



# UNIVERSITY OF CALCUTTA

GURUPADA SAREN

SECRETARY

COUNCILS FOR UNDERGRADUATE STUDIES,  
UNIVERSITY OF CALCUTTA.

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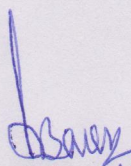
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## NOTICE

It is notified for all concerned that the **semester wise draft Syllabus for “Industrial Fish and Fisheries (Major)”** for three-year undergraduate Courses of Studies under **CBCS** has been prepared by the **U.G. Board of Studies in Zoology, C.U.** The detail syllabus is enclosed herewith.

  
Secretary 14.05.18



DRAFT

# **UNIVERSITY OF CALCUTTA**

**INDUSTRIAL FISH & FISHERIES SYLLABUS FOR B.SC. (MAJOR)**

*Under*

**CBCS SYSTEM**

## CBCS INDUSTRIAL FISH AND FISHERIES SYLLABUS FOR B.SC (MAJOR), CU

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<b>6.Generic Elective( Any four)</b>	
GE T1- Choose From the CBCS Syllabus of Zoology/ Chemistry/ Botany	
GE P1- Choose From the CBCS Syllabus of Zoology/ Chemistry/ Botany	
GE T2- Choose From the CBCS Syllabus of Zoology / Chemistry/ Botany	
GE P2- Choose From the CBCS Syllabus of Zoology/ Chemistry/ Botany	
GE T3- Choose From the CBCS Syllabus of Zoology/Chemistry/Botany	
GE P3- Choose From the CBCS Syllabus of Zoology/ Chemistry/ Botany	
GE T4-Choose From the CBCS Syllabus of Zoology/Chemistry /Botany	
GE P4- Choose From the CBCS Syllabus of Zoology/ Chemistry/Botany	

## 1. INTRODUCTION

The syllabus for Industrial Fish and Fisheries at undergraduate level using the Choice Based Credit system has been framed in compliance with model syllabus given by UGC. The main objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Industrial Fish and Fisheries. Keeping in mind and in tune with the changing nature of the subject, adequate emphasis has been given on new techniques and understanding of the subject. The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase. There is wide deviation in the infrastructure, be it physical or in human resource, in the form of teachers' expertise and ability and aspiration of the students. Hence, University is free to choose the Electives as per their infrastructural strengths and offer at least 6 to 7 electives While the syllabus is in compliance with UGC model curriculum, it is necessary that Industrial Fish and Fisheries students should learn "Immunology" along with "Fish pathology" as one of the core courses rather than as elective. Also, an important discipline specific elective on "Fishery Microbiology" has been added. Project Work have been introduced instead of the 4th Elective with a credit of 6 split into 2+4, where 2 credits will be for continuous evaluation and 4 credits reserved for the merit of the dissertation.

## 2. SCHEME FOR CBCS CURRICULUM(CREDIT DISTRIBUTION ACROSS COURSES)

Course Type	Number of Courses	Credits		
		Theory	Practical	Theory+ Practical
<b>Core Courses</b>	<b>14</b>	<b>14x4=56</b>	<b>14x2=28</b>	<b>84</b>
<b>Discipline specific Electives</b>	<b>4</b>	<b>4x4=16</b>	<b>4x2=8</b>	<b>24</b>
<b>Generic Elective</b>	<b>4</b>	<b>4x4=16</b>	<b>4x2=8</b>	<b>24</b>
<b>Ability Enhancement Course</b>	<b>2</b>	<b>2x2=4</b>		<b>4</b>
<b>Skill Enhancement Courses</b>	<b>2</b>	<b>2x2=4</b>		<b>4</b>
<b>Totals</b>	<b>26</b>	<b>96</b>	<b>44</b>	<b>140</b>

## 3. SCHEME FOR CBCS CURRICULUM (Courses at a glance under semester)

### 3 A. COMPULSORY CORE COURSES

Compulsory Courses			
Fish Taxonomy	Capture Fisheries	Fish Biology	Fresh Water Aquaculture
Fish Genetic Engineering & Molecular Biology	Fish Seed production technology	Brackish water aquaculture & Mariculture	Aquarium Fisheries
Fish pathology & Immunology	Fishing craft and gear Technology	Fisheries Post Harvest Technology	Fundamental of Biochemistry
Aquatic ecology	Fisheries Extension, Fisheries economics, Marketing & Entrepreneurship development		

### 3B. CHOICES FOR DISCIPLINE SPECIFIC ELECTIVES

Discipline Specific Elective-4	
1. Fishery Microbiology	2. On the Job Training
3. Biostatistics, Computer Application, Remote sensing & GIS	4. Project Work

### 3 C. CHOICES FOR SKILL ENHANCEMENT COURSES

Skill Enhancement Courses-2	
1. Pearl Culture	2. Crab culture

### 3 D. CHOICES FOR GENERIC ELECTIVE COURSES

Generic Elective Courses-4	
1. Zoology/ Chemistry/ Botany	2. Zoology/ Chemistry/ Botany
3. Zoology/ Chemistry/ Botany	4 Zoology/ Chemistry/ Botany

## SEMESTER WISE DISTRIBUTION OF COURSES

Semester	Course Name	Course Detail	Credit	Page No.
<b>Part-I: Semester I</b>	Ability Enhancement	English Communication	2	8
	Compulsory Course-I	Environmental Science	2	11
	Core course-I Theory	Fish Taxonomy(CT1)	4	8
	Core course-I Practical	Fish Taxonomy Lab(CP 1)	2	8
	Core course-II Theory	Capture Fisheries(CT2)	4	9
	Core course-II Practical	Capture Fisheries(CP2)	2	10
	Generic Elective-1 Theory	Zoology/ Chemistry/ Botany (GET 1)	4	11
	Generic Elective-1 Practical	Zoology/ Chemistry/ Botany (GEP-1)	2	11
<b>Part-I: Semester II</b>	Ability Enhancement	English Communication	2	
	Compulsory course II	Environmental Science	2	
	Core course III Theory	Fish Biology(CT3)	4	11
	Core course III Practical	Fish Biology(CP3)	2	12
	Core course IV Theory	Fresh Water Aquaculture(CT4)	4	13
	Core course IV Practical	Fresh Water Aquaculture Lab(CP4)	2	14
	Generic Elective-2 Theory	Zoology/ Chemistry/ Botany (GET-2)	4	14
	Generic Elective-2 Practical	Zoology/ Chemistry/ Botany (GEP-2)	2	14
<b>Part-II: Semester III</b>	Core course –V Theory	Fish genetic engineering & Molecular Biology(CT5)	4	15
	Core course –V Practical	Fish genetic engineering & Molecular Biology (CP5)	2	16
	Core course –VI Theory	Fish seed production technology(CT6)	4	17
	Core course –VI Practical	Fish seed production technology Lab(CP6)	2	18
	Core course –VII Theory	Brackish water aquaculture & Mariculture(CT7)	4	19
	Core course –VII Practical	Brackish water aquaculture & Mariculture Lab(CP7)	2	20
	Skill Enhancement Course-1 Theory	Pearl Culture(SET1)	4	20
	Generic Elective-3 Theory	Zoology/ Chemistry/ Botany(GET3)	4	21
	Generic Elective-3 Practical	Zoology/ Chemistry/ Botany (GEP3)	2	21
<b>Part-II: Semester IV</b>	Core course –VIII Theory	Aquarium Fisheries(CT 8)	4	22
	Core course –VIII Practical	Aquarium Fisheries Lab(CP8)	2	23
	Core course –IX Theory	Fish Pathology & Immunology(CT9)	4	23
	Core course –IX Practical	Fish Pathology & Immunology Lab(CP9)	2	24
	Core course –X Theory	Fishing Craft and Gears Technology(CT10)	4	25

