

**PITHAPUR RAJAH'S GOVT COLLGE (A),**  
**KAKINADA**

(Re- Accredited by NAAC with A Grade) Kakinada, AP –  
533002

**DEPARTMENT OF ZOOLOGY & AQUACULTURE**

**BOARD OF STUDIES**

**B.Sc. AQUACULTURE (Single Major System) &**  
**B.Voc. Commercial Aquaculture**

**2024-2025**



**CHOICE BASED CREDIT SYSTEM**

# Convened on 01-05-2024

## PROCEEDINGS OF THE PRINCIPAL, P.R. GOVERNMENT COLLEGE(A), KAKINADA – A.P

**Present: Dr. B.V.Tirupanyam,M.Sc;Ph.D.**

R.C.No.12A/A.C./BOS/2024-2025,Dated:29.05.2024.

**SUB:** P.R. Government College (A), Kakinada- UG Boards of studies (BOS)-Program/Course-B.Sc../ Zoology, Nomination of numbers—Orders issued

**REF:** 1.UGC Guidelines for Autonomous colleges-2018.

**ORDER:**The Principal, P.R. Government College(A), Kakinada is pleased to constitute UG Boards of Studies in Zoology for framing the syllabi in **Zoology** subject for the all semesters duly following the norms of the UGC Autonomous guidelines.

S.No	Name of the Nominee	Designation
1	Sri. B. Chakravarthi	Chairman & Lecturer In charge, Department of zoology & Aqaculture
2	Dr. K. Ramesh Babu	Dept of Marine Living Resources, Andhra University, Vishakapatnam.
3.	Dr. P. Ramaneswari	Subject Expert: I, Department of zoology ,Dean Research Cell, Adikavi nannaya University, Rajamahendravaram
4.	Dr. N. Srinivas	Subject Expert: II, Lecturer In zoology, Govt Degree college,Ramachandrapuram.
5.	Sri. M. Phaneendra	Representative from Industry, Aqua Industry Consultant
8.	Dr. P. Kiran Kumar	Member
9.	Dr. B. Elia	Member
10	Sri.T.Venkateswara Rao	Member
11.	Y. Gowthami	Member
12.	P.Vijaya Chandrika	Member
13	B. Devi	Member
15.	T. Sushma	Member
16.	M. Sowmya	Member
17	R.Sunitha	Member
18	D.R. Manjula	Member
19	O.V. Yellari	Member
20.	N.Rikitha Sai Lakshmi	Alumni Student Member B.Sc B.Z.C
21.	N. Dharani	Student Member I B.Sc B.Z.C
22	P. Ephraem	Student Member I B.Sc B.Z.C

The above members are requested to attend the BoS meeting on - 05 -2024 and share their valuable reviews,and suggestions on the following functionaries.

- Prepare syllabi for the subject keeping in view the objectives of the college, interest of the stake holders andNational requirement for consideration and approval of the IQAC and Academic Council.
- Suggested methodologies for innovative teaching and evaluation techniques.
- Suggest the panel of Names to the academic council for appointment of Examiners.
- Coordinate research, teaching, extension and other activities in the Department of the college.

  
PRINCIPAL  
PRINCIPAL  
P.R.Govt. College (A)  
KAKINADA

**P.R. GOVT COLEGE (A), KAKINADA**  
**ACTION PLAN 2024-25**

**DEPARTMENT OF ZOOLOGY & AQUACULTURE**

	July- 2024	Guest lectures to be organized by all Regular faculty Field Trip to B. Voc students	3 <sup>rd</sup> week of July 2024 4 <sup>th</sup> week of July	
	August- 2024	National Conference I Bridge course to I Sem students I Student seminars BOS for newly introduced Zoology Single major and Honors programme	4 <sup>th</sup> August 2024 2 <sup>nd</sup> week of August 3 <sup>rd</sup> week of Aug-2024 4 <sup>th</sup> week of Aug-2024	
	September 2024	Student Seminars	1st week of September	
Training to B.Voc students at SIFT, Kakinada		3 <sup>rd</sup> Week of September		
Field trip		4 <sup>th</sup> Week of September		
	October 2024	Wild Life week celebrations  Certificate course on Biodiversity and conservation Biology	First week of October  October 2024	

	November 2024	<ol style="list-style-type: none"><li>1. Extension activity in Rural high Schools</li><li>2. Guest Lecture by Fisheries experts</li></ol>	3rd Week of November 4th Week of November	
	December 2024	HIV-AIDS awareness programme	1st week of December 2024	

		Field visits, Industrial visits One day workshop for students in laboratory specimen examination and preservation tech.	2 <sup>rd</sup> week of December	
January 2025				
		Hands-on training to B.Voc students at CIFE, Kakinada	2 <sup>nd</sup> week of Jan-2025	
		Field Visit to III-year BZC students	Third week of Jan-2025	
February 2025		Work shop on Hematological Techniques National Science Day	4 <sup>th</sup> week of February 2025 28 <sup>th</sup> February	
March 2025		Practical exams Student Projects for Final year students.	1-13 March 3 <sup>rd</sup> week of March	

Tentative Budget Estimate for 2024-2025

1. Field trips	-	Rs.50,000
2. Guest lectures	-	Rs.10,000
3. Internships Programmes for CZAC & B Voc		- Rs.75,000
4. National Seminar		- Rs. 1,25,000
5. Purchase of Consumable items for Practicals		-Rs. 50,000
6. BOS Meetings		-Rs. 30,000
<b>Total</b>		<b>Rs. 3,40,000</b>



**ANDHRA PRADESH STATE COUNCIL OF HIGHER  
EDUCATION**



**Programme: B.Sc. Honours in Aquaculture (Major)**

w.e.f. AY 2023-24

**COURSE STRUCTURE**

<b>SEMESTER</b>	<b>Code</b>	<b>Title of the paper</b>	<b>Hr /week</b>	<b>Credits</b>
<b>I</b>	<b>1</b>	<b>Introduction to Classical Biology</b>	<b>5</b>	<b>4</b>
	<b>2</b>	<b>Introduction to Applied Biology</b>	<b>5</b>	<b>4</b>
<b>II</b>	<b>3</b>	<b>Taxonomy and Functional Anatomy of Fin Fish and Shellfish- (T)</b>	<b>3</b>	<b>3</b>
		<b>Taxonomy and Functional Anatomy of Fin Fish and Shellfish-(P)</b>	<b>2</b>	<b>1</b>
	<b>4</b>	<b>Biology of fin fish &amp; shell fish - (T)</b>	<b>3</b>	<b>3</b>
		<b>Biology of fin fish &amp; shell fish- (P)</b>	<b>2</b>	<b>1</b>
<b>III</b>	<b>5</b>	<b>Basic Principles of Aquaculture- (T)</b>	<b>3</b>	<b>3</b>
		<b>Basic Principles of Aquaculture - (P)</b>	<b>2</b>	<b>1</b>
	<b>6</b>	<b>Capture Fisheries- (T)</b>	<b>3</b>	<b>3</b>
		<b>Capture Fisheries- (P)</b>	<b>2</b>	<b>1</b>
	<b>7</b>	<b>Fresh water Aquaculture- (T)</b>	<b>3</b>	<b>3</b>
		<b>Fresh water Aquaculture- (P)</b>	<b>2</b>	<b>1</b>
	<b>8</b>	<b>Brackish water Aquaculture- (T)</b>	<b>3</b>	<b>3</b>
		<b>Brackish water Aquaculture- (P)</b>	<b>2</b>	<b>1</b>
<b>IV</b>	<b>9</b>	<b>Fish Health management- (T)</b>	<b>3</b>	<b>3</b>
		<b>Fish Health management- (P)</b>	<b>2</b>	<b>1</b>
	<b>10</b>	<b>Shrimp Health Management- (T)</b>	<b>3</b>	<b>3</b>
		<b>Shrimp Health Management- (P)</b>	<b>2</b>	<b>1</b>
	<b>11</b>	<b>Fish nutrition &amp; Feed technology - (T)</b>	<b>3</b>	<b>3</b>
		<b>Fish nutrition &amp; Feed technology - (P)</b>	<b>2</b>	<b>1</b>
<b>V</b>	<b>12</b>	<b>Extension, Economics &amp; Marketing- (T)</b>	<b>3</b>	<b>3</b>
		<b>Extension, Economics &amp; Marketing- (P)</b>	<b>2</b>	<b>1</b>
	<b>13</b>	<b>Ornamental Fishery- (T)</b>	<b>3</b>	<b>3</b>
		<b>Ornamental Fishery - (P)</b>	<b>2</b>	<b>1</b>
	<b>14</b>	<b>Fishery Engineering- (T)</b>	<b>3</b>	<b>3</b>
		<b>Fishery Engineering - (P)</b>	<b>2</b>	<b>1</b>
	<b>15</b>	<b>Fish Processing Technology- (T)</b>	<b>3</b>	<b>3</b>
		<b>Fish Processing Technology- (P)</b>	<b>2</b>	<b>1</b>
<b>VI</b>		<b>Internship</b>		
<b>VII</b>	<b>16</b>	<b>Post Harvest Technology&amp; Transportation- (T)</b>	<b>3</b>	<b>3</b>
		<b>Post Harvest Technology&amp; Transportation - (P)</b>	<b>2</b>	<b>1</b>
	<b>17</b>	<b>Fishery Microbiology- (T)</b>	<b>3</b>	<b>3</b>
		<b>Fishery Microbiology - (P)</b>	<b>2</b>	<b>1</b>
	<b>18</b>	<b>Quality Control in Processing Plants. - (T)</b>	<b>3</b>	<b>3</b>
		<b>Quality Control in Processing Plants. - (P)</b>	<b>2</b>	<b>1</b>
	<b>19</b>	<b>Crustacean culture- (T)</b>	<b>3</b>	<b>3</b>

<b>VIII</b>	<b>19</b>	Crustacean culture - (P)	<b>2</b>	<b>1</b>
	<b>20 A</b>	Molluscan and Seaweed culture- (T)	<b>3</b>	<b>3</b>
	<b>20 A</b>	Molluscan and Sea weed culture - (P)	<b>2</b>	<b>1</b>
		<b>OR</b>		
	<b>20 B</b>	Genetics in Aquaculture- (T)	<b>3</b>	<b>3</b>
	<b>20 B</b>	Genetics in Aquaculture - (P)	<b>2</b>	<b>1</b>
	<b>21 A</b>	Marine Fin Fish culture- (T)	<b>3</b>	<b>3</b>
	<b>21 A</b>	Marine Fin Fish culture - (P)	<b>2</b>	<b>1</b>
		<b>OR</b>		
	<b>21 B</b>	Fish Immunology- (T)	<b>3</b>	<b>3</b>
	<b>21 B</b>	Fish Immunology - (P)	<b>2</b>	<b>1</b>

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A), Kakinada**

**Aquaculture**

**BOARD OF STUDIES MEETING 2023-24**

**CHOICE BASED CREDIT SYSTEM**

**(2020-21 admitted batch onwards) Old Pattern**

YEAR	SEM	PAPER	TITLE	MARKS(100)		CREDITS	
				MID	END		
I	I	I	Animal Diversity-I Biology of Non- Chordates	50	50	04	
			Practical-I		50	01	
	II	II	Animal Diversity- II Biology of Chordates	50	50	04	
			Practical-II		50	01	
II	III	III	Fish Nutrition & Feed Technology	50	50	04	
			Practical-III		50	01	
III	IV	IV	Fresh Water & Brackish Water Aquaculture	50	50	04	
			Practical-IV		50	01	
		V	6	Fisheries Extension, Economics & Marketing	50	50	04
				Practical-V		50	01
	V	6	Marine Biology	50	50	04	
			Practical		50	01	
		7	7	Marine fisheries	50	50	04
				Practical		50	01
	VI		Apprenticeship				

B.Sc. Aquaculture

# SEMESTER-I

Introduction to Classical biology

Introduction to Applied biology



**Pithapur Rajah's Govt. Degree College (A)  
Kakinada.**

**Program &  
Semester**

B.Sc. Honours in Zoology  
(Major)

Semester-I

Course Code	<b>TITLE OF THE COURSE COURSE 1: INTRODUCTION TO CLASSICAL BIOLOGY</b>				
Teaching	Hours Allocated: 60 ( <b>THEORY</b> )	L	T	P	C
Pre-requisites:	Basics of Zoology	3	1	-	3

**Course Objectives:**

The student will be able to learn the diversity and classification of living organisms and understand their chemical, cytological, evolutionary and genetic principles.

**Course Outcomes:**

On Completion of the course, the students will be able to-	
CO1	1. Learn the principles of classification and preservation of biodiversity
CO2	2. Understand the plant anatomical, physiological and reproductive processes.
CO3	3. Knowledge on animal classification, physiology, embryonic development and their economic importance.
CO4	4. Outline the cell components, cell processes like cell division, heredity and molecular processes.
CO5	5. Comprehend the chemical principles in shaping and driving the macromolecules and life processes.

**Course with focus on employability / entrepreneurship / Skill Development modules**

Skill Development		Employability		Entrepreneurship	
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## Syllabus

**Unit 1:** Introduction to systematics, taxonomy and ecology.

- 1.1. Systematics – Definition and concept, Taxonomy – Definition and hierarchy.
- 1.2. Nomenclature – ICBN and ICZN, Binomial and trinomial nomenclature.
- 1.3. Ecology – Concept of ecosystem, Biodiversity and conservation.
- 1.4. Pollution and climate change.

**Unit 2:** Essentials of Botany.

- 2.1. The classification of plant kingdom.
- 2.2. Plant physiological processes (Photosynthesis, Respiration, Transpiration, phytohormones).
- 2.3. Structure of flower – Micro and macro sporogenesis, pollination, fertilization and structure of mono and dicot embryos.
- 2.4. Mushroom cultivation, floriculture and landscaping.

