B.Voc., (COMMERCIAL AQUACULTURE), SEMESTER-II,**  
**CORE-V HATCHERY TECHNOLOGY IN AQUATIC ORGNISMS,**  
**BLUE PRINT FOR QUESTION PAPER SETTER**

	<b>ESSAY QUESTIONS</b>	<b>SHORT ANSWER QUESTIONS</b>	<b>VERY SHORT ANSWER QUESTIONS</b>
<b>MODULE-I</b>	02	01	03
<b>MODULE-II</b>	01	02	03
<b>MODULE-III</b>	01	02	03
<b>MODULE-IV</b>	02	02	03

**NOTE:** The question paper setters are requested to kindly adhere to the format given in the above table.

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**CHOICE BASED CREDIT SYSTEM**  
**I.B.Voc., COMMERCIAL AQUACULTRE SEMESTER-II, 2019-20**  
**MODEL QUESTION PAPER**

**TITLE: HATCHERY TECHNOLOGY IN AQUATIC ORGNISMS, CORE-V**

**Time: 3 hrs.**

**Marks: 70**

**PART – 1**

**Note: Answer any THREE questions choosing at least one question from each section**

**3 x 10 = 30**

**SECTION- A**

1. Give an account of Hypophysation technique in Indian major carps.
2. Explain the brood stock management in Indian major carps.
3. What is the Bundh breeding? Explain the types of bundh breeding and their problems.

**SECTION- B**

4. Give an account on shrimp seed production.
5. Describe the shrimp hatchery management.
6. Explain the quarantine and disease management in hatcheries.

**Part – II**

Answer any **FOUR** Questions

**4x5=20**

7. Seed production of carps
8. Closed carp seed transportation
9. Techniques of transportation of seed
10. Transport of breeders
11. Seed production of molluscs
12. Quarantine management
13. Mechanical filters

**Part – III**

Answer any **TEN** Questions

**10x2=20**

14. Synthetic hormones
15. Exotic carp
16. Pituitary gland
17. Mortality
18. Anaesthetics
19. Breeding grounds
20. Live feed
21. Pearls oysters
22. Clams
23. Berried female
24. Quarantine
25. Biological filters

**P.R. Govt. College (A), Kakinada**  
**Bachelor of Vocational course (Commercial Aquaculture)**  
**Semester-II, Core-VI Fishing Methods**  
**Syllabus**  
**Hours 4 Credits 4**

<b>OBJECTIVES:</b>	<b>LEARNING OUT COME</b>
<ul style="list-style-type: none"> <li>➤ To develop basic knowledge about various crafts</li> <li>➤ To understand operation of various fishing gears</li> <li>➤ To create awareness about fish finding devices.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Student will learn the knowledge on the crafts.</li> <li>➤ Mechanism involved in the operation of the fishing gear will be learnt by the student.</li> <li>➤ Tools for the identification of fishery resources will be learnt by the student.</li> </ul>

**Objectives:****Module 1: Inland Fishing Crafts and Gears****Hrs. 14**

- 1.1. Introduction, Different types of fishing crafts and gears in India; Crafts-Rafts, Boats; Gears-Trap net, Hand net, Drag net, fixed net and miscellaneous types.
- 1.2. Boat building materials - wood, steel, FRP, ferro-cement, aluminum etc.

**Module 2: Marine Fishing Crafts and Gears****Hrs. 14**

- 2.1. Introduction, - crafts of the east coast and west coast. Gears-Fixed nets, Trawl nets, shore seines, drift nets, cast nets, trap nets, dip nets (scoop nets), long line and hooks.
- 2.2. Factors affecting the design of fishing gears and fish catching methods. Fishing accessories.
- 2.3. Introduction to netting materials - natural and synthetic fishing gear materials. Yarn numbering systems.

**Module 3: Active Fishing Gears, Passive Gears and Unconventional Fishing methods****Hrs. 14**

- 3.1. Active fishing gears, passive gears
- 3.2. Destructive and Prohibited fishing practices, fishing methods like electrical fishing, light fishing; Angling (line fishing) poisoning and use of dynamites.

**Module 4: Fish Finding Devices and Conservation.****Hrs. 14**

- 4.1. Introductory information on echo-sounder, sonar, net sonde, global positioning systems, remote sensing.
- 4.2. Potential fishing zones (EEZ) Turtle Exclusion Devices (TED) - By-catch Reduction Devices (BRD).