	Core course –X Practical	Fishing Craft and Gears Technology Lab(CP10)	2	26
	Skill Enhancement Course-2 Theory	Crab culture(SET2)	4	26
	Generic Elective-4 Theory	Zoology/ Chemistry/ Botany (GET4)	4	27
	Generic Elective-4 Practical	Zoology/ Chemistry/ Botany (GEP4)	2	27
<b>Part-III: Semester V</b>	Core course –XI Theory	Fisheries Post Harvest Technology(CT 11)	4	27
	Core course –XI Practical	Fisheries Post Harvest Technology Lab (CP 11)	2	28
	Core course –XII Theory	Fundamental of Biochemistry(CT 12)	4	29
	Core course –X II Practical	Fundamental of Biochemistry Lab(CP12)	2	30
	Discipline Specific Elective-1 Theory	Fishery Microbiology (DSET 1)	4	30
	Discipline Specific Elective-1 Practical	Fishery Microbiology Lab (DSEP1)	2	31
	Discipline Specific Elective-2	On the Job Training (DSE 2)	6	32
<b>Part-III: Semester VI</b>	Core course –XIII Theory	Aquatic Ecology(CT13)	4	33
	Core course –XIII Practical	Aquatic Ecology Lab(CP13)	2	34
	Core course –XIV Theory	Fisheries economics, Fisheries Extension, Marketing & Entrepreneurship development(CT14)	4	35
	Core course –X IV Practical	Fisheries economics, Fisheries Extension, Marketing & Entrepreneurship development Lab(CP 14)	2	37
	Discipline Specific Elective-3 Theory	Biostatistics, Computer Application, Remote sensing & GIS(DSET 3)	4	38
	Discipline Specific Elective-3 Practical	Biostatistics, Computer Application, Remote sensing & GIS Lab(DSEP 3)	2	38
	Discipline Specific Elective-4	Project Work (DSE 4)	6	39



## PART I: SEMESTER I

### ABILITY ENHANCEMENT COMPULSORY COURSE I: ENGLISH COMMUNICATION

#### CORE THEORY1 (CT1)

#### FISH TAXONOMY

CREDITS 4; CLASS 50; MARKS 50

**Unit 1: Systematics:** Definition, component, importance.

**Unit 2: Taxonomy:** Definition, component, importance, stages of taxonomy, Zoological Nomenclature.

**Unit 3. Classification:** Definition and types of classification. Classification of Crustaceans, Molluscs and Fishes.

**Unit 4: Species concept-** Biological and typological. Mechanism of Speciation. Subspecies and other intraspecific categories. Type concept.

**Unit 5: Origin & Evolution of fishes.**

[Note: Classification of Sub phylum Crustacea and Phylum Mollusca according to Ruppert & Barnes(1994) should be followed. On the other hand classification of Grade- Pisces according to Nelson(2010) should be followed.]

#### Examination Pattern

**Time: 2 Hour**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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#### Reference Books:

1. Kapoor V.C(2017) Theory and Practical of Animal Taxonomy diversity. Oxford & IBH Publishing Co. Pvt. Ltd.
2. Simpson G.G.(2012). Principles of Animal Taxonomy. Scientific publishers (India).
3. Jayaram K.C(2010). Fish Taxonomy. NPH
4. Jayaram K.C(2010). Fishes of the Indian region. NPH

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#### CORE PRACTICAL 1 (CP1)

#### FISH TAXONOMY LAB

**2 CREDITS**

#### LIST OF PRACTICAL

1. Identification of fresh water Fish
2. Identification of brackish water fish
3. Identification of marine water fishes.

4. Identification of Prawn/Shrimp, Lobster, Bivalves, Cephalopods.
5. Laboratory Note Book
6. Internal Assessment

Note: Systematic position as per the theory syllabus

### Question Pattern

**Time: 2½ Hour**

**Full Marks: 25**

Identification of two fresh water Fishes(Item No.1)4x2=8  
 Identification of one brackish water fish (Item No.2) 4x1=4  
 Identification of one marine water fishes (Item No.3) 3x1=4  
 Identification of one Prawn/Shrimp, Lobster, Bivalves, Cephalopods (Item No.4) 2x1=2  
 Laboratory Note Book= 2  
 Internal Assessment= 5

## PART I: SEMESTER I

**CORE THEORY2 (CT2)**

**CAPTURE FISHERIES**

**CREDITS 4; CLASS 50; MARKS 50**

- Unit 1: Riverine fisheries:** Major river system in India. Fishing methods, representative ichthyofauna, and recent catch statistics. Problems encountered in fisheries development of major rivers.
- Unit 2: Cold water fisheries:** Cold water fisheries resources of India. Ecological characters of cold water bodies of India. Representative species of fishes of cold water bodies of India. Present status, Prospect, Problems and development of cold water fisheries in India.
- Unit 3: Reservoir and Lacustrine fisheries:** Definition and ecological features of reservoirs and lakes. Major reservoirs and lakes in India with emphasis on capture fisheries. Development of reservoir fisheries in India.
- Unit 4: Estuarine fisheries:** Definition and classification of estuaries, capture fisheries-resident and migrant species, fishing methods, recent catch statistics. Fisheries of brackish water lake and backwaters. Problem of brakish water fishery.
- Unit 5: Marine fishery resources in India:** Marine capture fishery resources at inshore, offshore and deep sea. EEZ, PFZ and continental shelf, maritime states in India. Biology and fisheries of Oilsardine, Hilsa, Pomfret, Bombayduck, Mackerel, ribbon fish, sole fish, eel, catfishes, prawns, lobsters, mollusks.

**Unit 6: Conservation of marine fishery resources:** Deep sea fishing policies of India. Problems of overfishing. Conservation and management of marine fishery resources. Application of remote sensing technology in capture fisheries.