**Unit 3:** Essentials of Zoology

- 3.1. The classification of Kingdom Animalia and Chordata.
- 3.2. Animal Physiology – Basics of Organ Systems & their functions, Hormones and Disorders
- 3.3. Developmental Biology – Basic process of development (Gametogenesis, Fertilization, Cleavage and Organogenesis)
- 3.4. Economic Zoology – Sericulture, Apiculture, Aquaculture

**Activities :**

- Visit to Zoology Lab and observe different types of preservation of specimens
- List out different hormonal, genetic and physiological disorders from the society

#### **Unit 4:** Cell biology, Genetics and Evolution

- 4.1. Cell theory, Ultrastructure of prokaryotic and eukaryotic cell, cell cycle.
- 4.2. Chromosomes and heredity – Structure of chromosomes, concept of gene.
- 4.3. Central Dogma of Molecular Biology.
- 4.4. Origin of life

#### **Activities:**

- Draw the Ultrastructure of Prokaryotic and Eukaryotic Cell.
- Hands-on experience of various equipment – Microscopes
- Visit to Zoo / Sericulture / Apiculture / Aquaculture unit

#### **Unit 5:** Essentials of chemistry

- 5.1. Definition and scope of chemistry, applications of chemistry in daily life.
- 5.2. Branches of chemistry
- 5.3. Chemical bonds – ionic, covalent, noncovalent – Vander Waals, hydrophobic, hydrogen bond
- 5.4. Green chemistry

#### **ADDITIONAL INPUTS:**

Scope of Biology - For better understanding of importance of Biology in other sciences.

Branches of Biology - For systematic study of living things.

Microscopy

Slide preparation

Specimen Collection

#### **Reference books:**

Sharma O.P., 1993. Plant taxonomy. 2<sup>nd</sup> Edition. McGraw Hill publishers.

Pandey B.P., 2001. The textbook of botany Angiosperms. 4<sup>th</sup> edition. S. Chand publishers, New Delhi, India.

Jordan E.L., Verma P.S., 2018. Chordate Zoology. S. Chand publishers, New Delhi, India.

Rastogi, S.C., 2019. Essentials of animal physiology. 4<sup>th</sup> Edition. New Age International

Publishers.

1. Verma P.S., Agarwal V.K., 2006. Cell biology, genetics, Molecular Biology, Evolution and Ecology. S. Chand publishers, New Delhi, India.
2. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4<sup>th</sup> Edition. Elsevier publishers.
3. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.
4. Karen Timberlake, William Timberlake, 2019. Basic chemistry. 5<sup>th</sup> Edition. Pearson publishers.
5. Subrata Sen Gupta, 2014. Organic chemistry. 1<sup>st</sup> Edition. Oxford publishers.

#### Web Links:

1. <https://www.ignfa.gov.in/document/biodiversity-cell-ntfp-related-issues4.pdf>.
2. <https://www.fao.org/3/cb5353en/cb5353en.pdf>
3. [https://bio.libretexts.org/Bookshelves/Introductory\\_and\\_General\\_Biology/Introductory\\_Biology\\_\(CK-12\)/04%3A\\_Molecular\\_Biology/4.01%3A\\_Central\\_Dogma\\_of\\_Molecular\\_Biology](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Introductory_Biology_(CK-12)/04%3A_Molecular_Biology/4.01%3A_Central_Dogma_of_Molecular_Biology)

#### CO-PO Mapping:

( 1: Slight [Low]; 2: Moderate[Medium]; 3: Substantial[High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	2	1	2	1	3	2	3	2	1	2	2
CO2	2	1	3	2	1	1	2	3	1	1	2	2	2
CO3	1	1	2	3	3	1	1	1	2	3	1	2	1
CO4	2	2	3	2	2	2	1	2	1	2	2	1	2
CO5	1	2	1	1	1	2	2	1	1	1	1	1	2

Pithapur Rajah's Govt. Degree College (A) Kakinada.

DEPARTMENT OF ZOOLOGY

I SEMESTER ZOOLOGY - PAPER - I

COURSE I: **Introduction to Classical Biology**

**BLUE PRINT**

Time: 2 1/2 hrs

Max. Marks: 50

<b>Unit</b>	<b>Essay</b>	<b>Short</b>
I	1	1
II	1	1
III	1	2
IV	1	1
V	2 <b>Out of 6, 3 questions should be answered</b> <b>3X10=30M</b>	2 <b>Out of 7, 4 questions</b> <b>should be answered</b> <b>4X5=20M</b>

**COMMON QUESTION PAPER PATTERN TO BE FOLLOWED (From 2021-22AB, 2022-23AB AND 2023-24AB FOR CORE SUBJECTS)**

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A) KAKINADA  
DEPARTMENT OF ZOOLOGY  
SEMESTER - I  
INTRODUCTION TO CLASSICAL BIOLOGY**

**Time: 2 1/2 Hours**

**Max Marks: 50M**

**Section -I**

**Answer any three of the following questions. Must attempt at least one question from each part. Each question carries 10 Marks.**

**3 X 10 = 30M**

**Part – A**

Define Biodiversity. Write methods of conservation of biodiversity.

1. Give an account of Classification of Plant Kingdom
2. Describe any 5 animal Hormones and their functions


**Part - B**

3. Explain ultrastructure of Eukaryotic cell
4. Write an essay on the scope and applications of Chemistry in daily life
5. Write an essay on apiculture

**Section II**

**Answer any four of the following questions. Each question carries 5 marks. 4 X 5 = 20M**

6. Systematics
7. Pollination
8. Fertilization
9. Sericulture
10. DNA
11. Chemical bonding
12. Green Chemistry

	<b>Pithapur Rajah's Govt. Degree College (A) Kakinada.</b>	<b>Program &amp; Semester</b> B.Sc. Honours in Zoology (Major)			
Course Code	<b>TITLE OF THE COURSE COURSE 2: INTRODUCTION TO APPLIED BIOLOGY</b>	Semester-I			
Teaching	Hours Allocated: 60 ( <b>THEORY</b> )	L	T	P	C
Pre-requisites:	Basics of Zoology	3	1	-	3

### Course Objectives:

The student will be able to learn the foundations and principles of microbiology, immunology, biochemistry, biotechnology, analytical tools, quantitative methods, and bioinformatics.

On Completion of the course, the students will be able to-

CO1	Learn the history, ultrastructure, diversity and importance of microorganisms.
CO2	Understand the structure and functions of macromolecules.
CO3	Knowledge on biotechnology principles and its applications in food and medicine.
CO4	Outline the techniques, tools and their uses in diagnosis and therapy.
CO5	Demonstrate the bioinformatics and statistical tools in comprehending the complex biological data.

Skill Development		Employability		Entrepreneurship	
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### Syllabus Unit 1: Essentials of Microbiology and Immunology

12.1. History and Major Milestones of Microbiology; Contributions of Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister.

12.2. Groups of Microorganisms – Structure and characteristics of Bacteria, Fungi, Archaea and Virus.

12.3. Applications of microorganisms in – Food, Agriculture, Environment, and Industry.

12.4. Immune system – Immunity, types of immunity, cells, and organs of immune system.

## **Unit 2:** Essentials of Biochemistry

2.1. Biomolecules I – Carbohydrates, Lipids.

2.2. Biomolecules II – Amino acids & Proteins.

2.3. Biomolecules III – Nucleic acids -DNA and RNA.

2.4. Basics of Metabolism – Anabolism and catabolism.

## **Unit 3:** Essentials of Biotechnology

3.1. History, scope, and significance of biotechnology. Applications of biotechnology in Plant, Animal, Industrial and Pharmaceutical sciences.

3.2. Environmental Biotechnology – Bioremediation and Biofuels, Biofertilizers and Biopesticides.

3.3. Genetic engineering – Gene manipulation using restriction enzymes and cloning vectors; Physical, chemical, and biological methods of gene transfer.

3.4. Transgenic plants – Stress tolerant plants (biotic stress – BT cotton, abiotic stress – salt tolerance). Transgenic animals – Animal and disease models.

## **Unit 4:** Analytical Tools and techniques in biology – Applications

4.1. Applications in forensics – PCR and DNA fingerprinting

4.2. Immunological techniques – Immunoblotting and ELISA.

4.3. Monoclonal antibodies – Applications in diagnosis and therapy.

4.4. Eugenics and Gene therapy

## **Unit 5:** Biostatistics and Bioinformatics

1.1. Data collection and sampling. Measures of central tendency – Mean, Median, Mode.

1.2. Measures of dispersion – range, standard deviation and variance. Probability and tests of significance.

1.3. Introduction, Genomics, Proteomics, types of Biological data, biological databases- NCBI, EBI, Gen Bank; Protein 3D structures, Sequence alignment

1.4. **Accessing** Nucleic Acid and Protein databases, NCBI Genome Workbench

## ADDITIONAL INPUTS

1. Contribution of Yerrapragada Subba Rao to Microbiology
2. Vaccines
3. Life cell bank - stem cell therapy

## ACTIVITIES

1. Identification of given organism as harmful or beneficial.
2. Observation of microorganisms from house dust under microscope.
3. Finding microorganism from pond water.
4. Visit to a waste water treatment plant.
5. Retrieving a DNA or protein sequence of a gene?
6. Performing a BLAST analysis for DNA and protein.
7. Field trip and awareness programs on environmental pollution by different types of wastes and hazardous materials.

## Reference books:

1. Gerard J., Tortora, Berdell R. Funke, Christine L. Case., 2016. Microbiology: An Introduction. 11<sup>th</sup> Edition. Pearson publications, London, England.
2. Micale, J. Pelczar Jr., E.C.S. Chan., Noel R. Kraig., 2002. Pelczar Microbiology. 5<sup>th</sup> Edition. McGraw Education, New York, USA.
3. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4<sup>th</sup> Edition. Elsevier publishers.
4. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.
5. R.C. Dubey, 2014. Advanced Biotechnology. S. Chand Publishers, New Delhi, India.
6. Colin Ratledge, Bjorn, Kristiansen, 2008. Basic Biotechnology. 3<sup>rd</sup> Edition. Cambridge Publishers.
7. U. Sathyanarayana, 2005. Biotechnology. 1<sup>st</sup> Edition. Books and Allied Publishers pvt. ltd., Kolkata.
8. Upadhyay, Upadhyay and Nath. 2016. Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.
9. Arthur M. Lesk. Introduction to Bioinformatics. 5<sup>th</sup> Edition. Oxford publishers.
10. AP Kulkarni, 2020. Basics of Biostatistics. 2<sup>nd</sup> Edition. CBS publishers

## Web Links:

1. <https://microbiologynote.com/dna-fingerprinting-definition-steps-methods-applications/>  
<https://egyankosh.ac.in/bitstream/123456789/41406/1/Unit-4.pdf>

## CO-PO Mapping:

( 1: Slight [Low];                    2: Moderate[Medium];                    3: Substantial[High],                    '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	2	1	2	1	3	2	3	2	1	2	2
CO2	2	1	3	2	1	1	2	3	1	1	2	2	2
CO3	1	1	2	3	3	1	1	1	2	3	1	2	1
CO4	2	2	3	2	2	2	1	2	1	2	2	1	2
CO5	1	2	1	1	1	2	2	1	1	1	1	1	2

Pithapur Rajah's Govt. Degree College (A) Kakinada.

DEPARTMENT OF ZOOLOGY

I SEMESTER ZOOLOGY - PAPER - II

COURSE II: **Introduction to Applied Biology**

**BLUE PRINT**

Time: 2 1/2 hrs

Max. Marks: 50

<b>Unit</b>	<b>Essay</b>	<b>Short</b>
I	1	1
II	1	1
III	1	2
IV	1	1
V	1 <b>Out of 6, 3 questions should be answered 3X10=30M</b>	2 <b>Out of 7, 4 questions should be answered 4X5=20M</b>

**COMMON QUESTION PAPER PATTERN TO BE FOLLOWED (from 2021-22AB, 2022-23AB AND 2023-24AB FOR CORE SUBJECTS)**

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A) KAKINADA DEPARTMENT OF  
ZOOLOGY  
SEMESTER – I**

**Introduction to Applied Biology**

**Time: 2 1/2 Hours**

**Max Marks: 50M**

**Section -I**

**Answer any three of the following questions. Must attempt at least one question from each part. Each question carries 10 Marks.**

**3 X 10 = 30M**

**Part – A**

1. Write an essay on applications of microorganisms in food and industry.
2. Describe the classification of carbohydrates.
3. Explain the scope and benefits of environmental biotechnology


**Part - B**

4. Write an essay on the application of DNA finger printing in forensics
5. Describe the Measures of dispersion
6. Write an essay on transgenic organisms.

**Section II**

**Answer any four of the following questions. Each question carries 5 marks. 4 X 5 = 20M**

7. Edward Jenner
8. Proteins
9. Restriction enzymes
10. PBR 322
11. PCR
12. Genomics
13. Sequence alignment

	<b>Pithapur Rajah's Govt. Degree College (A) Kakinada.</b>		<b>Program &amp; Semester</b> B.Sc. Honours in Zoology (Major)		
	Course Code	<b>TITLE OF THE COURSE</b> <b>Multidisciplinary Courses</b>  <b>PRINCIPLES OF BIOLOGICAL SCIENCES</b>		Semester-I	
Teaching	Hours Allocated: 30 ( <b>THEORY</b> )		L	T	P
Pre-requisites:	Basics of Zoology		3	1	-

**Learning Objectives:** By the end of this course the learner can:

1. Acquire logic to evaluate fundamental biological concepts at various levels of biological organisation including the molecular, cellular, organismal and systems levels.
2. Communicate fundamental biological knowledge between tiers of biological organisation.
3. Apply common biological principles across all levels of biological organization.

**Learning Outcomes:** On completion of this course students will be able to:

1. Understand the relationship between structure and function at all levels.
2. Recognise the mechanisms underlying biological evolution, its patterns, and its significance as biology's overarching unifying principle.
3. Understand the contributions of biology to the resolution of medical, ethical, social, and environmental concerns in human affairs.