## **Internal Evaluation**

- Assignments
- Seminars
- Quiz
- Field Trips

## **Suggested reading**

### **Core reading**

1. Boopendranath, M.R., Meenakumari, B., Joseph, J., Sankar, T.V., Pravin, P., and Edwin, L. (Eds.) 2002, Riverine and Reservoir Fisheries of India, Society of Fisheries Technologists (India), Cochin.
2. Brandt, A. v. (1984) Fish catching methods of the world. Fishing News Books Ltd., London: 432 p.
3. George V.C. (1971) An account of the inland fishing gears and methods of India. Spl. Bull.No.1.CIFT
4. Hameed, M.S. and Boopendranath, M.R. (2000) Modern Fishing Gear Technology, Daya Publishing House, Delhi:186 p.
5. Klust, G. (1982) Netting materials for fishing gear, FAO Fishing Manual, Fishing News Books (Ltd)., Farnham, 192p.
6. Sainsbury, J.C. (1986) Commercial fishing methods- An introduction to vessels and gear. Fishing News Books, Oxford: 208pp
7. Sreekrishna, Y. and Shenoy L. (2001) Fishing gear and craft technology, Indian Council of Agricultural Research, New Delhi.

### **Supplementary & advanced reading**

1. Gulland, J.A. 1974, Guidelines for Fishery Management, IOFC Dev. 74-36 FAO Rome
2. FAO (1997) Fisheries management. FAO Technical Guidelines for Responsible Fisheries. No. 4.
3. FAO (1995) Code of Conduct for Responsible Fisheries, FAO, Rome: 41 p.
4. FAO (1997) Inland fisheries. FAO Technical Guidelines for Responsible Fisheries. No. 6 Fisheries Department, FAO, Rome: 36 p.

### **Other Reference Books:**

1. Jhingran, V.G. 1993. Fish and fisheries of India. Hindustan Publishing Corporation (India), New Delhi.
2. Ricker, W.E. 1984. Methods for assessment of fish production in freshwaters. Blackwell Publications.
3. Srivastava, C.B.L., 1985. Textbook of Fishery Science and Indian Fisheries. Kutub Mahal Publications, Allahabad.
4. S.S. Khanna. An introduction to fishes
5. Kurian, C.V. and Sebastian, V.O. 1986. Prawns and prawn fishery of India. Hindustan Publishing Corporation (India), New Delhi.
6. Yadav, B.N. Fish and Fisheries. Daya Publishing House.

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**I B.Voc., (COMMERCIAL AQUACULTURE), SEMESTER-II,**  
**CORE-VI, FISHING METHODS,**  
**BLUE PRINT FOR QUESTION PAPER SETTER**

	<b>ESSAY QUESTIONS</b>	<b>SHORT ANSWER QUESTIONS</b>	<b>VERY SHORT ANSWER QUESTIONS</b>
<b>MODULE-I</b>	01	01	03
<b>MODULE-II</b>	02	02	03
<b>MODULE-III</b>	02	02	03
<b>MODULE- IV</b>	01	02	03

**NOTE:** The question paper setters are requested to kindly adhere to the format given in the above table.



**P.R.GOVERNMENT COLLEGE (A), KAKINADA**  
**CHOICE BASED CREDIT SYSTEM**  
**IB.Voc., COMMERCIAL AQUACULTRE SEMESTER-II,2019-20**  
**MODEL QUESTION PAPER**

Time: 3 hrs.

TITLE: FISHING METHODS, CORE-VI

Marks: 70

**PART – 1**

Note: Answer any **THREE** questions choosing at least one question from each section

**3 x 10 = 30****SECTION- A**

1. Give an account of the different types of fishing crafts in India? Explain the traditional methods.
2. What is netting material? Explain the natural and synthetic fishing gear materials.
3. Explain the factors affecting the design of fishing gears and methods.

**SECTION- B**

4. Describe the modern fishing gears.
5. Explain the design and operation of different types of fishing gears.
6. What is the conservation? Explain the potential fishery zones.

**Part – II**Answer any **FOUR** Questions**4x5=20**

7. Mechanized boat
8. Fishing accessories
9. Modern fishing gears
10. Traditional fishing gears
11. Prohibited fishing practices
12. Electrical fishing
13. Remote sensing

**Part – III**Answer any **TEN** Questions**10x2=20**

14. Purse seiners
15. FRP
16. RCC
17. Do l net
18. Dip net
19. Cast net
20. Dynamites
21. Echo-sounder
22. EEZ
23. Net sonde
24. TED
25. Hoocks