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**Examination Pattern**

**Time: 2 Hour**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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**Reference Books:**

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**CORE PRACTICAL 2 (CP2)**

**CAPTURE FISHERIES LAB**

**2 CREDITS**

**List of practical**

1. Analysis of Data, Drawing of Graphs, Charts, Histograms in relation to abundance and catch particular of fish.
2. Field visit of any places of east coast and west coast of India in respect of marine fisheries.(Compulsory)
3. Laboratory Note Book.
4. Viva Voce
5. Internal Assessment

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**Question Pattern**

**Time: 2½ Hour**

**Full Marks: 25**

**(20 Theory + 5 Internal Assessment)**

1. One question from item no. 1 (10x1)=6
2. Submission of field note book: 8
3. Laboratory Note Book: 2
4. Viva Voce: 4
5. Internal Assessment: 5

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**PART I: SEMESTER I**  
**GENERIC ELECTIVE THEORY 1 (GET1)**

**4 CREDITS; CLASS 50; MARKS 50**

Choose from the CBCS syllabus of Zoology/ Chemistry/Botany

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**PART I: SEMESTER I**  
**GENERIC ELECTIVE PRACTICAL (GEP1)**

**CREDIT: 2; MARKS 25**

Choose from the CBCS syllabus of Zoology/ Chemistry/ Botany

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**PART I SEMESTER II**  
**ABILITY ENHANCEMENT COMPULSORY COURSE II: ENVIRONMENTAL SCIENCE**

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**PART I SEMESTER II**  
**CORE THEORY 3(CT3) FISH BIOLOGY**

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1: Fin fish and Shell fish anatomy:**

- I. Morphology of skin, colouration, scales, mouth, jaws, teeth, fin and fin rays and their taxonomic importance.
- II. Internal anatomy of a typical elasmobranch and Teleost fish: Alimentary canal and associated structure, Respiratory and accessory respiratory organs, Heart and circulatory system, Reproductive system, sense organs, Lateral line system, outlines of skeletal system
- III. Structure of Digestive system, Respiratory system, Circulatory system, excretory system, Reproductive and Endocrine system of Prawns.
- IV. External Character of Prawn, Crab, Lobster, Bivalves, Gastropods and Cephalopod.

**Unit 2: Fish Growth:** Isometric and allometric growth, the cube law, analysis of growth check on hard parts(Scale, otolith,vertebrae), Marking and tagging of fish for growth studies, length-weight relationship, poderal index, relative condition factor and gonadosomatic index.

**Unit 3: Fish Physiology:** Physiology and osmoregulation of fish. Endocrine organs in fishes and their roles in control of reproduction in fishes. Physiology of digestion, respiration(aquatic and aerial) and vision. Bioluminescence in fishes. Physiology of electric organs in fishes. Gametogenesis and fertilization of fishes.

**Unit 4: Fish Nutrition:** Food and feeding habit of fish, prawn, crab, bivalves and cephalopod.

**Unit 5: Fish behavior:** Parental care of fishes. Fish Migration.

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### Examination Pattern

**Time: 2 Hour**

**Full Marks: 50**

#### (40 Theory + 10 Internal Assessment)

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question (Out of two) of 8 marks each(8x2=16), are to be answered.

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#### Reference Books:

1. Ganguly B.A.,Sinha A.K., Adhikari S., Goswami B.C.B.(2018). Biology of Animals(Vol I& II). NCBA
2. Khanna S.S.(214). Introduction to Fishes. Silver Line
3. Srivastava C.B.L.(2014). Fishery Science and Indian Fisheries.

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### CORE PRACTICAL3 (CP3)

### FISH BIOLOGY LAB

**2 CREDITS**

#### LIST OF PRACTICAL

**1. Major Dissection:**

- (i) Urinogenital system of Mrigal&Tilapia.
- (ii) Weberian ossicles of Catla.

**2. Minor Dissection:**

- (i) Digestive system of Mrigal& Tilapia.
- (ii) Mounting of appendages of Prawn/Shrimp.
- (iii) Study of the different types of scales of fishes.
- (iv) Gill rackers of fishes of different feeding habit.
- (v) Pharyngeal teeth in fishes.
- (vi) Otolith of Tilapia

**3. Determination of RLG and Gut content analysis/Gonado Somatic index/ Condition factor/FecundityofRohu, Catla, Mrigal.**

**4. Laboratory Note Book.**

**6. Viva-Voce**

**7. Internal Assessment**

## Question Pattern

**Time: 2½ Hour**

**Full Marks: 25**

**(20 Theory + 5 Internal Assessment)**

One question from item no. 1 (10x1)=10

One question from item no.2 and 3 (5x1)=5

Laboratory Note Book: 3

Viva Voce: 2

Internal Assessment: 5

### PART I SEMESTER II

**CORE THEORY 4 (CT4)**

**FRESHWATER AQUACULTURE**

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1: Scope and present status of aquaculture:**Principles of site selection of various kinds of fish farms- quality and productivity of water, soil characteristics and other parameters.

**Unit 2: Carp Culture:** Pre -stocking, Stocking and Post stocking management of Nursery, Rearing and Stocking pond.

**Unit 3: Different systems of aquaculture:** Monoculture, Polyculture, Integrated fish farming, cage culture, pen culture, raft culture, extensive, semi intensive and intensive fish culture, raceway culture, culture in re-circulatory systems-Criteria for selection of species for culture. Aquaculture diversification- Aquaponics system, Biofloc culture, IMTA and periphyton culture.

**Unit 4: Sewage fed fish culture:** Selection of species, methods of culture, advantage and disadvantage.

**Unit 5: Culture of Catfishes and Murrels:**Culturable species, Spawning and fry production and grow out.

**Unit 6:Cold water aquaculture:** Culture of Trout, Mahseer and Salmon- Culture systems, Development of brood stock, Techniques of propagation, Grow out in tanks, raceways, cages and ponds.

**Unit 7:Culture of Tilapias:** Cultivated species of tilapia, Culture systems, Spawning and production of seed stock, Growout and feeding.

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### Examination Pattern

**Time: 2 Hour**

**Full Marks: 50**

**(40 theory + 10 internal assessments)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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**Reference Books:**

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**CORE PRACTICAL 4 (CP3) FRESH WATER AQUACULTURE LAB**

**2 CREDITS**

**List of practical**

1. Analysis of water parameters(Pond water, riverine water, lake water) by titration method: D.O, Free CO<sub>2</sub>, Total alkalinity, Total Hardness, Salinity, Organic Carbon, Nitrogen, Phosphate, Sulphate, Chloride, BOD, COD.
2. Training on Fresh water aquaculture.
3. Submission of Laboratory Note Book.

**Question Pattern**

**Time: 2½ Hour**

**Full Marks: 25**

**(20 Theory + 5 Internal Assessment)**

1. One question from the item no. 1 (15x1)=10
2. Submission of training report(Compulsory) =08
3. Submission of Laboratory Notebook= 2
4. Internal Assessment=05

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**PART I: SEMESTER II**

**GENERIC ELECTIVE THEORY 2 (GET2)**

**4 CREDITS; CLASS 50; MARKS 50**

Choose from the CBCS syllabus of Zoology/ Chemistry/ Botany

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**PART I: SEMESTER I**

**GENERIC ELECTIVE PRACTICAL 2 (GEP2)**

**CREDIT: 2; MARKS 25**

Choose from the CBCS syllabus of Zoology/ Chemistry/ Botany

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## **PART II - SEMESTER III**

### **CORE THEORY 5 (CT5) FISH GENETIC ENGINEERING & MOLECULAR BIOLOGY**

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1:** Nucleic acids: Salient features of DNA and RNA; Watson and Crick Model of DNA.

**Unit 2:** DNA Replication: Enzymes of DNA replication, Mechanism of DNA replication in Prokaryotes, prove that replication is semi-conservative, bidirectional and discontinuous Replication. Fidelity of DNA replication.

**Unit 3:** Transcription: Mechanism of Transcription in prokaryotes and eukaryotes, transcription factors, difference between prokaryotes and eukaryotic transcription.