## UNIT-I Diversity of Life

- 1.1 Introduction to Biology, Branches of Biology, Basic Principles of Biology
- 1.2 Biological Classification-Two kingdom and Five kingdom classification, Viruses, Viroid's and Lichens
- 1.3 Diversity in the living world, Taxonomic categories, Taxonomic aids
- 1.4 Plant organization-The form, structure and function of plant vegetative and reproductive organs, Classification of Plant Kingdom,
- 1.5 Basis of Animal Classification, Classification of Animal Kingdom

## UNIT-II Biomolecules and metabolism

- 2.1 Ultra structure of cell and Cell organelles (Structure and Functions), Plant cell vs Animal cell
- 2.2 Plant Physiology: Photosynthesis, Respiration, Transportation, Mechanisms of Nitrogen fixation.
- 2.3 Plant growth and development, physiology of flowering.

- 2.4 Human Physiology: Digestion, Respiration, Circulation
- 2.5 Male and female reproductive organs, gametogenesis, fertilization.

### **UNIT-III Principles of Biology**

- 3.1 Genetics: Mendel's laws of inheritance, Genetic disorders- Colour blindness, Sickle cell anaemia.
- 3.2 Evolution: Geological time scale for evolution of plants and vertebrates, Origin and evolution of plants and man
- 3.3 Common Human Diseases: causing organism, prevention and treatment- malaria, dengue, AIDS, cancer, corona.
- 3.4 Common Plant Diseases: causing organism, prevention and treatment- Black spot, Leaf spots, Powdery mildew, Blight, Canker.
- 3.5 Biotechnology: Tools and process of recombinant DNA technology, Applications of biotechnology in agriculture, food industry, medicine and transgenic animals.

## **Text Books**

1. Pandey, B.P. (2013) College Botany, Volume-I, S. Chand Publishing, New Delhi.
2. Kotpal, R.L.2022. Modern textbook of zoology, Vertebrates. (Rastogi Publ., Meerut).
3. Verma P.S., Agarwal V.K., 2006. Cell biology, genetics, Molecular Biology, Evolution and Ecology. S. Chand publishers, New Delhi, India.

## **Reference Books**

1. Sreekrishna V. 2005. Biotechnology –I, Cell Biology and Genetics. New Age International Publ. New Delhi, India.
2. Rastogi, S.C., 2019. Essentials of animal physiology. 4<sup>th</sup> Edition. New Age International Publishers.

BLUE PRINT

MODULE	ESSAY QUESTIONS 10 MARKS	SHORT ANSWER QUESTIONS 5 MARKS	MARKS ALLOTTED TO THE UNIT
MODULE – I	01	02	20
MODULE – II	02	02	30
MODULE – III	02	03	35
Total no.of Questions	05 Of which 3 to be answered	07 Of which 4 to be answered	85 marks including choice Of which 50 marks to be answered

**PITAPUR RAJAH'S GOVERNMENT COLLEGE (A), KAKINADA**

**MULTI DISCIPLINARY COURSE SEM I**

**PRINCIPLES OF BIOLOGICAL SCIENCES MODEL PAPER**

**SECTION- A**

Time:2hrs.

Max.Marks:50

Answer any THREE of the following questions

3X10=30

1. Write an overview on five kingdom classification?
2. Discuss the ultrastructure of a cell and the functions of cell organelles. Compare the structure of plant cells and animal cells?
3. Explain the physiology of photosynthesis, respiration, and transportation in plants.
4. Discuss Mendel's laws of inheritance and their significance in understanding genetic traits.
5. Examine common plant diseases. Describe the causal preventive measures, and treatment methods.

**SECTION- B**

Answer any FOUR of the following questions


4X5=20

6. Viroid
7. Plant Reproductive organs
8. Plant cell structure
9. Fertilization
10. Geological time scale
11. Applications of Biotechnology
12. Photosynthesis

# SEMESTER-II

Course 3: Taxonomy and Functional Anatomy of Fin Fish and Shellfish Course 4:

Biology of fin fish & shell fish

	<b>Pithapur Rajah's Govt. Degree College (A) Kakinada.</b>	<b>Program &amp; Semester</b> B.Sc. Honours in Aquaculture(Major)			
Course Code	<b>TITLE OF THE COURSE</b> <b>COURSE 3: Taxonomy and Functional Anatomy of Fin Fish and Shellfish</b>	Semester-II			
Teaching	Hours Allocated: 45 ( <b>THEORY</b> )	L	T	P	C
Pre-requisites:	Basics of Aquaculture	3	1	-	3

### Course Objectives:

- To understand the taxonomy and functional anatomy position of Fin fish and Shell fish
- To understand the general characteristics of animals belonging to Fin fish and Shell fish
- To understand the structural organization of fin and shell fish
- Understand the digestive and respiratory systems of fin and shell fish
- Understand the reproductive biology of fin and shell fish fish

### Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Acquire knowledge on the Classification of major groups of Finfish and Shell fish
CO2	Students will be familiar with the Digestive & Respiratory systems of Finfish and Shell fish
CO3	Gain knowledge on the structure and functions of circulatory system
CO4	Understand the difference between the brain of fish and prawn
CO5	Acquire knowledge on the Reproductive system of fish and prawn

# **Pithapur Rajah's Govt. Degree College (A) Kakinada.**

## **DEPARTMENT OF ZOOLOGY**

### **Syllabus:**

#### **Unit I: General characters & Classification of Cultivable fin fish and shell fish**

1.1 General Characters of Crustacea

1.2 Classification of Crustacean: Major groups up to orders and their important characters

1.3 General Characters of fishes

1.4 Classification of Fishes: Major groups up to subclass and their important characters.

**Activity: Assignment /Seminar /Quiz/Project/Peer teaching on the above**

**Evaluation: Instructor supposed to prepare detailed Rubrics for the evaluation of the above activit**

#### **Unit 2: Digestive and Respiratory systems of Fish and shell fish**

2.1: Digestive system of fish

2.2 Respiratory system of fish

2.3 Digestive system of Prawn

2.4 Respiratory system of prawn

**Activity : comparative study on different systems is emphasized .Seminars/Quiz/Projects are given .**

**Evaluation : students are evaluated on their knowledge and skills.**

#### **Unit 3: Circulatory systems of Fish and shell fish**

3.1 Cardiovascular system: Structure of heart in fishes

3.2 Blood vascular system in prawn

**Activity : Detailed study on structure and functions of heart is emphasized.**

#### **Unit 4: Nervous system of Fish and shell fish**

4.1 Nervous system in fish: Structure and functions of Brain

4.2 Central Nervous system in prawn.

#### **Unit 5: Reproductive system of Fish and shell fish**

5.1 Urino-genital system in fishes

5.2 Reproductive system in prawn

**Activity: Assignment /Seminar /Quiz/Project/ is conducted**

#### **Co-Curricular activities:**

- Prepare an album depicting various fin and shell fishes
- Should be able to identify and classify various fin and shell fishes
- Differentiate between different systems and prepare working models of fin and shell fishes
- Thermocol and clay models of fin and shell fishes

#### **REFERENCE BOOKS**

Bond E. Carl. 1979. *Biology of Fishes*, Saunders. Halver

JE. 1972. *Fish Nutrition*. Academic Press.

Hoar WS and Randall DJ. 1970. *Fish Physiology*, Vol. I-IX, Academic Press, New York.

Lagler KF, Bardach, JE, Miller, RR, Passino DRM. 1977. *Ichthyology*, 2<sup>nd</sup> Ed. John Wiley & Sons, New York.

Lovell J. 1989. *Nutrition and Feeding of Fish*. Van Nostrand Reinhold, New York.

Moyle PB and Joseph J. Cech Jr. 2004. *Fishes: An Introduction to Ichthyology*. 5<sup>th</sup> Ed. Prentice Hall. Nikolsky

GV. 1963. *Ecology of Fishes*, Academic Press.

#### **Web links**

[https://med.libretexts.org/Courses/Kansas\\_State\\_University/FNDH\\_413%3A\\_Science\\_of\\_Food/02%3A\\_A\\_Proteins/2.03%3A\\_Fish\\_Shellfish/2.3.01%3A\\_Fish\\_Classifications\\_and\\_Composition](https://med.libretexts.org/Courses/Kansas_State_University/FNDH_413%3A_Science_of_Food/02%3A_A_Proteins/2.03%3A_Fish_Shellfish/2.3.01%3A_Fish_Classifications_and_Composition)

<https://courseware.cutm.ac.in/courses/anatomy-and-biology-of-finfish/>

## CO-PO Mapping:

( 1: Slight [Low]; 2: Moderate[Medium]; 3: Substantial[High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	3	2	3	2	1	2	2
CO2	2	1	3	2	1	1	2	3	1	1	2	2	2
CO3	1	1	2	3	3	1	1	1	2	3	1	2	1
CO4	3	2	3	2	2	2	1	2	1	2	2	1	2
CO5	1	2	1	1	1	2	2	1	1	1	1	1	2

Pithapur Rajah's Govt. Degree College (A) Kakinada.

DEPARTMENT OF ZOOLOGY

II SEMESTER ZOOLOGY - PAPER - I

COURSE 3: ANIMAL DIVERSITY-I BIOLOGY OF NON-CHORDATES

**BLUE PRINT**

Time: 2 1/2 hrs

Max. Marks: 50

Unit	Essay	Short
I	1	1
II	1	1
III	1	2
IV	1	1
V	2 Out of 6, 3 questions should be answered 3X10=30M	2 Out of 7, 4 questions should be answered 4X5=20M

**Pithapur Rajah's Govt. Degree College (A) Kakinada.**

**DEPARTMENT OF ZOOLOGY MODEL PAPER FOR II SEMESTER**

**ZOOLOGY**

**PAPER - I**

**COURSE 3: Taxonomy and Functional Anatomy of Fin Fish and Shellfish**

**Time: 2 1/2 hrs**

**Max. Marks: 50**

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**I.**

**Answer**

**any THREE of the following. Choosing at least one from each part.**

**Draw labeled diagrams wherever necessary**

**3x10=30**

**SECTION - A PART- I**

1. What is the Whittaker's Five Kingdom concept and how does it classify the animal kingdom?
2. Describe the Canal system in sponges
3. Explain Parasitic Adaptations in helminthes

**PART- II**

4. Explain Vermicompost, economic importance of vermicompost
5. Describe the Pearl formation in Pelecypoda
6. Describe the Water vascular system in star fish

**SECTION - B**


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

**Draw labeled diagrams wherever necessary**

**4x5=20**

7. Amoeboid Movement
8. Ascon type canal System
9. Trematoda
10. Pathogenicity of Ascaris
11. Nephredia
12. Gastropoda
13. Affinities of Balanoglossus

**Pithapur Rajah's Govt. Degree College (A) Kakinada.**  
**DEPARTMENT OF ZOOLOGY**  
**SEMESTER-II**

	<b>Pithapur Rajah's Govt. Degree College (A) Kakinada.</b>	<b>Program &amp; Semester</b> B.Sc. Honours in Aquaculture(Major)			
Course Code	<b>TITLE OF THE COURSE</b> <b>COURSE 3: Taxonomy and Functional Anatomy of Fin Fish and Shellfish</b>	Semester-II			
Teaching	Hours Allocated: 30 ( <b>LAB</b> )	L	T	P	C
Pre-requisites:	Basics of Aquaculture			2	1

**SYLLABUS**

**List of Practicals:**

- 1). Study of mouth parts in herbivorous and carnivorous fishes
- 2). Comparative study of digestive system of herbivorous and carnivorous fishes
- 3). Demonstration of brain of fish
- 4). Demonstration of cranial nerves of fish
- 5). Demonstration of Nervous system of prawn
- 6). Exposure of gills of prawn
- 7). Exposure of gills of fish

**REFERENCE BOOKS**

Bond E. Carl. 1979. *Biology of Fishes*, Saunders. Halver JE. 1972.

*Fish Nutrition*. Academic Press.

Hoar WS and Randall DJ. 1970. *Fish Physiology*, Vol. I-IX, Academic Press, New York.

Lagler KF, Bardach, JE, Miller, RR, Passino DRM. 1977. *Ichthyology*, 2<sup>nd</sup> Ed. John Wiley & Sons, New York.

Lovell J. 1989. *Nutrition and Feeding of Fish*. Van Nostrand Reinhold, New York.

Moyle PB and Joseph J. Cech Jr. 2004. *Fishes: An Introduction to Ichthyology*. 5<sup>th</sup> Ed. Prentice Hall.

Nikolsky GV. 1963. *Ecology of Fishes*, Academic Press.