## PRACTICALS PAPER I

**Title: Identification of Cultivable Fishes and Aquatic Weeds**

**Hours 3, credits 3**

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- I. Morphometric and meristimatic characters of fish.
- II. Identification of cultivable fishes
  - A. Fresh water fishes
    1. *Catla catla*
    2. *Labeo rohita*
    3. *Cirrhinus mrigala*
    4. *Clarias batrachus*
    5. *Heteropneutes fossilis*
  - B. Brackish water fishes/Estuarine fishes
    1. *Chanos chanos*
    2. *Etroplus surantensis*
    3. *Mugil cephalus*
    4. *Megalopa cyprinoides*
    5. *Eleutheronema tetradachylum*
  - C. Marine water fishes
    1. *Lates calcarifer*
    2. *Scomberomorus guttatus*
    3. *Scomberomorus commerson*
    4. *Rachycentron canadom*
    5. *Stromateus argnteus*
  - D. Exotic fishes
    1. *Tilapia mossambica*
    2. *Hypophthalmichthys molitrix*
    3. *Ctenopharyngodon idella*
    4. *Cypinus carpio*
  - E. Migratory fishes
    1. *Hilsa ilisha*
    2. *Anguilla anguilla*
- III. Dissections
  1. Mounting of scales in fishes
  2. Digestive system of fish
  3. Gut content analysis of fish
- IV. Identification of Aquatic weeds
 

A. Floating weeds	B. Emergent weeds	C. Submerged weeds	D. Marginal weeds
1. Pistia	1. Typha	1. Vallisneria	1. Marsilia
2. Lemna	2. Nymphaea	2. Hydrilla	2. Ipomoea
3. Eichhornia		3. Utricularia	3. Jussiaea
4. Azolla			

**PRACTICAL MODEL PAPER I**  
**Title: Identification of Cultivable Fishes and Aquatic Weeds**  
**Hours 3, credits 3**

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Examinations at the end of the II Semester.

Internal:

Examinations at the end of the II Semester.

Internal:30 Marks, Time 1 Hour

External: 70 Marks Time 3 Hours

1. Major Dissection	10 Marks
Dissection } Display } 10 Marks	
Diagram & Labeling 5 Marks	
2.. Identification Cultivable fishes	10 Marks.
(Morphometric and meristimatic)	
3. Spotters 6x 5 Marks	30 Marks
3. Record	10 Marks
Total	70 Marks

**PRACTICAL PAPER II**

**Title: Identification of plankton, crustaceans, soil and water parameters**  
**Hours 3, credits 3**

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- I. Identification of phytoplanktons
  - A. Diatoms
    1. *Coscinodiscus* sp.
    2. *Chaetoceros* sp.
    3. *Biddulphia* sp.
    4. *Skeletonema* sp.
    5. *Leptocylindrus* sp.
    6. *Pleurosigma* sp.
    7. *Thalassionema* sp.
    8. *Thalassiothrix* sp.
    9. *Asterionella* sp.
    10. *Amphora* sp.
  - B. Dinoflagellates
    1. *Ceratium* sp.
    2. *Protoperdinium* sp.
    3. *Dinophysis* sp.
  - C. Blue Green Algae (BGA)
    1. *Trichodesmium* sp.
    2. *Spirulina* sp.
    3. *Nostoc* sp.
    4. *Anabena* sp.
- II. Identification of zooplankton
  1. Copepods
  2. Amphipods
  3. Luciferans
  4. Ephasids
  5. Mysids
  6. Zoea larvae
  7. Megalopa larvae
  8. Pteropods
  9. Ostracoda
  10. Cladocerans
- III. Biology and Identification of fresh water prawns (Scampi)
  1. *Macobrahium rosenbergii*
  2. *M. malcolmsonii*
- IV. Biology and Identification of shrimps (Marine/Brackish water)
  1. *Penaeus monodon*
  2. *P. indicus*
  3. *Litopenaeus vennamei*
- V. Biology and Identification of crabs
  1. *Scylla serrata*
  2. *S. oceanica*
  3. *S. caribdis*

## VI. Dissections

- A. Mounting of the prawn appendages
- B. Digestive system of prawn
- C. Nervous system of prawn
- D. Eye stalk ablation in Prawn

**PRACTICAL MODEL PAPER II**  
**Title: Identification of Cultivable Fishes and Aquatic Weeds**  
**Hours 3, credits 3**

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Examinations at the end of the II Semester.

Internal:

Examinations at the end of the II Semester.

Internal:30 Marks, Time 1 Hour

External: 70 Marks Time 3 Hours

1. Major Dissection		10 Marks
Dissection	}	
Display	}	10 Marks
Diagram & Labeling		5 Marks
3. Spotter 6 x5		30 Marks
4. Identification of Phytoplankton		10 Marks
5. Identification of Zooplankton		10Marks
3. Record		10 Marks
Total		70 Marks

**PRACTICAL PAPER III**  
**SKILL COMPONENT AND BENCH WORK**

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1. Training – OJT (On Job Training) in the collaborative institute or linkage organisation  
(Or )Internshipin in the collaborative institute or linkage organization  
Total 30Hours 3 Credits
2. Project/ Seminar 2 Credits
3. Field visits 1 Credit

Examinations at the end of the II Semester.