**Unit 4:** Translation: Mechanism of translation in Prokaryotes and eukaryotes. Genetic code, Degeneracy of the genetic code, wobble hypothesis, inhibitors of protein synthesis, difference between prokaryotic and eukaryotic translation.

**Unit 5:** Post Transcriptional modifications and processing of eukaryotic RNA: Capping, splicing and polyadenylation.

**Unit 6:** DNA Repair mechanism: Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair.

**Unit 7:** Molecular techniques: PCR, Western, Southern and Northern Blot, Sanger DNA sequencing.

**Unit 8:** Gene structure and Function- Gene complementation, Cistron, muton, recon, molecular recombination, gene regulation.

**Unit 9:** Principle of Genetic Engineering- Isolation of DNA and RNA, Recombinant DNA Technology, Cloning, Plasmids, Cosmids, Bacteriophages, Transformation and Transduction. Construction of genomic and cDNA library.

**Unit 10:** Molecular hybridization- Labelling of Nucleic acid, molecular markers, amplification of DNA, Blotting techniques- Southern, Northern and Western blotting, DNA sequencing.

**Unit 11:** Chromosomal types and composition in fish. Chromosomal manipulation in fish, Hybridization. Polyploidy, androgenesis and gynogenesis.

**Unit 12:** Transgenic fish production.

**Unit 13:** Cryopreservation of gametes.



**Unit 14:** Production of monosex and sterile fishes and their significance in aquaculture.

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**Examination Pattern**

**Time: 2 Hour**

**Full Marks: 50**

**40 theory + 10 internal assessments**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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**Reference Books:**

1. Allison LA. 2007. Fundamental of Molecular Biology. Blackwell Publishing. W.H.Freeman
  2. Lodish, B, Matsudaira, KB, Plough, A, and Martin, 2016. Molecular Cell Biology. W.H.Freeman
  3. Cooper GM, Hausman RE, 2009. The Cell: A molecular approach. ASM
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**CORE PRACTICAL 5 (CP5)**

**FISH GENETIC ENGINEERING & MOLECULAR BIOLOGY**

**CREDITS 2; MARKS 25**

**List of practical**

1. Demonstration of polytene and lampbrush chromosome from photograph.
  2. Isolation and quantification of genomic DNA using UV Spectrophotometer; Procedure/reference to be mentioned.
  3. Agarose gel electrophoresis for DNA.
  4. DNA isolation from fish liver.
  5. Differential centrifugation of an artificially prepared mixture.
  6. Histological staining of DNA & RNA in prepared slide.
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**Question Pattern**

**Time: 2½ Hour**

**Full Marks: 25**

1. One experiment from item no. 2=08
  2. One experiment from item no. 6=04
  3. One experiment from item no. 3,4,5=06
  4. Laboratory note book=02
  5. Internal assessment=05
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**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1:** Reproductive Biology of Fishes: Morphology and Histology of Pituitary, Testis and Ovary. Hormonal regulation of spermatogenesis and oogenesis. Hormonal control of maturation and ovulation of oocyte. Role of GnRH and GTH on gonadal functions. Environmental regulation of reproduction.

**Unit 2:** Induced Breeding of Fishes: Hypophysation of Indian major carps and exotic carps. History of hypophysation. Methods of pituitary extract preparation, dosage determination, injection to the brood fishes, spawning and hatching. Use of different synthetic hormones and analogues for induced spawning. Stripping and fertilization. Transport of fish seeds and brood fishes, use of anesthetics. Bundh breeding, types of bundh breeding techniques and problems of bundh breeding.

**Unit 3:** Hatchery Technology of For fishes: Indian Major Carps, Mahseer and Trout hatchery. Design and function of incubators, glass jar hatchery, Chinese hatchery and other hatchery systems.

**Unit 4:** Hatchery technology for different species: Indian major and minor carps, Exotic carps, Catfishes, Tilapia, Masheerand Trout.

**Unit 5:** Marine fish seed production: Seabass, milkfish, mullets, cobia and silver pompano.

**Unit 6:** Reproductive Biology of Prawns/Shrimps: Morphology of Reproductive systems, Hormonal control of reproduction. Developmental stages.

**Unit 7:** Seed production in shell fishes: Seed production and nursery rearing of *Penaeus monodon* and *Macrobrachium rosenbergii*. Various components, equipments and infrastructures facilities required.

**Unit 8:** Riverine seed production techniques.

**Unit 9:** Different stages of seed: Spawn, Fry and Fingerlings.

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**Suggested Readings:**

- FAO. 1992. Manual of Seed Production of Carps. FAO Publ.  
ICAR. 2006. Hand Book of Fisheries and Aquaculture. ICAR.  
Jhingran VG & Pullin RSV. 1985. Hatchery Manual for the Common, Chinese and Indian Major Carps. ICLARM, Philippines.  
Jhingran VG. 1991. Fish and Fisheries of India. Hindustan Publ.  
Landau M. 1992. Introduction to Aquaculture. John Wiley & Sons.  
Mcvey JP. 1983. Handbook of Mariculture. CRC Press.  
Pillay TVR & Kutty MN. 2005. Aquaculture- Principles and Practices. Blackwell.

Rath RK. 2000. Freshwater Aquaculture. Scientific Publ.

Thomas PC, Rath SC & Mohapatra KD. 2003. Breeding and Seed Production of Finfish and Shellfish. Daya Publ.

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### **Examination Pattern**

**Time: 2 Hrs.**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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### **CORE PRACTICAL 6 (CP6)**

### **FISH SEED PRODUCTION TECHNOLOGY**

**CREDITS 2; MARKS 25**

#### **List of practical**

1. Histological techniques: Preparation of Permanent Histological slide of different organs of fishes.
2. Dissection and collection of fish pituitary gland, preservation, extract preparation, doses determination and injection to the brood fishes.
3. Hatchery training(Fresh water fish/Brackish water fish/Aquarium fish/Prawns)
4. Laboratory Note Book.
5. Internal Assessment.

### **QUESTION PATTERN**

**Time: 2½ Hour**

**Full Marks: 25**

1. Staining of one histological slide, identification, drawing and labeling. 5+2+1+1=09
2. Submission of two permanent histological slides: 02
3. Collection of Pituitary gland, extract preparation and dose determination. 06
4. Hatchery training report submission and Laboratory Note Book=03
5. Internal Assessment=05

## PART II - SEMESTER III

### CORE THEORY 7 (CT7) BRACKISH WATER AQUACULTURE&MARICULTURE

CREDITS 4; CLASS 50; MARKS 50

**Unit 1:** Introduction: History, development and present status of brackishwater farming in India. Brackishwater as a medium for aquaculture, ecological factors – abiotic and biotic factors. Selection of site, general planning and design of brackish water farms.

**Unit 2:** Brackishwater Finfish Culture: Cultivable species in brackish water systems. Culture practices – monoculture and polyculture of *Chanos chanos*, *Mugilcephalus*, *Latescalcarifer*, *Etrophus suratensis*, *Oreochromismossambicus*. Nursery, rearing and grow out in ponds, cages and pens.

**Unit 3:** Crustacean Culture: Species of shrimps cultured in brackishwater – *Penaeus mondon*, *Penaeus indicus*, *Litopenaeus vannamei*. Extensive, semi-intensive and intensive shrimp farming practices. Species of crabs cultured and culture techniques, prospects in India. Species of lobsters, culture, problems and prospects in India; lobster fattening.