**Pithapur Rajah's Govt. Degree College (A) Kakinada.**  
**DEPARTMENT OF ZOOLOGY**  
**Taxonomy and Functional Anatomy of Fin Fish and Shellfish**

PRACTICAL MODEL PAPER

**Time: 3hrs**

**Max. Marks: 50**

I. Identify the following specimens or spotters & slides, draw neat labeled diagrams

–write notes on

4x5=20M

A. Nauplius

B. Glochidium

C. Alima

D. Oyster eggs

II Write notes on the following

20x1=20M


E. Study of nest building and brooding of fishes

III. Practical Record

5x1=5 M

Viva voce

5M

	<b>Pithapur Rajah's Govt. Degree College (A) Kakinada.</b>	<b>Program &amp; Semester</b> B.Sc. Honours in Zoology (Major)			
Course Code	<b>TITLE OF THE COURSE</b> <b>COURSE 4: BIOLOGY OF FIN FISH AND SHELL FISH</b>	Semester-II			
Teaching	Hours Allocated: 60 ( <b>THEORY</b> )	L	T	P	C
Pre-requisites:	Basics of Aquaculture	3	1	-	3

**Course Objectives :**

- Gain Knowledge of feeding habits, gut content analysis and growth factors in fishes. 2.Understand the commercial importance of crustaceans and Fish
- Understand and learn breeding in fishes, breeding habits, method of induced breeding in fishes.
- To create awareness on parental care of Fishes and embryonic and larval development and environmental factors affecting development of major aquaculture organisms.
- Acquire knowledge about Endocrine system in fishes

On Completion of the course, the students will be able to-

<i>CO1</i>	Gain knowledge on classification of fishes
<i>CO2</i>	Nuturing the skills on food,feed and growth parameters
<i>CO3</i>	Understand the reproductive biology of fish
<i>CO4</i>	Understand the parental care in fishes
<i>CO5</i>	Understand the endocrine system in fishes

Skill Development		Employability		Entrepreneurship	
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**Pithapur Rajah's Govt. Degree College (A) Kakinada.**  
**DEPARTMENT OF ZOOLOGY II SEMESTER**

**Course No.: 4 -Biology of Fin Fish & Shellfish**

**SYLLABUS**

**UNIT- I: Specialized organs in fish**

- 1.1 Sense organs of fishes and crustaceans.
- 1.2 Specialized organs in fishes – electric organ, venom and toxins
- 1.3 Buoyancy in fishes- swim bladder and mechanism of gas secretion
- 1.4 Fish and Crustaceans of commercial importance

**Activity: Assignment /Seminar /Quiz/Project/Peer teaching on the above**

**Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity**

**UNIT- II: Food, Feeding and Growth**

- 2.1 Natural fish food, feeding habits, feeding intensity, stimuli for feeding, utilization of food, gut content analysis, forage ratio
- 2.2 Principles of Age and growth determination; growth regulation, Growth rate measurement – scale method, otolith method, skeletal parts as age indicators
- 2.3 Length-frequency method, age composition, age-length keys, absolute and specific growth, back calculation of length and growth, annual survival rate,
- 2.4 Length-weight relationship.

**Activity: Assignment /Seminar /Quiz/Project/Peer teaching on the above**

**Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity**

**UNIT- III: Reproductive Biology**

- 3.1 Breeding in fishes, breeding places, breeding habits & places, breeding in natural environment and in artificial ponds, courtship and reproductive cycles
- 3.2 Induced breeding in fishes

3.3 Breeding in shrimp, oysters, mussels, clams, pearl oyster, pila, and cephalopods.

**Activity: Assignment /Seminar /Quiz/Project/Peer teaching on the above**

**Evaluation: Instructor supposed to prepare detailed Rubrics for the evaluation of the above activity**

#### **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 molluscans of commercial importance
- 4.4. Environmental factors affecting reproduction and development of cultivable aquatic fin & shell fish

**Activity: Assignment /Seminar /Quiz/Project/Peer teaching on the above**

**Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity**

#### **UNIT- V: Hormones & Growth.**

- 5.1 Endocrine system in fishes.
- 5.2 Neuro-secretory cells, androgenic gland, ovary, chromatophores,
- 5.3 Molting, molting stages, metamorphosis in crustacean shell fish

**Activity: Assignment /Seminar /Quiz/Project/Peer teaching on the above**

**Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity**

#### **Co- Curricular Activities**

- Identify different sense organs of fishes
- To make chart on feed formulation
- To identify age determination of fishes –scales,otolith and skeletal methods
- Collect different larval forms of fish ,shrimps,crabs and molluscans
- To know about hypophysation techniques from the Fisheries Department.

### Text books:

Bone Q et al., 1995. Biology of fishes, Blackie academic & professional, LONDON

Saxena AB 1996. Life of Crustaceans. Anmol Publications Pvt.Ltd., New Delhi

### Reference 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

### Web Links:

1. <https://www.slideshare.net/sbmptdr/biology-of-finfish-2nd-semester-full-sylabus-106322965>

2. <http://ecoursesonline.iasri.res.in/course/view.php?id=427>

### CO-PO Mapping:

( 1: Slight [Low]; 2: Moderate[Medium]; 3: Substantial[High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	2	1	2	1	3	2	3	2	1	2	2
CO2	2	1	3	2	1	1	2	3	1	1	2	2	2
CO3	1	1	2	3	3	1	1	1	2	3	1	2	1
CO4	2	2	3	2	2	2	1	2	1	2	2	1	2
CO5	1	2	1	1	1	2	2	1	1	1	1	1	2

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Pithapur Rajah's Govt. Degree College (A) Kakinada.

DEPARTMENT OF ZOOLOGY II SEMESTER - AQUACULTURE

COURSE 4: **BIOLOGY OF FIN FISH AND SHELL FISH**

**BLUE PRINT**

Time: 2 1/2 hrs

Max. Marks: 50

<b>Unit</b>	<b>Essay</b>	<b>Short</b>
I	1	1
II	1	1
III	1	2
IV	1	1
V	2 <b>Out of 6, 3 questions should be answered 3X10=30M</b>	2 <b>Out of 7, 4 questions should be answered 4X5=20M</b>

**Pithapur Rajah's Govt. Degree College (A) Kakinada.**

**DEPARTMENT OF ZOOLOGY MODEL PAPER FOR  
II SEMESTER**

**COURSE 4: BIOLOGY OF FIN FISH AND SHELL FISH**

**Time: 2 1/2 hrs**

**Max. Marks: 50**

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**Answer any THREE of the following. Choosing at least one from each part.**

**Draw labeled diagrams wherever necessary**

**3x10=30**

**SECTION - A**

**PART- I**

1. Explain sensory organs of Fish
2. How do you analyze gut contents to estimate quality of fish
3. Write an essay on Induced breeding in fish

**PART- II**

4. Discuss larval stages in the development of shrimp
5. Discuss the commercial importance of Crabs and Molluscs
6. Write an essay on metamorphosis in crustaceans

**SECTION - B**

**Answer any FOUR of the following:**

**Draw labeled diagrams wherever necessary**

**4x5=20**

7. Swim bladder
8. Natural fish food
9. Otolith method
10. Artificial ponds
11. Parental care in fish
12. Neurosecretory cells
13. Growth rate measurement

**Pithapur Rajah's Govt. Degree College (A) Kakinada.**  
**SEMESTER-II**  
**Course -4: BIOLOGY OF FINFISH AND SHELLFISH**  
**Practical Syllabus**

Credits :1

**List of Practicals:**

1. Length-weight relationship of fishes
2. Gut content analysis in fishes and shrimp
3. Mouth parts and appendages of cultivable prawns, shrimps and other crustaceans
4. Study of eggs of fishes, shrimps, prawns and other crustaceans
5. Study of oyster eggs
6. Embryonic and larval development of fish
7. Study of gonadial maturity and fecundity in fishes and shellfish 8..Observation of crustacean larvae
8. Study of nest building and brooding of fishes

**PRESCRIBED BOOK(S)**

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

**REFERENCES:**

Tandon KK & Johal MS 1996. Age and Growth in Indian Fresh Water Fishes. Narendra Publishing House, New Delhi.

Raymond T et al., 1990. Crustacean Sexual Biology, Columbia University Press, New York

GuilandJ.A (ed) 1984. Penaeid shrimps- Their Biology and Management.

1.18 Barrington FJW 1971. Invertebrates: Structure and Function.ELBS

1.19 Parker F & Haswell 1992. The text book of Zoology, Voll. Invertebrates (eds. Marshal AJ & Williams).  
ELBS & Mc Millan & Co.

**Pithapur Rajah's Govt. Degree College (A) Kakinada.**

**DEPARTMENT OF ZOOLOGY**

**ZOOLOGY PRACTICAL SYLLABUS FOR II SEMESTER BIOLOGY OF FINFISH**

**AND SHELLFISH**

**PRACTICAL MODEL PAPER**

**Time: 3hrs**

**Max. Marks: 50**

I. Identify the following specimens or spotters & slides, draw neat labeled diagrams

–write notes on

4x5=20M

- A. Nauplius
- B. Glochidium
- C. Alima
- D. Oyster eggs

II Write notes on the following

10x2=20M

- A. Study of nest building and brooding of fishes
- B. Appandages of Prawn

III. Practical Record

5x1=5M

IV. Viva voce

5M

## **MINOR SYLLABUS FOR AQUACULTURE II SEMESTER SEMESTER-II**

### **COURSE 1: BIOMOLECULES AND ANALYTICAL TECHNIQUES**

Theory Credits: 3

3 hrs/week

#### **I. LEARNING OUTCOMES**

On successful completion of the course, the students will be able to

1. Learn about classification, structure and properties of Carbohydrates, Proteins and Lipids.
2. Learn about structure and function of DNA, RNA, Vitamins and Bioenergetics.
3. Learn about basic principles of Centrifugation, Chromatography and Electrophoresis.
4. Learn about principles of Spectroscopy, Microscopy and Techniques.
5. Learn about basics of Biostatistics.

#### **II. Syllabus**

##### **Unit-I-Carbohydrates, Protein and Lipids**

1. Classification, structure, properties of carbohydrates, amino acids, peptide bond and peptides.
2. Classification, structure (primary, secondary, tertiary, quaternary) and functions of proteins.  
Denaturation and renaturation of proteins.
3. Classification structure and properties of saturated and unsaturated fatty acids.

##### **Unit-II- Nucleic acid, Vitamins, and Bioenergetics**

1. Structure and functions of DNA and RNA.
2. Source, structure, biological role, and deficiency manifestation of vitamin A, B, C, D, E, and K.  
Free energy, entropy, enthalpy, and redox potential.
3. High energy compounds, Electron-Transport System and Oxidative Phosphorylation.

##### **Unit-III-Centrifugation, Chromatography, and Electrophoresis**

1. Basic principles of sedimentation and types of centrifugations.
2. Principle, instrumentation, and application of partition, absorption, paper, TLC, ion exchange, gel permeation, and affinity chromatography.

3. Basic principles and types of electrophoresis, factors affecting electrophoretic migration. PAGE (Native, SDS-PAGE). Introduction to 2D & Isoelectric Focusing.

#### **Unit - IV-Spectroscopy, Microscopy and Laser Techniques**

1. Beer-Lambert law, light absorption and transmission. Extinction coefficient, Design and application of photoelectric calorimeter and UV-visible spectrophotometer. Introduction to crystallography and application.

2. Types and design of microscopes - compound, phase contrast, fluorescent electron microscopy (TEM, SEM).

3. Introduction to radioisotopes, measurement of radioactivity (scintillation counter and autoradiography)

#### **Unit –V- Biostatistics**

1. Mean, median, mode, standard deviation,

2. One-way ANOVA, Two-way Anova

3. t-test, F-test and chi-square.

III. Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. learn about basic instruments and their operation

2. learn about Qualitative and Quantitative analysis of carbohydrates

3. Learn about estimations nucleic acids and protein by various methods

4. learn about the separation of molecules by chromatography and electrophoresis

5. Learn about problems on mean median mode

## SEMESTER-II

### COURSE 1: BIOMOLECULES AND ANALYTICAL TECHNIQUES

#### Practical Syllabus

**Practical Credits: 1**

**2 hrs/week**

1. Introduction to basic instruments (Principle standard operation procedure) demonstration and record
2. Calculation of molarity, normality, and molecular weight of compounds.
3. Qualitative analysis of carbohydrates (sugars)
4. Quantitative analysis of carbohydrates
5. Quantitative estimation of protein - Lowery method
6. Estimation of DNA by diphenylamine reagent
7. Estimation of RNA by orcinol reagent
8. Assay of protease activity
9. Preparation of starch from potato and its hydrolyze by salivary amylase
10. Preparation of standard buffer and pH determination
11. Separation of amino acids by paper chromatography
12. Separation of lipids of TLC
13. Agarose gel electrophoresis
14. Calculation of mean, median and mode

#### V. REFERENCES

1. Outlines of Biochemistry, 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
2. Principles of Biochemistry, 4th edition, (1997), Jeffory Zubey; McGraw-Hill College, USA
3. Principles of Biochemistry, 5th Edition (2008), Lehninger, David Nelson & Michael Cox; W.H. Freeman and Company, NY
4. Fundamentals of Biochemistry, 3rd Edition (2008), Donald Voet & Judith Voet; John Wiley and Sons, Inc. USA

5. Biochemistry, 7th Edition, (2012), Jeremy Berg & Lubert Stryer; W.H.Freeman and Company,
6. An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGraw Hill Edu. Pvt.Ltd. New Delhi, India
7. Biochemical Methods, 1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India
8. Textbook of Biochemistry with Clinical Correlations, 7th Edition, (2010), Thomas M. Devlin; John Wiley and Sons, USA
9. Proteins: biotechnology and biochemistry, 1st edition, (2001), Gary Walsch; Wiley, USA
10. Biochemical Calculations, 2nd Ed., (1997), Segel Irvin H; John Wiley and Sons, NY
11. Biophysical Chemistry Principles & Techniques Handbook, (2003), A. Upadhyay, K. Upadhyay, and N. Nath
12. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001), Palmer Trevor, Publisher: Horwood Pub. Co., England.
13. Analytical Biochemistry, 3rd edition, (1998), David Holmes, H.Peck, Prentice-Hall, UK
14. Introductory Biostatistics, 1st edition, (2003), Chap T. Le; John Wiley, USA.
15. Methods in Biostatistics, (2002), B. K. Mahajan –Jaypee Brothers.
16. Statistical methods in biology, (1995), Bailey, N. T.; Cambridge university press

## VI. CO-Curricular Activities

### a) Suggested CO-Curricular Activities

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts preparation on vitamins

## II

## SEMESTER

**Course No.: 5 - Basic Principles of Aquaculture**  
credits :3

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## COURSE OUTCOMES

Co1 Understand the concept of blue revolution, analyse the history and compare the present status of aquaculture at global, national and state levels and its significance over agriculture .

Co2: Acquire knowledge in the different types of aquaculture, culture systems and culture methods in practice worldwide.

CO3: Gain knowledge in the different types of culture ponds.