Internal:

Examinations at the end of the II Semester.

Internal:30 Marks, Time 1 Hour

External: 70 Marks Time 3 Hours

1. Major Dissection	20 Marks
Determination of moisture content in fish and fishery products	
3. Spotter 6 x5	30 Marks
4. Value added products	10 Marks
5. Fishery by-products	10Marks
3. Record	10 Marks
Total	70 Marks



**DEPARTMENT OF ZOOLOGY**  
**BACHELOR OF VOCATIONAL COURSE**  
**(COMMERCIAL AQUACULTURE)**  
**LIST OF EXAMINERS**

<b>S.NO.</b>	<b>NAME OF THE EXAMINER</b>	<b>SUBJECT</b>	<b>NAME OF THE COLLEGE/INSTITUTION</b>
01.	Dr. D. Padmavathi	Zoology	MSN Degree College, Kakinada
02.	P.V.B.K.R.L. Saibaba	Zoology	SKBR College, Amalapuram
03.	R. Indira	Zoology	St. Theresa College, Eluru
	K. Madhavi Rani	Zoology	St. Theresa College, Eluru
04.	Dr. P. Ram Mohan Rao	FDO	SIFT, Jaganaikpur, Kakinada
05.	Dr. Ramatheerdham	FDO	SIFT, Jaganaikpur, Kakinada
06.	Dr. Chandra Sekhar Reddy	FDO	SIFT, Jaganaikpur, Kakinada
07.	Murali Mohan	Senior Technical Officer	CIFE, Kakinda
08.	Dr. P. Rami Reddy	Senior Technical Officer	CIFE, Kakinda
09.	Dr. K.V.C.S Appa Rao	Zoology	Y.N. College, Narsapur
10.	Dr. P.Jaya	Zoology	Dr. V.S.K. College (A), Visakhapatnam
11.	Dr. K. Usharani	Zoology	D.N.R. College, Bheemavaram
12.	Smt. M. Vasanthalakshmi	Zoology	D.R.G.Govt. Degree College, Tadepalligudam
13.	Dr. K.S.R. Prakasa Rao	Zoology	S.N.K.P. & Dr. K.S. Raju Arts & Science College, Penugonda, W.G.
14.	B. Vijayabhaskara Rao	Zoology	A.V.N. College, Visakhapatnam
15.	V. Surya Kumari	Zoology	M.R. College (A), Vizianagaram

Lecturer in Incharge  
Dept. of Zoology

**P.R. GOVT. COLLEGE (A)**  
**DEPT. OF ZOOLOGY**  
**BACHELOR OF VOCATIONAL COURSE**  
**(COMMERCIAL AQUACULTURE)**  
**QUESTION PAPER SETTERS**

<b>S.NO.</b>	<b>NAME OF THE EXAMINER</b>	<b>SUBJECT</b>	<b>NAME OF THE COLLEGE/INSTITUTION</b>
01.	Dr. D. Padmavathi	Zoology	MSN Degree College, Kakinada
02.	P.V.B.K.R.L. Saibaba	Zoology	SKBR College, Amalapuram
03.	R. Indira	Zoology	St. Theresa College, Eluru
	K. Madhavi Rani	Zoology	St. Theresa College, Eluru
04.	Dr. P. Ram Mohan Rao	FDO	SIFT, Jaganaikpur, Kakinada
05.	Dr. Ramatheerdham	FDO	SIFT, Jaganaikpur, Kakinada
06.	Dr. Chandra Sekhar Reddy	FDO	SIFT, Jaganaikpur, Kakinada
07.	Murali Mohan	Senior Technical Officer	CIFE, Kakinda
08.	Dr. P. Rami Reddy	Senior Technical Officer	CIFE, Kakinda
09.	Dr. K.V.C.S Appa Rao	Zoology	Y.N. College, Narsapur
10.	Dr. P.Jaya	Zoology	Dr. V.S.K. College (A), Visakhapatnam
11.	Dr. K. Usharani	Zoology	D.N.R. College, Bheemavaram
12.	Smt. M. Vasanthalakshmi	Zoology	D.R.G.Govt. Degree College, Tadepalligudam
13.	Dr. K.S.R. Prakasa Rao	Zoology	S.N.K.P. & Dr. K.S. Raju Arts & Science College, Penugonda, W.G.
14.	B. Vijayabhaskara Rao	Zoology	A.V.N. College, Visakhapatnam
15.	V. Surya Kumari	Zoology	M.R. College (A), Vizianagaram

Lecturer in Incharge  
 Dept. of Zoology