**Unit 4:** Mariculture: Open sea farming – scope and species cultured. Selection of site for sea farming. Different designs of open sea farming structures – construction of cages – bioengineering problems and solutions.

**Unit 5:** Molluscs, Echinoderms and Seaweed Culture: Molluscan culture – species of edible oysters, mussels and clams cultured. Importance of Echinoderms and species cultured. Culture of seaweeds, common cultivable species, culture techniques and harvesting. Important seaweed products.

**Unit 6:** Environmental Impacts: Environmental impact of brackish water and coastal aquaculture - Salinity intrusion, effluent discharge, eutrophication, chemical residues including antibiotics and hormones, destruction of natural habitat including paddy field and mangroves. Social issues and conflicts with other users on resources.

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### Examination Pattern

**Time: 2 Hrs**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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**CORE PRACTICAL 7 (CT7)**

**BRACKISH WATER AQUACULTURE & MARICULTURE**

**CREDITS 2; MARKS 25**

#### List of practical:

1. Analysis of water parameters(Brackish water/marine water) by titration method: D.O, Free CO<sub>2</sub>, Total alkalinity, Total Hardness, Salinity, Organic Carbon, Nitrogen, Phosphate, Sulphate, Chloride, BOD, COD.
  2. Analysis of Soil parameters: pH, Nitrate, Potassium and Organic Carbon.
  3. Visit to any brackish water fish farm.
  4. Laboratory Note Book.
  5. Internal Assessment
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### Question Pattern

**Time: 2½ Hour**

**Full Marks: 25**

One question from item no. 1=10

One question from item no. 2=05

Field Note Book: 03

Laboratory Note Book: 02

Internal Assessment: 05

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## **PART II - SEMESTER III CHOOSE EITHER SEC 1**

**SKILL ENHANCEMENT COURSE 1 (SET1) PEARL CULTURE 2 CREDITS: CLASS 25: MARKS 25**

**Unit 1:** Biology of Pearl oyster: Pearl producing molluscs. Morphology and anatomy of Pearl oyster, Life cycle of pearl oyster.

**Unit 2:** Structure and Histology of mantle. Natural Process of Pearl formation. Chemical composition of Pearls. Economic importance of pearls.

**Unit 4:** Pearl oyster culture: Techniques of pearl oyster culture (Fresh water and Marine water) for artificial production of pearls. Pearl culture techniques -Rafts, long lines, Pearls

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oyster baskets, under water platforms, mother oyster culture/Collection of oysters, rearing of oysters, Environmental parameters. Pearl Oyster surgery (Selection of Oyster, Graft tissue preparation, Nucleus insertion, Conditioning for surgery), Post-operative culture, harvesting of pearl, clearing of pearl.

**Unit 5:** Diseases and Predators of Pearl oysters.

**Unit 6:** Present status, prospects and problems of pearl industry in India.

**Reference Books:**

1.

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**EXAMINATION PATTERN**

**Time: 1 Hrs.**

**Full Marks: 25**

**20 Theory + 05 Internal Assessment**

Question are to be set covering the entire syllabus; 2 questions; out to four of 2 marks each (2x2=4), 2 questions; out of four of 4 marks each(4x2=08) and one question; out of three of 8 marks(8x1=08), are to be answered.

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**PART II: SEMESTER III**

**GENERIC ELECTIVE THEORY 3 (GET3)**

**4 CREDITS; CLASS 50; MARKS 50**

**Choose from the CBCS syllabus of Zoology/ Chemistry/ Botany**

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**PART II: SEMESTER III**

**GENERIC ELECTIVE PRACTICAL 3 (GEP3)**

**CREDIT: 2; MARKS 25**

**Choose from the CBCS syllabus of Zoology/ Chemistry/ Botany**

## PART II SEMESTER IV

CORE THEORY 8 (CT8)

AQUARIUM FISHERIES

CREDITS 4; CLASS 50; MARKS 50

**Unit 1:** Aquarium design and Construction: Introduction to aquarium. World aquarium trade and present status. Design and construction of home and public aquaria (freshwater and marine), oceanarium. Aquarium accessories - Aerators, filters (different types) and lighting. Water quality requirements.

**Unit 2:** Aquarium Management: Setting up of aquarium – under gravel filter, pebbles, plants, drift wood, ornamental objects and selection of fishes, Quarantine measures. Aquarium maintenance and water quality management. Control of snail and algal growth. Handling, care, packing and transportation of fishes - Use of anesthetics. Temperature acclimation.

**Unit 3:** Freshwater Ornamental Fishes: Species of ornamental fishes - their taxonomy and biology- Live bearers, Gold fish and koi, Gourami, Barbs and Tetras, angel fish, cichlids. Maturation, secondary sexual characters, breeding habits, spawning, parental care, fertilization and development of eggs. Hatching, larval rearing and their health. Freshwater plants – their taxonomy and morphology, multiplication of aquarium plants – different methods. Indigenous ornamental fishes of West Bengal.

**Unit 4:** Commercial Production: Requirements and design for the commercial production of ornamental fishes. Commercial production of goldfish, live bearers, gouramies, barbs and tetras, angel fish. Natural ponds for the mass production of ornamental fishes. Mass production of aquarium plants.

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### Examination Pattern

**Time: 2 Hrs**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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## CORE PRACTICAL 8 (CP8)

## AQUARIUM FISHERIES

CREDITS 2; MARKS 25

### LIST OF PRACTICAL

1. Construction of a glass aquarium.
2. Identification of aquarium fishes.
3. Identification of aquarium plants.
4. Laboratory Note Book.
5. Internal Assessment.

### QUESTION PATTERN

Time: 2½ Hour

Full Marks: 25

1. Construction of a model glass aquarium: 03
2. Identification of 4 aquarium fishes: 4x3=12
3. Identification of 2 aquarium plants: 2x2=04
4. Laboratory Note Book: 01
5. Internal Assessment: 05

## CORE THEORY 9 (CT9)

## FISH PATHOLOGY AND IMMUNOLOGY

CREDITS 4; CLASS 50; MARKS 50

**Unit 1:** Fin Fish Pathology: Causative agents, symptoms and control of some infectious diseases of fish- Fungal Diseases(Saprolegniasis, Branchiomycosis), Bacterial Diseases(Fin and Tail rot, Ulcer diseases, Dropsy, Eye diseases, Ferunculosis, Bacterial Gill diseases, ERM, Edwardsiellosis, Vibriosis), Protozoan Diseases(White spot diseases, Costiasis, Trichodinosis, Whirling disease), Metazoans( Dactylogyrus, Gyrodactylus, Hirodinosis, Lernaea, Argulus)- Morphology, life cycle, symptom and control. Viral diseases(IPN, IHN, VHs, CCVD). EUS.

**Unit 2:** Shell Fish Pathology: Some common diseases of prawns – pathogens, symptoms and control- IHN, Baculovirus, Black gill disease, brown spot disease.



**Unit 3:** Immunology: Antigen and antibody, Different types of immunoglobulins. Cells and organs of immune system in fish. Innate and adaptive immunity. Humoral and Cell mediated immunity. MHC, Antigen presentation. Vaccination. Recent trend in piscine immunology.