Co4: Understand the arrangement of different types of ponds in a fish farm and design an ideal fish farm

CO5: Comprehend the best management practices to be adopted in aquaculture for good yield and acquire the skill in the analysis of water and soil parameters of a culture pond.

## **SYLLABUS**

### UNIT-I ( Introduction)

1. Definition and History of Aquaculture
2. Concept of Blue Revolution and Pradhan Mantri Matsya Sampada Yojana (PMMSY)
3. Present status of Aquaculture at global level, India and Andhra Pradesh
4. Aquaculture versus Agriculture; Present day needs with special reference to Andhra Pradesh

### UNIT-II (Types of Fish Ponds)

1. Lotic and lentic systems, streams and springs

Classification of ponds based on water resources – spring, rain water, flood water, wellwater and water course ponds

2. Functional classification of ponds – head pond, hatchery, nursery, rearing, production and stocking
3. ponds; quarantine ponds, isolation ponds and wintering ponds

### UNIT- III (Design and Construction of Aqua Farms)

1. Important factors in the construction of an ideal fish pond – site selection, topography, nature of the soil, water resources
2. Lay out and arrangement of ponds in a fish farm
3. construction of an ideal fish pond – space allocation, structure and components of barrage Pond

### UNIT-IV (Aquaculture Systems and Practices )

1. Types of aquaculture Fresh water aquaculture - Brackish water aquaculture - Mari culture
2. Aquaculture Systems – Pond, Raceways, Cage, Pen, Rafts, Running water, Water Recirculating Systems, Biofloc Technology and 3-C System
3. Pond culture practices- Traditional, Extensive, Modified Extensive, Semi-Intensive, Intensive & Super-intensive systems of fish and shrimp and their significance.
4. Fin fish culture methods - Monoculture, Poly culture and Monosex culture and Integrated fish farming.

#### UNIT-V ( Management Factors of Culture Ponds, Pre-stocking Management

1. Dewatering, drying, ploughing/desilting
2. Predators, weeds and weed fish in culture ponds - Advantages and disadvantages of weed plants; Toxins used for weed control and control of predators. Liming and fertilization;
3. Algal blooms and their control
4. Stocking Management – Stocking density and stocking
5. Post-stocking Management Feeding: Role of nutrients
6. Water quality: Physico-chemical conditions of soil and water optimum for culture – temperature, depth, turbidity, light, water and shore currents, PH, DOD, CO<sub>2</sub>, NH<sub>3</sub>, NO<sub>2</sub>

### III SEMESTER

#### Course No.: 5 - Basic Principles of Aquaculture

credits :1

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1. Estimation of Carbonates, Bicarbonates in watersamples
2. Estimation of DissolvedOxygen
3. Estimation of Ammonia in water.
4. Estimation of Total Hardness of water sample.
5. Study of beneficial and harmful algal species
6. Collection, identification and isolation of zooplankton and phytoplankton
- 7 Collection and study of aquaticweeds, aquatic insects, weed fish and larvivorous fish
8. Field visit to hatchery, nursery, rearing and stocking ponds of aqua farms.

#### 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:

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
4. Bose AN et.al, 1991. *Costal Aquaculture Engineering*. Oxford & IBH Publishing Company.

## REFERENCES

1. Boyd CE. 1979. *Water Quality in Warm Water Fish Ponds*. Auburn University
2. Boyd, CE. 1982. *Water Quality Management for Pond Fish Culture*. Elsevier Sci. Publ. Co.
3. FAO. 2007. *Manual on Freshwater Prawn Farming*.

### III SEMESTER Course No.: 6 - Capture Fisheries credits :3

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#### Course Outcomes

**CO1:** Understand the EEZ concept & its implementation in fisheries

**CO2:** Knowledge on Fish Distribution

**CO3:** Acquire Knowledge on the Riverine systems of India

**CO4:** Gain Knowledge on Reservoir Fishery

#### **Unit I : Fish Catch Statistics :-**

1.1 Fish production of the world both inland and marine, contribution of different countries, position of India in the Fish Catches.

1.2 The EEZ concept & its implementation in fisheries. The Indian EEZ, Fishery survey in India

#### **Unit II : Fish Distribution .**

2.1 General account of the distribution

2.2 Biology and fishery of important fishes and other aquatic animals of India,

2.3. Economically Important Fresh Water Fishes of Andhra Pradesh.

#### **Unit-III Riverine Fishery I :-**

3.1 Important characters of Streams.

3.2 Different riverine systems in India, and their fishery: The Ganga River System, the Brahmaputra river system,

#### **Unit-IV Riverine Fishery II :-**

4.1 The East Coast River System.

4.2 The West Coast River System, River Jhelum of the Indus River System, Fisheries of trout and Mahseer, Problems and management.

#### **Unit-V Reservoir Fishery (Lacustrine Fishery) :-**

5.1 Definition of a Lake, Origin and classification of lakes.

5.2 Kolleru Lake and its fishery.

5.3 Different reservoirs of River systems in India with special reference to Nagarjuna Sagar,

### III SEMESTER

#### Course No.: 6 - Capture Fisheries

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#### PRACTICALS SEMESTER – II

1. Identification of Freshwater fishes based on colour, Pigmentation, morphometric and meristic characters and other characters relevant to the group.
2. Identification of fry and fingerlings of Indian Major Carps.
3. Examination of Commercially Important Freshwater fishes and prawns, from the point of view of ecology and fishery.
4. Knowledge of common types of Freshwater craft and gear on models provided in the department.

Field Work : Visit to fish landing centers of rivers, lakes and reservoirs.

#### Reference Books :-

1. Jhingram, V.G. Fish and Fisheries of India. Second edition 1983, Hindustan Pub.Co. Picker,
2. W.E. Methods for assessment of Fish Production in Fresh Waters. Blackwell Scient. Publ. 1970
3. Bal, D.V. and Veerabhadra Rao, K. Marine Fisheries, Tata MC Grawhill Publications, New Delhi.
4. Srivastava, U.K. et.al. Freshwater aquaculture in India, Oxford and IBH Publ. Co. New Delhi 1980
5. C.B.L. Srivastava – A text book of Fishery Science and Indian Fisheries. Kitab Mahal Agencies, Patna.

## III SEMESTER

### Course No.: 7 - Fresh water Aquaculture

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#### Course outcomes:

1. Learn the Status, Scope and Prospects of fresh water aquaculture in the world, India and AP.
2. Learn about Major Cultivable Indian Carps and Exotic fish Species introduced in India
3. Know about recent developments in the culture of clarius, anabas and murrels and special systems of aquaculture.
4. Gain knowledge of commercially valuable Fresh water prawns of India and their culturing methods.

#### UNIT-1: 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. **Unit-III**

- 3.1 Composite fish culture system of Indian and exotic carps
- 3.2 Impact of exotic fish, Compatibility of Indian and exotic carps and competition among them

#### UNIT-IV: Culture of air-breathing and cold water fish

4-1 Recent developments in the culture of clarius, anabas, murrels,

4-2 Advantages and constraints in the culture of air-breathing and cold water fishes- seed resources,

feeding, management and production

4-3 Special systems of Aquaculture- brief study of culture in running water, re-circulatory systems, cages and pens, sewage-fed fish culture

#### UNIT-V: Culture of Prawn

5-1 Fresh water prawns of India - commercial value

5-2 Macrobrachium rosenbergii and M. Malcomsonii– biology, seed production, pond preparation,

stocking, management of nursery and grow-out ponds, feeding, morphotypes and harvestin

### III SEMESTER

#### Course No.: 7 - Fresh water Aquaculture.

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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 fresh water prawn.
- 6 Identification of commercially viable crabs – *Scylla cerrata*, *Portunus pelagicus*,  
*P.sanguinolentus*,  
*Neptunus pelagicus*, *N. Sanguinolentus* .
7. Identification of lobsters – *Panulirus polyphagus*, *P.ornatus*, *P.homarus*, *P.sewelli*,  
*P.penicillatus*.
8. Identification of oysters of nutritional significance – *Crossostrea madrasensis*,  
*C.gryphoides*,  
*C. cucullata*, *C.rivularis* , *Picnodanta* .
9. Identification of mussels and clams.
10. Identification of developmental stages of oysters.

#### PRESCRIBED BOOK(S):

- 1 Jhingran VG 1998. Fish and Fisheries of India. Hindusthan Publishing Corporation, NewDelhi

#### REFERENCES:

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 Marcel H 1972. Text book of fish culture.Oxford fishing news books.

**III SEMESTER**  
**Course No.: 8 - Brackish water Aquaculture**  
credits :3

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**Course Outcomes:**

**CO1:** Knowledge on development and present status of brackish water farming in India.

**CO2:** Learn about the types of culture systems

**CO3:** Gain knowledge on commercial value of prawns in India

**CO4:** Know about the biology of important shrimps

**CO5:** Know about the species of crabs and edible oysters cultured

**Unit – I Introduction**

1.1 Introduction, History, Development and present status of brackish water farming in India.

1.2 Brackish water as a medium for aquaculture, ecological factors – Abiotic and biotic factors.

1.3 Types of culture systems – Traditional, extensive, semi-intensive and intensive culture systems of shrimp, their management and economics.

**Unit – II Culture of brackish water prawns**

2.1 Culture practices of *Penaeus monodon*/ *P.vannamei*

2.2 Brackish water prawns of India – Commercial value.

2. Morphotypes and harvesting

**Unit – III Biology of Shrimp**

3.1 Biology of *Penaeus monodon*,

3.2 Biology of *P.indicus*

3.3 Biology of *P.vannamei*.

**Unit – IV Management practices**

4.1 Nutritional requirements of cultivable prawns.

4.2 Natural food and artificial feeds and their importance in shrimp culture

4.3. Pond preparation, stocking, of Hatchery, Nursery, grow out ponds. and harvesting of shrimp.

**Unit – V Culture of Brackish water species**

5.1 Species of crabs cultured, biology and culture technique, prospects in India.

5.2 Species of edible oysters, culture techniques used for farming edible oysters.

5.3 Important species of pearl oysters and method of artificial pearl production.

**III SEMESTER**  
**Course No.: 8 - Brackish water Aquaculture**  
credits :1

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Identification of cultivable fresh water and marine water prawns (any 3 each)

Identification of marine crabs and oysters of commercial importance (any 2 each).

3. Identification of Phytoplankton and Zooplankton (any 5 each).

4. Identification of different live feed organisms for shrimp larvae (any 4)

5. Identification of larval stages of prawn. 6. Demonstration of eye stalk ablation in penaeus monodon.

**References :**

1. Pillay, TVR. Aquaculture principles and practices, Fishery News (Books) Ltd., London 1990.

2. Prawn and prawn fisheries by Kurain and Sebestain.

3. Shankar KM & Mohan CV 2002. Fish and Shell Fish Health Management UNESCO. Publ. Sundermann CJ 1990.

4. Johnson SK 1995. Hand book of shrimp diseases Texas A & M university, Texas.

5. Guland J.A. (ed) 1984. Penaeid Shrimps – Their Biology and Management.

6. Raymond T et al., 1990. Crustacean Sexual Biology, Columbia University Press, New York.

7. Identification and mounting of appendages of prawn / shrimp.

8. Field visit to prawn / shrimp hatchery

. 9. Field visit to prawn / shrimp culture ponds.

## IV SEMESTER

### Course No.: 9 - Fish Health Management

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#### **Course outcomes:**

1. Provide students with knowledge about fish diseases and pathological aspects of diseases.
2. Learn about Fungal, Viral and Bacterial diseases of finfish.
3. Gain knowledge of Nutritional deficiency related diseases and antibiotic and chemotherapeutics.
4. Understand and learn the importance of diagnostic tools in identification of diseases and application and development of vaccines.

#### **UNIT I: Pathology and parasitology**

1-1 Introduction to fish diseases –Definition and categories of diseases – Disease and environment

1-2 Disturbance in cell structure – changes in cell metabolism, progressive and retrogressive tissue changes, types of degeneration, infiltration, necrosis, cell death and causes

1-3 Atrophy, hypertrophy, neoplasms, inflammation, healing and repair

#### **UNIT II: Fungal and viral Diseases of fin fish.**

2-1 Fungal diseases (both of shell and finfish) – Saprolegniosis, brachiomycosis, ichthyophorus

diseases – Lagenidium diseases – Fusarium disease, prevention and therapy

2-2 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

#### **UNIT III: bacterial Diseases of fin fish.**

2-3 Bacterial diseases – Emerging bacterial diseases, aeromonas, 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 IV: Protozoan Diseases of fin fish.**

Protozoan diseases: Ichthyophthiriasis( White spot Disease), Costiasis, Whirling disease

#### **UNIT V: Nutritional diseases**

4-1 Nutritional pathology – lipid liver degeneration, Vitamin and mineral deficiency diseases. Aflatoxin and dinoflagellates.

4-2 Antibiotic and chemotherapeutics. Nutritional cataract. Genetically and environmentally induced diseases.

## IV SEMESTER

### Course No.: 9 - Fish Health Management

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1. Enumeration of Bacteria by TPC Method
2. Enumeration of total Coli forms
3. Observation of gross pathology and external lesions of fish 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. Collection, processing and analysis of data for epidemiological investigations of viral diseases
6. Bacterial pathogens – isolation, culture and characterization
7. Identification of parasites in fishes: Protozoan, Helminths, Crustaceans
8. Estimation of dose, calculation of concentration, methods of administration of various chemotherapeutics to fish and shell fish
9. Estimation of antibiotics used in aquaculture practices

#### **PRESCRIBED BOOK(S):**

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

#### **REFERENCES:**

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

## IV SEMESTER

### Course No.:10 - Shrimp Health Management

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#### **Course outcomes:**

1. Provide students with knowledge about shrimp diseases and pathological aspects of diseases.
2. Learn about Fungal, Viral and Bacterial diseases of shellfish.
3. Gain knowledge of Nutritional deficiency related diseases and antibiotic and chemotherapeutics.
4. Understand and learn the importance of diagnostic tools in identification of diseases and application and development of vaccines.
5. To know about production of disease free seeds and good feed management.

#### **Syllabus**

##### **UNIT I: Viral Diseases of shell fish (Symptoms, Treatment and Prophylaxis)**

- 1-1 Major shrimp viral diseases – Baculovirus penaeii, Monodon Baculovirus,
- 1-2 Baculoviral midgut necrosis, Infectious hypodermal and haematopoietic necrosis virus, Hepatopancreatic parvo like virus,
- 1-3 Yellow head baculovirus, white spot baculovirus.

##### **UNIT II: Bacterial Diseases of shell fish (Symptoms, Treatment and Prophylaxis)**

- 2.1 Bacterial diseases of shell fish – aeromonas, pseudomonas and vibrio infections,
- 2.2 Luminous bacterial disease, filamentous bacterial disease. Prevention and therapy

##### **UNIT III: Protozoan Diseases of shell fish (Symptoms, Treatment and Prophylaxis)**

- 3-1 Protozoan diseases- Ichthyophthiriasis, Costiasis,
- 3-2 Whirling diseases, trypanosomiasis

##### **UNIT IV: Health management**

- 4-1 Diagnostic tools – immune detection- DNA/RNA techniques, General preventive methods and prophylaxis. Application and development of vaccines.

- 4-2 Quarantine – Significance, methods and regulations for transplants.

##### **UNIT V: Production of disease free seeds**

- 5-1 Production of disease-free seeds. Evaluation criteria of healthy seeds.
- 5-2 Good Feed management for healthy organisms, Zero water exchange, Probiotics in

## IV SEMESTER

### Course No.:10 - Shrimp Health Management

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1. Enumeration of Bacteria by TPC Method
2. Observation of gross pathology and external lesions of fish and prawn with reference to the common diseases in aquaculture
3. Examination of pathological changes in gut lumen, hepatopancreas, lymphoid organ, muscles and nerves of prawn and shrimp
4. Collection, processing and analysis of data for epidemiological investigations of viral diseases
5. Bacterial pathogens – isolation, culture and characterization
6. Antibioassays – preparation and evaluation
7. Molecular and immunological techniques; Biochemical tests; PCR; ELISA; Agglutination test; Challenge tests; Purification of virus for development of vaccines (Demonstration at institutes/labs)
8. Estimation of dose, calculation of concentration, methods of administration of various chemotherapeutics to fish and shell fish
9. Estimation of antibiotics used in aquaculture practices
10. Estimation of probiotics used in aquaculture

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**Course outcomes:**

1. Understand Nutritional requirements of cultivable fishes and factors affecting energy partitioning and feeding.
2. Know different types of feed and FCR and different types of feeders
3. Gain Knowledge of Feed manufacture and storage methods of feeds
4. Understand the value of Feed additives and Non-Nutrient ingredients.
5. To create awareness of different nutritional deficiency and importance of natural and supplementary feeds and balanced diet.

**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 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

**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

**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.

**UNIT-V: Nutritional Deficiency in Cultivable fish**

- 5-1 Protein deficiency, vitamin and mineral deficiency symptoms
- 5-2 Nutritional pathology and anti-nutrients
- 5-3 Importance of natural and supplementary feeds, balanced diet.


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

**PRESCRIBED BOOK(S):**

1. HALVER JE 1989. Fish nutrition. Academic press, San diego
- REFERENCES:**
- 1.1 Lovell rt 1998. Nutrition and feeding of fishes, Chapmann & Hall, New York
  - 1.2 Sena de silva, trevor a anderson 1995. Fish nutrition in aquaculture. Chapmann & Hall, New York.

**P.R. GOVERNMENT COLLEGE (A), KAKINADA CHOICE BASED**

**CREDIT SYSTEM**

	<b>P. R. GOVERNMENT COLLEGE (A) KAKINADA</b>	<b>Program &amp; Semester</b>			
	Course Code	<b>TITLE OF THE COURSE MARINE BIOLOGY</b>	<b>SEMESTER - V PAPER-VI</b>		
Teaching	Hours Allocated: 60 ( <b>Theory</b> )	L	T	P	C

Pre-requisites:		4	1	2	5
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I.  
II. COURSE OUT COMES:

- After successful completion of this course student will be able to
- Understand the Divisions, life of Marine Ecosystem
- Assess the Productivity of Marine Ecosystem
- Know the ecological importance of critical ecosystems associated with marine ecosystem
- Judge the adaptations of animals in the marine ecosystem

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

**Unit – I Introduction:**

Divisions of marine environment- pelagic, benthic, euphotic, aphotic divisions and their subdivisions.

Life in oceans – general account of major groups of phytoplankton, sea weeds, major zooplankton groups.

Environmental factors affecting life in the oceans- salinity, temperature, light, currents, waves, tides, oxygen, and carbon dioxide.

**Unit – II**

2.1 Primary, secondary and tertiary production.

2.2 Marine food chains and food webs. Vertical migration of zooplankton. Phytoplankton-Zooplankton relationship, plankton and fisheries.

**Unit – III**

3.1 Benthos- a life in rocky, sandy, and muddy shores.

3.2 Mangroves Ecosystem and Ecological importance

3.3 Coral reefs ecosystem-ecological importance

## Unit – IV

4.1 Boring and fouling organisms- examples with adaptations.

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4.1 Nekton- outline composition of nekton, habitats of nekton.

4.3 Bioluminescence and indicator species, red tides

## Unit –V

5.1 Biology and classification of marine mammals,

5.2 Adaptations in marine mammals for conserving body heat and submersion for long dive.

## IV. References:

### Reference Books

1. Carmelo, T.R., 1997. Identifying Marine Phytoplankton by Academic Press.
2. ICES Zooplankton Methodology Manual Ed. by Harrish. R., P. Wiebe., J. Leng., H.R. Skyoldal., M. Huntley. Academic Press 2000.
3. Gage. J.D. and Tyler, P.A. 1991. Deep Sea Biology, Cambridge University Press, Cambridge.
4. William, C., 1991. Seashore life between the tides. Dover Publication
5. Makoto, Omori and Tsutomu Ikeda, 1984. Methods in Marine Zooplankton Ecology, Wiley & Sons. Inc. Canada
6. Venkataraman, K., C. Raghunathan. R. Raghuramanand C.R. Sreeraj. 2012. Marine Biodiversity in India, Zoological Surv. India, Kolkata, 164pp.
7. Morrissey, J.F. and J.L. Sumich. 2012. Introduction to the Biology of Marine Life. Jones & Bartlett learning, U.K., 467pp.
8. Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited.
9. Fish, J.D & S. Fish. 2010. A Students Guide to the Seashore. Cambridge University Press, 527pp.
10. Chapman, V.J. and D.J. Chapman, 1980. Seaweed and Their Use. Chapman & Hall, London.
11. Chapman, V.J., 1976. Mangrove Vegetation. J. Gramer, Berlin.
12. Balakrishnan Nair, N. and D.M. Thampy, 1980. A Text Book of Marine Ecology. The Macmillan Co. of India Ltd., New Delhi
13. Svedrup et al The Oceans Prentice Hall
14. Tait RV Elements of marine ecology Butterworths
15. Riley & Skirrow Chemical Oceanography Academic Press

16. Newell RC Biology of intertidal animals Logos Press
17. Kinne O (Ed) Marine ecology John Wiley & Sons

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18. Marshall NB Aspects of Deepsea Biology Hutchinson
19. Ekman S Zoogeography of the sea. Sidgwick & Jackson
20. <http://ecoursesonline.iasri.res.in/course/view.php?id=430>

### CO-POMapping:

(1:Slight[Low];                      2:Moderate[Medium];                      3:Substantial[High],    '-':No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	2	1	2	2	3	2	3	2	2	2	2
CO2	2	1	2	2	1	1	2	3	1	2	2	2	2
CO3	1	1	2	3	2	1	1	2	2	2	1	2	1
CO4	2	2	3	2	2	2	2	2	2	2	2	2	2
CO5	2	2	1	1	1	2	2	1	1	1	1	1	2

**BLUE PRINT**

Time: 2 1/2 hrs

Max. Marks: 50

<b>Unit</b>	<b>Essay</b>	<b>Short</b>
I	1	1
II	1	1
III	1	2
IV	1	1
V	2 <b>Out of 6, 3 questions should be answered 3X10=30M</b>	2 <b>Out of 7, 4 questions should be answered 4X5=20M</b>

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TITLE OF THE COURSE: MARINE BIOLOGY  
SEMESTER -V PAPER-VI  
MODEL QUESTION PAPER

Time: 2 1/2 hrs.

Max Marks: 50

Answer any THREE of the following. Choosing at least one from each part.  
Draw labeled diagrams wherever necessary

3x10=30

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**SECTION - A PART- I**

1. Write an essay on environmental factors affecting the life in oceans
2. Describe the divisions of Marine environment
3. Explain about the relationship of phytoplankton and zooplankton

**PART- II**

4. Describe the ecological importance of mangrove ecosystem
5. Discuss about boring and fouling organisms
6. Analyze the advantages of marine mammal adaptations.

**SECTION - B**

Answer any FOUR of the following:

Draw labeled diagrams wherever necessary

**4x5=20**

7. See weed
8. Primary production
9. Marine food chain
10. Rocky shore environment
11. Nekton habitat
12. Red tides
13. Coral reefs

**P. R. GOVERNMENT COLLEGE (A) KAKINADA**

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**TITLE OF THE COURSE: MARINE BIOLOGY**  
**SEMESTER -V PAPER-VI Course 6A: MARINE BIOLOGY**

**PRACTICAL (LAB) SYLLABUS**

Lab work - Skills Outcomes:

- After successful completion of this practical course student will be able to
- Operate the instruments for collection of plankton
- Identify the plankton
- Preserve the plankton

Practical (Laboratory) Syllabus: (30 hrs) (Max.50 Marks)

1. Study of common instruments used for collection of phytoplankton
2. Study of common instruments used zooplankton
3. Study of common instruments benthos.
4. Collection, preservation and analysis of phytoplankton, zooplankton, and benthos
5. Identification of Phytoplankton – (Identification and Record work)
6. Identification of Zooplankton - (Identification /Microscopy/Record work)
7. Identification of Boring and fouling organisms

Lab references

ICES Zooplankton Methodology Manual Ed. by Harrish. R., P. Wiebe., J. Leng., H.R. Skyoldal., M. Huntley. Academic Press 2000.

[https://drs.nio.org/drs/bitstream/handle/2264/95/Zooplankton\\_Manual.pdf?sequence=1&isAllowed=y](https://drs.nio.org/drs/bitstream/handle/2264/95/Zooplankton_Manual.pdf?sequence=1&isAllowed=y)

<https://drs.nio.org/drs/bitstream/handle/2264/97/Phytoplankton-manual.PDF>

[http://www.coastalwiki.org/wiki/Sampling\\_tools\\_for\\_the\\_marine\\_environment](http://www.coastalwiki.org/wiki/Sampling_tools_for_the_marine_environment)

<https://www.fao.org/3/W3732E/w3732e0s.htm>

<https://adkinstruments.in/categories/oceanography/plankton-nets>

<https://www.slideshare.net/poojakamble1609/fouling-and-boring>

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**P. R. GOVERNMENT COLLEGE (A) KAKINADA**

**TITLE OF THE COURSE: MARINE BIOLOGY  
SEMESTER -V PAPER-VI**

**Course 6A: MARINE BIOLOGY PRACTICAL (LAB) MODEL**

**PAPER**

1. Phytoplankton /Zooplankton/Benthos collection instrument details explanation with diagram ---10
2. Phytoplankton /Zooplankton/Benthos collection instruments Explanation with diagrams ----- 10
3. Collection of Zooplankton/Phytoplankton/Benthos—procedure / Preservation of  
Zooplankton/Phytoplankton/Benthos -----5

Marks

4. Spotters/images/charts 5 x 4= 20 Marks

A. Zooplankton

B. Phytoplankton

C. Benthos

D. Borer


E. Foulter

5. Record 5 Marks

**P.R. GOVERNMENT COLLEGE (A), KAKINADA CHOICE BASED**

**CREDIT SYSTEM**

**MARKET ORIENTED COURSE- AQUACULTURE TECHNOLOGY**

	<b>P. R. GOVERNMENT COLLEGE (A) KAKINADA</b>	<b>Program &amp; Semester</b>			
Course Code	<b>TITLE OF THE COURSE MARINE FISHERIES</b>	<b>SEMESTER -V PAPER-VII</b>			
Teaching	Hours Allocated: 60 ( <b>Theory</b> )	L	T	P	C
Pre-requisites:		4	1	2	5

**Semester – V Course 7 A: MARINE FISHERIES**

**Learning Outcomes:**

- After successful completion of this course student will be able to
- Understand Marine fishery resources
- Assess the Pelagic fishery resources
- Know the ecological importance of India's EEZ
- Judge the applications of remote sensing & GIS in capture fishery

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

**Unit – I**

- 1.1 Classification and definition of fishery zones and fishery resources of world.
- 1.2 Overview of marine fisheries resources of the world and India.
- 1.3 Marine capture fishery of Andhra Pradesh.

**Unit – II**

- 2.1 Major exploited marine fisheries of India, their developmental history and present status
- 2.2 Pelagic fisheries of India: sardines, mackerels, anchovies, tuna, ribbonfish, Bombay duck, pomfrets, mullets.
- 2.3 Features and trends in the production of pelagic fisheries. Conservation of pelagic fish stocks.

### **Unit – III**

3.1 Demersal fisheries of India: sharks, major perches, threadfin, breams, sciaenids, silver belly.

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3.2 Features and trends in production of demersal fisheries.