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### **Examination Pattern**

**Time: 2 Hrs**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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**CORE PRACTICAL 9 (CP9)  
CREDITS 2; MARKS 25**

**FISH PATHOLOGY AND IMMUNOLOGY**

#### **LIST OF PRACTICAL**

1. Identification of fish diseases.
2. Identification of fish pathogen.
3. Preparation of stained blood film to study various types of blood cells.

#### **QUESTION PATTERN**

**Time: 2½ Hour**

**Full Marks: 25**

1. Identification of two fish diseases (2x2)=04
2. Identification with reasons of one fish pathogen(4x1)=04
3. Preparation of blood film of fishes, Differential count of WBC, drawing and labeling= 10
4. Laboratory note book=02
5. Internal Assessment=05

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1:** Fishing crafts: Fishing craft materials-introduction to fishing craft technology- Boat building material- wood, steel, aluminum, Ferro-cement, FRP (GRP)-advantages and disadvantages. Classification and description of different type of fishing crafts in India (inland and marine) traditional, motorized and mechanized. General arrangements of different type of fishing boats, trawlers, gill netters, purse seiners, long liners, trollers, deep sea vessels. Classification of Marine corrosion.

**Unit 2:** Fishing gear: Classification of fishing gear (FAO and A. Von Brandt). Fishing gear materials- natural, synthetic materials, properties and preservation,yarn numbering systems, direction of netting,type of knots, meshes, fly meshing. Mounting and webbing-different methods, hanging co-efficient. Fishing gear accessories- floats, sinkers, otter board, hook and ropes. Operation,Classification and design description of trawling, purse seining, gill netting, line fishing and squid jigging.

**Unit 3:** FAD's, Fish finding devices and conservation: Fish aggregating devices and artificial reefs; Impact of artificial reefs on fish stock improvement; Turtle Exclusion Devices (TED) - By-catch Reduction Devices (BRD). Fish finder, GPS navigator, sonar, net sonde, gear monitoring equipments; remote sensing.

**Unit 4:** Responsible Fisheries and Fisheries Legislation: Concept of Responsible Fisheries; Monsoon trawl ban, closed season, mesh size regulations, juvenile fishing, Exclusive Economic Zone (EEZ), Coastal Regulation Zone (CRZ), Integrated Coastal Zone Management (ICZM). MSY, MEY, Over fishing, Recruitment over fishing, Aquaranching. Indian fisheries Act.1976. Coast Guard Act.1978, Maritime zones of India Act.1981.

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**Examination Pattern****Time: 2 Hrs****Full Marks: 50****(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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## CORE PRACTICAL 10 (CP10)

## FISHING CRAFT AND GEAR TECHNOLOGY

CREDITS 2; MARKS 25

### LIST OF PRACTICAL

1. Identification of fishing crafts, gears, fishing accessories, (floats/sinkers/hook/synthetic and natural fibres, twines, ropes, iron wares).
2. Preparation of fishing nets.
3. Submission of a model fishing crafts/gears.
4. Laboratory Note Book.
5. Internal Assessment.

### QUESTION PATTERN

Time: 2½ Hour

Full Marks: 25

1. Two Identification from the item no. 1(2x4)=08
3. Preparation of one fishing net/ a part/knot)=06
4. Laboratory Note Book=02
5. Submission of a model fishing craft/gear=04
6. Internal Assessment=05

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## PART II SEMESTER IV

SKILL ENHANCEMENT COURSE 2 (SEC T2)

CRABS CULTURE

2 CREDITS: CLASS 25 : MARKS 25

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**Unit 1:** Introduction: History and Present status of crab culture.

**Unit 2:** Biology of Crabs: Economically important species of crabs. Morphology and anatomy of crabs. Life cycle of crabs.

**Unit 3:** Crabs culture: Cultivable species of crabs in India. Techniques of Crabs culture. Crabs fattening

**Unit 4:** Prospect, problems and development of crab culture in India.

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## EXAMINATION PATTERN

**Time: 1 Hrs.**

**Full Marks: 25**

**20 Theory + 05 Internal Assessment**

Question are to be set covering the entire syllabus; 2 questions; out to four of 2 marks each (2x2=4), 2 questions; out of four of 4 marks each(4x2=08) and one question; out of three of 8 marks(8x1=08), are to be answered.

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## PART II SEMESTERIV

### GENERIC ELECTIVE THEORY 4 (GET-4)

**CHOOSE FROM THE CBCS SYLLABUS OF ZOOLOGY / CHEMISTRY /BOTANY**

**CREDIT: 4; CLASS 50; MARKS 50**

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## PART II SEMESTERIV

### GENERIC ELECTIVE PRACTICAL4 (GEP-4)

**FOLLOW THE RESPECTIVE CBCS SYLLABUS OF ZOOLOGY / CHEMISTRY /BOTANY**

**CREDIT: 2; MARKS 25**

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## PART III SEMESTERV

**CORE THEORY 11 (CT11 )**

**FISHERIES POST HARVEST TECHNOLOGY**

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1:** Post Harvest Technology: Principles and importance of fish preservation. Fish s spoilage- post mortem changes and rigor mortis, post rigor spoilage. Methods of fish preservation- Icing, Freezing, Cold storage, Drying, Salting, Smoking, Canning and Fish Pickling.

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**Unit 2:** Fish product and Byproduct: Fish Oil, Fish liver oil, Fish meal, Fish manure, Fish flour, fish glue, isinglass.

**Unit 3:** Quality Assurance and Export of Fishery Products: Quality control – basic concepts, quality and quality control. Sanitation procedures in seafood processing plants. Waste management in fish processing industries. Risk factors in seafood biotoxins, seafood pathogens, endogenous parasites. Methods of evaluating fish freshness and quality – organoleptic, physical, chemical, microbiological and instrumental methods. Quality control programmes - pre-shipment inspection, IPQC, MIPQC, HACCP and ISO Series in seafood industry. Quality standards in India and major importing countries like USA, Japan and EU. Export of fishery products from India – major countries, important products, export documents and procedures. Traceability, Quality certifications, Ecolabelling.

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### Examination Pattern

**Time: 2 Hrs**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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**CORE PRACTICAL 11 (CP10)**

**FISHERIES POST HARVEST TECHNOLOGY**

**CREDITS 2; MARKS 25**

#### **LIST OF PRACTICAL**

1. Quality control of fishes: Crude protein analysis of fish muscle by lowry method.
2. Detection of organoleptic changes in fish.
5. Laboratory Note Book.
6. Internal Assessment.

## QUESTION PATTERN

**Time: 2½ Hour**

**Full Marks: 25**

1. One question from item no.1=10
2. One question from item no.2=05
3. Laboratory Note Book=05
4. Internal Assessment=05

## PART III SEMESTER V

**CORE THEORY 12 (CT12)**

**FUNDAMENTAL OF BIOCHEMISTRY**

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1:** Elementary idea of structure and classification of carbohydrate, protein, lipid and amino acids. Essential amino acids and fatty acids. Significance of omega3 and omega 6 fatty acids.

**Unit 2:** Carbohydrate metabolism: Process of Glycolysis, TCA cycles, Glycogenolysis, Glycogenesis, Gluconeogenesis.

**Unit 3:** Elementary idea of biological oxidation, oxidative phosphorylation and electron transport chain.

**Unit 4:** Lipid metabolism: synthesis and oxidation of fatty acid.

**Unit 5:** Protein Metabolism: Transamination, Deamination and urea cycle.

**Unit 6:** Enzymes: Classification, Kinetics(Michelis-Menten Concept), Factors affecting enzymatic action.

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### Examination Pattern

**Time: 2 Hrs**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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## CORE PRACTICAL 12 (CP12)

## FUNDAMENTAL OF BIOCHEMISTRY

**CREDITS 2; MARKS 25**

### LIST OF PRACTICAL

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids. Qualitative tests for carbohydrate; starch, sucrose, Maltose , fructose, glucose, protein; albumin, gelatin, peptone, fat; Test to be performed- Biuret test, Millon's test, Iodine test, Benedict's test, Barfoed test, Seliwantof's test.
2. Paper chromatography of essential amino acids.
3. Quantitative estimation of water soluble protein following Lowry' Methods.
4. Laboratory Note Book.
6. Internal Assessment.

### QUESTION PATTERN

**Time: 2½ Hour**

**Full Marks: 25**

1. Identification of one unknown sample; Qualitative test; Item No. 1=08
2. Identification of one amino acid; From Item 2=04
3. Quantitative estimation of concentratioin of unknown protein sample=06
4. Laboratory Note Bood=02
5. Internal Assessment=05

## PART III SEMESTER V

**DISCIPLINE SPECIFIC ELECTIVE; DSET 1**

**FISHERY MICROBIOLOGY**

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1:** Introduction: History and development of microbiology – Contributions of Louis Pasteur, Koch and Winogradsky –Diversity of microbial community – General characteristics of bacteria, fungi, viruses, algae and protozoans. .

**Unit 2:** Structure of microbes: Structure of prokaryotic cell, Structure and function of bacterial cell wall, plasma membrane, capsule, flagella and endospore. Structure of fungi

and yeast cell. Structure of virus. Classification of viruses. Life cycle bacteriophages - lytic and lysogenic cycle.

**Unit 3:** Isolation and culture of microbes: Prokaryotic growth – characteristic features of bacterial growth curve – Effect of environmental factors on growth. Nutrition and growth of bacteria – different types of media for isolation of bacteria and fungi. Isolation and cultivation of bacteria and fungi from water and sediment. Different culture techniques.

**Unit 4:** Aquatic Microbiology: Microflora of aquatic environment. Autotrophic and heterotrophic microorganisms in aquatic environment. Nutrient regeneration, role of microbes in biogeochemical cycles – Carbon, Nitrogen, Phosphorus and Sulphur cycles. Autochthonous and allochthonous microorganisms in aquatic environment.

**Unit 5:** Bacteria in culture pond: Health significant bacteria in culture ponds. Culture characteristics and epidemiology of *E. coli*, pathogenic *Vibrios*, *Salmonella*, *Aeromonashydrophila*, and *Pseudomonas*.

**Unit 6 :** Fish Microbiology: Perishability of seafood – Microbial spoilage of fish and shell fish. Spoilage microflora. Intrinsic and extrinsic factors affecting spoilage. Microflora associated with body parts. Food borne pathogens. Sources of contamination.

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### Examination Pattern

**Time: 2 Hrs**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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**DISCIPLINE SPECIFIC ELECTIVE PRACTICAL 1; DSEP 1**

**FISHERY MICROBIOLOGY**

**CREDITS 2; MARKS 25**

#### LIST OF PRACTICAL

1. Sterilization technique- dry heating, autoclaving
2. Media preparation.
3. Isolation and maintenance of bacteria from fishes and water.
4. Gram staining of bacteria.
5. Laboratory Note Book.
6. Internal Assessment.



## QUESTION PATTERN

**Time: 2½ Hour**

**Full Marks: 25**

1. One question from item1=05
2. One question from item2 and 3=05
3. One question from item4=08
4. Laboratory Note Book=02
5. Internal Assessment=05

## PART III SEMESTER V

**DISCIPLINE SPECIFIC ELECTIVE; DSE 2**

**ON THE JOB TRAINING**

**CREDITS 6; CLASS 75; MARKS 75**

(CREDIT2: CONTINUOUS EVALUATION+CREDIT4: MERIT OF THE TRAINING PROGRAMME UNDERTAKEN)

The students of semester V will have to undergo On the Job training for one month in any central or state government or recognized private institute concerning fisheries post harvest technology/ fresh water fish farm/ prawn or shrimp farm or any other fisheries institute.

## QUESTION PATTERN

**Time: 3 Hours**

**Marks: 75**

1. Submission of the training report= 20
2. Power Point Presentation=10
3. Grand Viva= 30
5. Continuous Evaluation(Internal Assessment) by the Training Institute: 15

## PART III SEMESTER VI

**CORE THEORY 13 (CT13 )**

**AQUATIC ECOLOGY**

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1:** Introduction: Definition of Ecology and Ecosystem, Subdivision of ecology- autecology and synecology.

**Unit 2:** Species and the individual in the ecosystem: Concept of habitat and ecological niche, ecological equivalents, character displacements- sympatry and allopatry, Biological clocks.

**Unit 3:** Population(Structure and dynamics): Population characteristics, theories of population growth, population interactions.

**Unit 4:** Community(Structure, classification and dynamics): Characteristics of community- species diversity, growth forms and structure, dominance, composition, structure. Ecological succession- definition, types of succession, general process of succession, hydrocerc.

**Unit 5:** Ecosystem(Structure and function): Definition, kinds of ecosystem, structure of ecosystem, ecological pyramids, productivity, food chains, food webs, energy flow in ecosystem, pond ecosystem, ocean(marine) ecosystem.

**Unit 6:** Fresh water ecology: The freshwater environment, types and limiting factor, ecological classification of freshwater organism, the freshwater biota, lentic communities, lakes, ponds, lotic communities, longitudinal Zonation in streams, springs.

**Unit 7:** Marine ecology: The marine environment, the marine biota, Zonation in the sea, communities of the marine environment.

**Unit 8:** Estuarine ecology: Definition and types, biota and productivity.

**Unit 9:** Water pollution: Sources of water pollution, Ground water pollution, marine pollution, mercury pollution, fluoride pollution, Ganga action plan(GAP), Yamuna action plan(YAP), Prevention and control of water pollution, wetland conservation.

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### Examination Pattern

**Time: 2 Hrs**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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### CORE PRACTICAL 13 (CP13)

### AQUATIC ECOLOGY

**CREDITS 2; MARKS 25**

#### LIST OF PRACTICAL

1. Estimation of productivity in water bodies.
2. Collection, fixation and Identification of living phytoplankton and zooplankton from the water bodies (not by permanent slide).
3. Laboratory Note Book.
4. Internal Assessment.

### QUESTION PATTERN

**Time: 2½ Hour**

**Full Marks: 25**

1. One question from the item no1=10
2. One question from the item no2=08
3. Laboratory Note Book=02
4. Internal Assessment=05

## PART III SEMESTER VI

### CORE THEORY 14 (CT14) FISHERIES ECONOMICS, FISHERIES EXTENSION, MARKETING & ENTREPRENEURSHIP DEVELOPMENT

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1:** Principles of economics: Definition, subject matter and scope of economics. Law of diminishing returns, laws of increasing, constant and decreasing utility and returns. Importance of economics in aquaculture development.