3.3 Impact of trawling. Conservation of demersal fish stocks.

### **Unit – IV**

4.1 Potential marine fishery resources of the India's EEZ.

4.2 History of deep-sea fishing.

4.3 Oceanic and deep-sea fisheries of India. Deep sea fishing policy of India.

### **Unit – V**

5.1 GIS and remote sensing in marine capture fishery

5.2 Ancillary fishery resources - seaweeds, crab, lobsters, chank and bivalves.

## II. References:

### **Text Books**

1. Bal, D.V., and Rao, K.V. 1990. Marine Fisheries of India. Tata McGraw Hill Pub. Co.

2. Srivastava, C.B.L. and Mahal, K., 1999. A text book of fishery science and Indian fisheries. Shree Publishers.

### **Reference Books**

1. Carmelo, T.R., 1997. Identifying Marine Phytoplankton by Academic Press.

2. ICES Zooplankton Methodology Manual Ed. by Harrish. R., P. Wiebe., J. Leng., H.R. Skyoldal., M. Huntley. Academic Press 2000.

3. Biswas, K.P. 2011. Marine Prawns & Shrimps. Daya Publishing House, Delhi, 329pp.

4. ICAR 2011. Handbook of Fisheries and Aquaculture. ICAR, New Delhi, 1116 pp.

5. Jhingran, V.G. 1983. Fish and Fisheries of India. Hindustan Publ. Corpn. (India), Delhi, 666 pp.

6. Pillai, N.G.K. 2011. Marine Fisheries & Mariculture in India. Narendra Publishing House, Delhi, 352pp.

7. Aravind Kumar, 2004. Fishery Management. APH Publ. Corpn., New Delhi, 371 pp.

8. Belgrano & Andrea. 2011. Ecosystem Based Management for Marine Fisheries. Cambridge University Press, Cambridge, 402pp.

9. Dholakia, A.D. 2004. Fisheries and Aquatic Resources of India. Daya Publ. Hse., Delhi.

10. FAO (2012). The State of World Fisheries and Aquaculture. FAO Fisheries and Aquaculture Department, FAO, Rome (<http://www.fao.org/docrep/016/i2727e/i2727e00.htm>)

11 ICAR 2011. Handbook of Fisheries and Aquaculture. ICAR, New Delhi, 1116 pp.

### **BLUE PRINT**

Time: 2 1/2 hrs

Max. Marks: 50

<b>Unit</b>	<b>Essay</b>	<b>Short</b>
I	1	1
II	1	1
III	1	2
IV	1	1
V	2 <b>Out of 6, 3 questions should be answered 3X10=30M</b>	2 <b>Out of 7, 4 questions should be answered 4X5=20M</b>

**P. R. GOVERNMENT COLLEGE (A) KAKINADA**

**TITLE OF THE COURSE: MARINE FISHERIES**

**SEMESTER - V PAPER-VII  
MODEL QUESTION PAPER**

**Time: 2 1/2 hrs.**

**Max Marks: 50**

**Answer any THREE of the following. Choosing at least one from each part.**

**Draw labeled diagrams wherever necessary**

**3x10=30**

**SECTION - A PART- I**

1. Write an essay on the marine fishery resources of India

2. Describe the Divisions of Marine environment

3. Write an essay on the sardine and mackerel fishery of India

**PART- II**

4. Describe the conservation measures of demersal fish stocks.

5. Describe the history of deep-sea fishing.

6. Write an essay on the application of remote sensing in marine fish capture.

**SECTION - B**

**Answer any FOUR of the following:**

**Draw labeled diagrams wherever necessary**

**4x5=20**

7. Marine fishery of AP

8. Ribbon fish

9. Conservation of pelagic fish stock

10. Silver belly fish

11. EEZ of India

12. Deep sea fishing policy

13. Seaweed economic importance

## **P.R. GOVERNMENT COLLEGE (A), KAKINADA CHOICE BASED**

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### **CREDIT SYSTEM**

#### **MARKET ORIENTED COURESE- AQUACULTURE TECHNOLOGY**

Course 7 A: MARINE FISHSERIES

PRACTICAL (LAB) SYLLABUS

III. Lab work - Skills Outcomes:

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

Identify the commercially important marine products

Analyze the marine catches

Identify the potential marine landing centers Understand

the records related to catch data

**IV.**

**Practical (Laboratory) Syllabus: (30 hrs)(Max.50 Marks)**

1. Visit to marine fish landing centers.
2. Familiarization of commercially important groups viz., marine and elasmobranchs, crustaceans, molluscs and seaweeds
3. Analysis of marine catches by major crafts and gears
4. Analysis and species composition of commercial fish catches at landing and centers
5. Maintenance of records of marine fish catch data
6. GIS and Remote Sensing Applications in capture fishery

V. Lab References:

<http://krishi.icar.gov.in/jspui/handle/123456789/63903>

[https://mpeda.gov.in/?page\\_id=1007](https://mpeda.gov.in/?page_id=1007)

<https://icar.org.in/content/icar-cmfri-launches-gis-based-info-vicinity-fish-landing-centres-covid-19-hotspots>

<https://incois.gov.in/MarineFisheries/PfzAdvisory>

<http://kvkernakulam.org.in/fishwatch.html>

**P. R. GOVERNMENT COLLEGE (A) KAKINADA TITLE OF THE COURSE:**

**MARINE FISHERIES**

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**SEMESTER -V PAPER-VII Course 7A: MARINE FISHERIES**

**PRACTICAL (LAB) MODEL PAPER**

1. SPOTTERS 5 X 4 = 20 Marks
  - A. MARINE FISH
  - B. MARINE FISH
  - C. MARINE ELASMOBRANCH
  - D. MARINE ELASMOBRANCH
  - E. MARINE CRUSTACEAN
2. Submission of Report on the filed vist to Fish landing center with photos and catches 20 Marks
3. Record 5 Marks
4. Viva-voce 5 M

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE**

**(AUTONOMOUS) KAKINADA**

**NAAC "A" GRADE**

# B VOC COMMERCIAL AQUACULTURE

**DEPARTMENT OF  
Zoology and Aquaculture  
2024-25**


**(CHOICE BASED CREDIT SYSTEM)  
P.R. GOVT.COLLEGE (AUTONOMOUS) KAKINADA.**

**P.R. Govt. College (Autonomous), Kakinada  
DEPARTMENT OF ZOOLOGY AND AQUACULTURE  
B.VOC (Commercial Aquaculture) SYLLABUS AND NAME OF THE PAPERS  
NSDC, NSQF & ASCI - LEVELS OF ASSESSMENT – 2020-21**

S.No	VOCATIONAL COMPONENT	Marks	Credits	GENERAL COMPONENT	Marks	Credits		
I	I Year	First Semester				<b>(28)</b>		
1.	Core I	Biology of Fin fishes and shell fishes	100	4	Major I	Zoology	100	4
		Lab	50	1		Practical	50	1
2.	Core II	Principles of Aquaculture	50	2	Major II	Chemistry	100	4
						Practical	50	1
		Lab/ind.training	50	1	Languages	English	100	3
						Language T/H/S	100	3
				Life skills and skill development course	(CSS)-Comp	50	2	
					( Plant Nursery)-Bot. dept	50	2	
II		Second Semester				<b>(30)</b>		

1.	Core III	Freshwater, Brackishwater and Mariculture	100	4	Major I	Zoology	100	4
		Lab	50	1		Practical	50	1
2.	Core IV	Crafts and Gears in Fisheries	50	2	Major II	Chemistry	100	4
		Lab/ind.training	50	1		Practical	50	1
					Languages	English	100	3
						Language T/H/S	100	3
					Life skills and skill development course	(ICT)-Computer dept	50	2
						(Diary techniques)- Zoology dept	50	2
						(Fruit & Veg preservation)- Botany dept	50	2
III	II Year	Third Semester						(30)
	Core V	Aquaculture Nutrition	100	4	Major I	Zoology	100	4
		Lab	50	1		Practical	50	1
	Core VI	Inland and Marine Fisheries	50	2	Major II	Chemistry	100	4
		Lab/ind.training	50	1		Practical	50	1
					Languages	English	100	3
						Language T/H/S	100	3
					Life skills and skill development course	(Environment education)- Zoology dept.	50	2
						(Personality development and leadership)-Eng dept.	50	2
						(Environment audit)- Chemistry dept.	50	2
IV		Fourth Semester						(30)
	Core VII	Pathology in Aquaculture	100	4	Major I	Zoology I	100	4
		Practical	50	1		Practical	50	1
	Core VIII	Fisheries Management	100	4		Zoology II	100	4
		Practical	50	1		Practical	50	1
					Major II	Chemistry I	100	4
						Practical	50	1
						Chemistry II	100	4
						Practical	50	1
V		III Year FIFTH Semester						
	CORE IX	MARINE BIOLOGY	100	4	MAJOR I	SEC A ZOOLOGY	100	4
		LAB	50	1		SEC A LAB ZOOLOGY	50	1
	CORE X	MARINE FISHERIES	100	4	MAJOR I	SEC B ZOOLOGY	100	4
		LAB	50	1		SEC B LAB ZOOLOGY	50	1
					MAJOR II	SEC A CHEMISTRY	100	4
						SEC A CHEMISTRY LAB	50	1
						SEC A CHEMISTRY	100	4
						SEC B CHEMISTRY LAB	50	1
SIX Semester								
INTERNSHIP								

**P.R. GOVERNMENT COLLEGE (A),  
KAKINADA CHOICE BASED CREDIT SYSTEM B VOC  
COMMERCIAL AQUACULTURE**

	<b>P. R. GOVERNMENT COLLEGE (A) KAKINADA</b>	<b>Program &amp; Semester</b>			
Course Code	<b>TITLE OF THE COURSE MARINE BIOLOGY</b>	<b>SEMESTER -V</b>			
Teaching	Hours Allocated: 60 ( <b>Theory</b> )	L	T	P	C
Pre- requisites:	<b>CORE IX</b>	4	1	2	5

**I. COURSE OUT COMES:**

- After successful completion of this course student will be able to
- Understand the Divisions, life of Marine Ecosystem
- Assess the Productivity of Marine Ecosystem
- Know the ecological importance of critical ecosystems associated with marine ecosystem
- Judge the adaptations of animals in the marine ecosystem

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

**Unit – I Introduction:**

Divisions of marine environment- pelagic, benthic, euphotic, aphotic divisions and their subdivisions.

Life in oceans – general account of major groups of phytoplankton, sea weeds, major zooplankton groups.

Environmental factors affecting life in the oceans- salinity, temperature, light, currents, waves, tides, oxygen, and carbon dioxide.

**Unit – II**

2.1 Primary, secondary and tertiary production.

2.2 Marine food chains and food webs. Vertical migration of zooplankton.  
Phytoplankton-Zooplankton relationship, plankton and fisheries.

**Unit – III**

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3.1 Benthos- a life in rocky, sandy, and muddy shores.

3.2 Mangroves Ecosystem and Ecological importance

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3.3 Coral reefs ecosystem-ecological importance

#### Unit – IV

4.1 Boring and fouling organisms- examples with adaptations.

4.1 Nekton- outline composition of nekton, habitats of nekton.

4.3 Bioluminescence and indicator species, red tides

#### Unit –V

5.1 Biology and classification of marine mammals,

5.2 Adaptations in marine mammals for conserving body heat and submersion for long dive.

### III. References:

#### Reference Books

1. Carmelo, T.R., 1997. Identifying Marine Phytoplankton by Academic Press.
2. ICES Zooplankton Methodology Manual Ed. by Harrish. R., P. Wiebe., J. Leng., H.R. Skyoldal., M. Huntley. Academic Press 2000.
3. Gage. J.D. and Tyler, P.A. 1991. Deep Sea Biology, Cambridge University Press, Cambridge.
4. William, C., 1991. Seashore life between the tides. Dover Publication
5. Makoto, Omori and Tsutomu Ikeda, 1984. Methods in Marine Zooplankton Ecology, Wiley & Sons. Inc. Canada
6. Venkataraman, K., C. Raghunathan. R. Raghuraman and C.R. Sreeraj. 2012. Marine Biodiversity in India, Zoological Surv. India, Kolkata, 164pp.
7. Morrissey, J.F. and J.L. Sumich. 2012. Introduction to the Biology of Marine Life. Jones & Bartlett learning, U.K., 467pp.
8. Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited.
9. Fish, J.D & S. Fish. 2010. A Students Guide to the Seashore. Cambridge University Press, 527pp.

10. Chapman, V.J. and D.J. Chapman, 1980. Seaweed and Their Use. Chapman & Hall, London.

11. Chapman, V.J., 1976. Mangrove Vegetation. J. Gramer, Berlin.

12. Balakrishnan Nair, N. and D.M. Thampy, 1980. A Text Book of Marine Ecology. The Macmillan Co. of India Ltd., New Delhi

13 Svedrup et al The Oceans Prentice Hall

14. Tait RV Elements of marine ecology Butterworths

15. Riley & Skirrow Chemical Oceanography Academic Press

16. Newell RC Biology of intertidal animals Logos Press

17. Kinne O (Ed) Marine ecology John Wiley & Sons

18. Marshall NB Aspects of Deepsea Biology Hutchinson

19. Ekman S Zoogeography of the sea. Sidgwick & Jackson

20. <http://ecoursesonline.iasri.res.in/course/view.php?id=430>

**CO-POMapping:**

(1:Slight[Low];                    2:Moderate[Medium];                    3:Substantial[High],                    '-':No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO 1	1	2	2	1	2	2	3	2	3	2	2	2	2
CO 2	2	1	2	2	1	1	2	3	1	2	2	2	2
CO 3	1	1	2	3	2	1	1	2	2	2	1	2	1
CO 4	2	2	3	2	2	2	2	2	2	2	2	2	2
CO 5	2	2	1	1	1	2	2	1	1	1	1	1	2

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**BLUE PRINT**

Time: 2 1/2 hrs

Max. Marks: 50

<b>Unit</b>	<b>Essay</b>	<b>Short</b>
I	1	1
II	1	1
III	1	2
IV	1	1
V	2 <b>Out of 6, 3 questions should be answered 3X10=30M</b>	2 <b>Out of 7, 4 questions should be answered 4X5=20M</b>

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**P. R. GOVERNMENT COLLEGE (A) KAKINADA B VOC COMMERCIAL**

**AQUACULTURE**

**TITLE OF THE COURSE: MARINE BIOLOGY SEMESTER -V CORE IX**

**MODEL QUESTION PAPER**

**Time: 2 1/2 hrs**

**Max. Marks: 50**

**Answer any THREE of the following. Choosing at least one from each part.**

**Draw labeled diagrams wherever necessary**

**3x10=30**

**SECTION - A PART- I**

1. Write an essay on the environmental factors affecting the life in oceans
2. Describe the Divisions of Marine environment
3. Explain about the phytoplankton zooplankton relationship.

**PART- II**

4. Describe the ecological importance of mangrove ecosystem.
5. Write an essay on the boring and fouling organisms with suitable examples.
6. Write an essay on the adaptations in Marine mammals

**SECTION - B**

**Answer any FOUR of the following:**

**Draw labeled diagrams wherever necessary**

**4x5=20**

7. Sea weed
8. Primary production
9. Rocky shore- environment
10. Coral reefs ecological importance
11. Bioluminescence
12. Classification of Marine mammals
13. Body heat conservation by marine mammals

**AQUACULTURE**

**TITLE OF THE COURSE: MARINE BIOLOGY SEMESTER -V CORE IX**

**CORE IX : MARINE BIOLOGY PRACTICAL (LAB) SYLLABUS**

Lab work - Skills Outcomes:

- After successful completion of this practical course student will be able to
- Operate the instruments for collection of plankton
- Identify the plankton
- Preserve the plankton

Practical (Laboratory) Syllabus: (30 hrs) (Max.50 Marks)

1. Study of common instruments used for collection of phytoplankton
  2. Study of common instruments used zooplankton
  3. Study of common instruments benthos
  4. Collection, preservation and analysis of phytoplankton, zooplankton, and benthos
18. Identification of Phytoplankton – (Identification and Record work)
  19. Identification of Zooplankton - (Identification /Microscopy/Record work)
  20. Identification of Boring and fouling organisms

Lab references

ICES Zooplankton Methodology Manual Ed. by Harrish. R., P. Wiebe., J. Leng., H.R. Skyoldal., M. Huntley. Academic Press 2000.

[https://drs.nio.org/drs/bitstream/handle/2264/95/Zooplankton\\_Manual.pdf?sequence=1&isAllowed=y](https://drs.nio.org/drs/bitstream/handle/2264/95/Zooplankton_Manual.pdf?sequence=1&isAllowed=y)

<https://drs.nio.org/drs/bitstream/handle/2264/97/Phytoplankton-manual.PDF>

[http://www.coastalwiki.org/wiki/Sampling\\_tools\\_for\\_the\\_marine\\_environment](http://www.coastalwiki.org/wiki/Sampling_tools_for_the_marine_environment)

<https://www.fao.org/3/W3732E/w3732e0s.htm>

<https://adkinstruments.in/categories/oceanography/plankton-nets>

<https://www.slideshare.net/poojakamble1609/fouling-and-boring>

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**P. R. GOVERNMENT COLLEGE (A) KAKINADA TITLE OF THE COURSE: MARINE**

**BIOLOGY**

**SEMESTER -V CORE IX**

**B VOC COMMERCIAL AQUACULTURE CORE IX : MARINE BIOLOGY**

**PRACTICAL (LAB) MODEL PAPER**

1. Phytoplankton /Zooplankton/Benthos collection instrument details explanation  
with diagram ---10
2. Phytoplankton /Zooplankton/Benthos collection instruments Explanation with  
diagrams -----10
3. Collection of Zooplankton/Phytoplankton/Benthos—procedure / Preservation of  
-----Zooplankton/Phytoplankton/Benthos-----

5 Marks -----

4. Spotters/images/charts

5 x 4= 20 Marks

- A. Zooplankton
- B. Phytoplankton
- C. Benthos
- D. Borer
- E. Fouler


5. Record

5 Marks

# P.R. GOVERNMENT COLLEGE (A), KAKINADA

## CHOICE BASED CREDIT SYSTEM

### B VOC COMMERCIAL AQUACULTURE

	<b>P. R. GOVERNMENT COLLEGE (A) KAKINADA</b>	<b>Program &amp; Semester</b>			
Course Code	<b>TITLE OF THE COURSE MARINE FISHSERIES</b>	<b>SEMESTER -V CORE X</b>			
Teaching	Hours Allocated: 60 ( <b>Theory</b> )	L	T	P	C
Pre-requisites:	<b>CORE X</b>	4	1	2	5

#### Semester – V

#### Course CORE X : MARINE FISHERIES

#### Learning Outcomes:

- After successful completion of this course student will be able to
- Understand Marine fishery resources
- Assess the Pelagic fishery resources
- Know the ecological importance of India's EEZ
- Judge the applications of remote sensing & GIS in capture fishery

#### II. Syllabus:

#### Unit – I

- 1.1 Classification and definition of fishery zones and fishery resources of world.
- 1.2 Overview of marine fisheries resources of the world and India.
- 1.3 Marine capture fishery of Andhra Pradesh.

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**Unit – II**

- 2.1 Major exploited marine fisheries of India, their developmental history and present status
- 2.2 Pelagic fisheries of India: sardines, mackerels, anchovies, tuna, ribbonfish, Bombay duck, pomfrets, mullets.
- 2.3 Features and trends in the production of pelagic fisheries. Conservation of pelagic fish stocks.

**Unit – III**

- 3.1 Demersal fisheries of India: sharks, major perches, threadfin, breams, sciaenids, silver belly.
- 3.2 Features and trends in production of demersal fisheries.
- 3.3 Impact of trawling. Conservation of demersal fish stocks.

**Unit – IV**

- 4.1 Potential marine fishery resources of the India's EEZ.
- 4.2 History of deep-sea fishing.
- 4.3 Oceanic and deep-sea fisheries of India. Deep sea fishing policy of India.

**Unit – V**

- 5.1 GIS and remote sensing in marine capture fishery
- 5.2 Ancillary fishery resources - seaweeds, crab, lobsters, chank and bivalves.

III. References:

**Text Books**

1. Bal, D.V., and Rao, K.V. 1990. Marine Fisheries of India. Tata McGraw Hill Pub. Co.
2. Srivastava, C.B.L. and Mahal, K., 1999. A text book of fishery science and Indian fisheries. Shree Publishers.

**Reference Books**

1. Carmelo, T.R., 1997. Identifying Marine Phytoplankton by Academic Press.
2. ICES Zooplankton Methodology Manual Ed. by Harrish. R., P. Wiebe., J. Leng., H.R. Skyoldal., M. Huntley. Academic Press 2000.

3. Biswas, K.P. 2011. Marine Prawns & Shrimps. Daya Publishing House, Delhi, 329pp.
4. ICAR 2011. Handbook of Fisheries and Aquaculture. ICAR, New Delhi, 1116 pp.
5. Jhingran, V.G. 1983. Fish and Fisheries of India. Hindustan Publ. Corpn. (India), Delhi, 666 pp.

**BLUE PRINT**

Time: 2 1/2 hrs

Max. Marks: 50

<b>Unit</b>	<b>Essay</b>	<b>Short</b>
I	1	1
II	1	1
III	1	2
IV	1	1
V	2 <b>Out of 6, 3 questions should be answered 3X10=30M</b>	2 <b>Out of 7, 4 questions should be answered 4X5=20M</b>

**AQUACULTURE**

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**TITLE OF THE COURSE: MARINE FISHERIES SEMESTER -V CORE X  
MODEL QUESTION PAPER**

**Time: 2 ½ hrs. Max Marks: 60**

**SECTION- A**

**PART – 1**

**Answer any THREE of the following. Choosing at least one from each part.**

**Draw labeled diagrams wherever necessary**

**3x10=30**

1. Write an essay on the marine fishery resources of India
2. Describe the Divisions of Marine environment
3. Write an essay on the sardine and mackerel fishery of India

**PART – II**

1. Describe the conservation measures of demersal fish stocks .
2. Describe the history of deep sea fishing .
3. Write an essay on the application of remote sensing in marine fish capture.

**SECTION- B**

**Answer any FOUR of the following:**

**Draw labeled diagrams wherever necessary**

**4x5=20**

7. Marine fishery of AP
8. Ribbon fish
9. Bombay duck
10. Silver belly fish
11. EEZ of India
12. Deep Sea fishing policy
13. Red tide

**P.R. GOVERNMENT COLLEGE (A), KAKINADA CHOICE BASED**

**CREDIT SYSTEM**

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**B VOC COMMERCIAL AQUACULTURE**

**CORE X: MARINE FISHERIES PRACTICAL (LAB) SYLLABUS**

**IV. Lab work - Skills Outcomes:**

On successful completion of this practical course, student shall be able to: Identify the commercially important marine products

Analyze the marine catches

Identify the potential marine landing centers Understand the records related to catch data

**V. Practical (Laboratory) Syllabus: (30 hrs) (Max.50 Marks)**

- Visit to marine fish landing centers.
- Familiarization of commercially important groups viz., marine and elasmobranchs, crustaceans, molluscs and seaweeds
- Analysis of marine catches by major crafts and gears
- Analysis and species composition of commercial fish catches at landing and centers
- Maintenance of records of marine fish catch data
- GIS and Remote Sensing Applications in capture fishery

**VI. Lab References:**

<http://krishi.icar.gov.in/jspui/handle/123456789/63903>

[https://mpeda.gov.in/?page\\_id=1007](https://mpeda.gov.in/?page_id=1007)

<https://icar.org.in/content/icar-cmfri-launches-gis-based-info-vicinity-fish-landing-centres-covid-19-hotspots>

<https://incois.gov.in/MarineFisheries/PfzAdvisory>

<http://kvkernakulam.org.in/fishwatch.html>

**VII. Co-Curricular Activities**

a) Mandatory: (Student training by teacher in field skills: Total 15 hrs., Lab:10 + field 05)

1. For Teacher: Training of students by the teacher in the classroom or in the laboratory for a total of not less than 10 hours various concepts of marines fishery resources- fish landing centers- major catches-records @ landing centers awareness on the GIS and remote sensing applications in marine fishing
2. For Student: Individual laboratory work and visit to Any fish landing center for observation of proceeding at fish landing centers - a brief report preparation with pictures and data /survey
3. Max marks for Field Work Report: 05.
4. Suggested Format for Field work

Name of the landing center visited, date of visit, persons contacted, fish landings visited- details observed in landing center - important points to be correlated with the theory/ practical curriculum

5. Unit tests (IE).

b) Suggested Co-Curricular Activities

1. Visit to fish landing center
2. Collection of web resources on details of landings and revenue
3. Interaction with local fishermen to know about the catch particulars
4. Collection of web resources on the details of development of new fish landing centers in Andhra Pradesh
5. Seminar, Invited lecture, Assignment, Group discussion. Quiz, Collection of Material,

Commissionerate of Collegiate Education

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**P. R. GOVERNMENT COLLEGE (A) KAKINADA TITLE OF THE COURSE: MARINE**

**FISHERIES**

**SEMESTER -V CORE X**

**CORE X: MARINE FISHERIES PRACTICAL (LAB) MODEL PAPER**

**SPOTTERS**

5 X 4 = 20 Marks

- A. MARINE FISH
  - B. MARINE FISH
  - C. MARINE ELASMOBRANCH
  - D. MARINE ELASMOBRANCH
  - E. MARINE CRUSTACEAN
2. Submission of Report on the filed visit to Fish landing center with photos and catches 20 Marks
  3. Record 5 Marks
  4. Viva-voce 5 Marks

**DEPARTMENT OF ZOOLOGY**  
**LIST**  
**OF EXAMINERS**

<b>S. No</b>	<b>Name of the Examiners</b>	<b>Subject</b>	<b>Name of the College</b>
1.	Dr. N. Sreenivas	Zoology	GDC Ramachandrapuram
2.	B. Ahmad Ali Baba	Zoology	GDC Pithapuram
3.	Dr. P John Kiran	Zoology	GDC Perumallapuram
4.	Dr.M. Vijaya Kumar	Zoology	SRR GDC Vijayawada
5.	Dr.P. Jaya Bharathi	Zoology	VSK College, Vizag
6.	N. Suneetha	Zoology	SRR GDC, Vijayawada
7.	V. Sandhya	Zoology	GDC, Kaikaluru
8.	Dr. R P Dattu	Zoology	GDC, Tiruvuru.
9.	Dr. K Rama Rao	Zoology	VSK College, Vizag
10.	Dr. T Samuel David Raj	Zoology	VSK College, Vizag
11.	Dr. P R Vani	Zoology	VSK College, Vizag
12.	Dr Y. Poli Naidu	Zoology	GDC, Srikakulam
13.	A. Arjuna Apparao	Zoology	GDC, Yellamanchili
14.	Dr G. Mani	Zoology	GDC (M), Srikakulam
15.	P.S.C.H.P Deepika Rani	Zoology	SKR College (W), Rajahmundry
16.	Dr G. Vijay Prathap	Zoology	VSK College, Vizag
17.	Dr. Y. Shantiprabha	Zoology	VSK College, Vizag
18.	M. Hima Sridevi	Zoology	SKR College(W), Rajahmundry



Lecturer in charge  
Dept of Zoology & Aquaculture

**DEPARTMENT OF ZOOLOGY**  
**LIST OF QUESTION PAPER SETTERS**

<b>S. No</b>	<b>Name of the Examiners</b>	<b>Subject</b>	<b>Name of the College</b>
1.	Dr. N. Sreenivas	Zoology	GDC Ramachandrapuram
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