**Unit 2:** Economy of fishermen: Fishermen populations, GDP from fisheries sector, foreign exchange earnings and employment potential of fishing industry.

**Unit 3:** Prospective of Aquaculture in Socio-Economic impact & Rural Development: Resource use and development, Socio-economic analysis, Socio-demographic profile, work contribution, household expenditure, income contribution, decision making, female headed household, impact of different age groups, socio-economic condition of fisherman.

**Unit 4:** Marketing: Markets and their kinds. Law of demand and supply, price determination, problems of fish marketing in India. Exports of fish and fishery products, trends and problems therein. Role of MPEDA in exports of fish and fishery products.

**Unit 5:** Fishery co-operatives: Functions, financial assistance, input supplies, marketing of fish. Socio-economic development. Role of fisheries corporations and Missionary Organizations in fisheries development.

**Unit 6:** Fishery extension: Extension education- objective and principles. Role of extension in community development. Integrated rural development strategies. Programmes for weaker section of the community. Fishery development plans and various schemes

**Unit 8:** Entrepreneurship Development:

(A) Entrepreneurship Building:

1. Meaning, Importance, Psychological, Sociological factors and distinctive competence. Entrepreneurship process.
2. Need, scope, characteristics and types of Entrepreneurship. STED.
3. Social responsibility and business ethics.
4. Human resource management, Leadership, Motivation attitude, communication, Group dynamics, Delegation, Setting of goals, Transactional analysis, Creativity, Problem solving, Strength weakness opportunity and threat (SWOT) Techniques, Decision making, Stress management.

(B) Financial Management:

1. Institutions, Financing procedure and Financial incentives, Banking norms as in vogue.
2. Financial ratios & and their significance, Costing and Pricing.
3. Fund flow and Cash flow concept.
4. Break even analysis

**(C) Technology Management :**

1. Criteria for principles of product, selection and development.
2. Choice of technology, plant and equipment.
3. Critical Path Method ( CPM ) & Project Evaluation Review Techniques (PERT) as planning tools for establishing SSI.
4. Quality control / quality assurance and testing of product.
5. Production Management : Elements of production process, Production Planning and control, Product development, Testing facilities, Patents, Quality Assurance, Time control and Cost control, Total Quality Management.

8. Materials Purchasing Management : Material Planning and Budgeting, Value engineering, Value analysis, Economic ordering quantity, Inventory control.

**(D) Marketing Management :**

1. Elements of marketing & sales management.
2. Nature of product and market strategy – Packing & advertising – After sales service.
3. Touch on Import – Export procedure and methods.
4. Analyzing marketing opportunities, Planning marketing strategy, Forecasting, Marketing mix, Advertising the marketing programme & sales management, market survey techniques.

**(E) Project Formulation:**

1. Stages and methodology in Project identification, Selection of a project format, Project report writing.
2. Analysis and evaluation of a Project report.

**(F) Statutory provisions:**

1. Licensing, Registration – Municipal bye laws and Insurance coverage.
2. Important provisions of Factory Act, Sales of Goods Act, Partnership Act.
3. Pollutional control & Environmental Act.
4. Income Tax, Sales Tax and Excise Rules.
5. Business & Industrial laws, labour relations.

**(G) Knowledge input:**

1. Industrial and Economic policy declared by Government from time to time.
2. Sickness in small scale industries and their remedial measures.
3. Management Information System(MIS)

**(H) Data Base management:**

1. Books of accounts, financial statements.

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### Examination Pattern

**Time: 2 Hrs**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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### **CORE PRACTICAL 14 (CP14) FISHERIES ECONOMICS, FISHERIES EXTENSION, MARKETING & ENTREPRENEURSHIP DEVELOPMENT**

**CREDITS 2; MARKS 25**

#### **LIST OF PRACTICAL**

1. Fish market survey.
2. Study of socio-economic status of fishermen of any fishing villages in West Bengal.
4. Seminar on Fisheries extension/rural economics.
5. Internal Assessment.

#### **EXAMINATION PATTERN**

1. Submission of a fish market survey report or the report of socio-economic status of fishermen of any fishing villages of West Bengal =08
2. Seminar on Fisheries extension/rural economics.(Hard copy 6+ Presentation 6)=12
3. Internal Assessment=05

## PART III SEMESTER VI

**DISCIPLINE SPECIFIC ELECTIVE; DSET 3 BIOSTATISTICS, COMPUTER APPLICATION, REMOTE SENSING & GIS.**

**CREDITS 4; CLASS 50; MARKS 50**

**Unit 1:** Biostatistics: Preliminary concept, definition and application of Biostatistics. Measures of Central Tendency- Mean, Median, Mode. Measures of variation-Range, mean deviation, standard deviation, coefficient of variation. Testing of hypothesis- Chi-squar test and student T-Test. Probability theory, correlation, regression.

**Unit 2:** Computer Application: Introduction to computer, advantages, limitations, classification of computer, elementary idea of desktop, input-output devices-CPU, Key Board, Mouse, FD drive, CD-DVD Rom drive, RAM, Hardware and software. Office application- software: Introduction to windows, MS Word, MS-Excel and Powerpoint Presentation. Concept of Internet and its application in information collection. Basic ideas of www.

**Unit 3:** Remote sensing and GIS: Definition and principle of remote sensing and GIS. Sensing mechanism. Analysis of images and data. Fisheries forecasting system in India and other countries. GPS. Application of remote sensing and GIS in fisheries conservation and management of fish faunal diversity and exploitation of capture fisheries.

### Examination Pattern

**Time: 2 Hrs**

**Full Marks: 50**

**(40 Theory + 10 Internal Assessment)**

Question are to be set from entire syllabus; 4 question (out of six) of 2 marks each(2x4=8), four question (out of six) of 4 marks each(4x4=16), and two question ( Out of two) of 8 marks each(8x2=16), are to be answered.

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**DISCIPLINE SPECIFIC ELECTIVE PRACTICAL 3; DSEP 3 BIOSTATISTICS, COMPUTER APPLICATION, REMOTE SENSING & GIS.**

**CREDITS 2; MARKS 25**

### LIST OF PRACTICAL

1. Identification of computer accessories.
2. Preparation of chart, graphs and power point presentation in computer.
3. Seminar on remote sensing (Hardcopy-6, presentation-6).
4. Internal Assessment.

## QUESTION PATTERN

1. One question from item no.2 =08
2. One question from item no.3=12
3. Internal Assessment=05

## PART III SEMESTER VI

**DISCIPLINE SPECIFIC ELECTIVE; DSET 4**

**PROJECT WORK**

**CREDITS 6; CLASS 75; MARKS 75**

**2 CREDITS FOR CONTINUOUS EVALUATION + 4 CREDITS FOR MERIT OF THE PROJECT**

Project work to be done under a faculty member of the department. Project supervisors may be allocated during the end of second semester. Completed project report may be submitted at the end of Semester VI.

### Examination Pattern

**Time: 3Hrs**

**Full Marks: 75**

1. Submission of Project Report=30
2. Power Point Presentation=10
3. Grand Viva=20
4. Internal Assessment=15

**END OF SYLLABUS**



