# UNIVERSITY OF CALCUTTA

## Notification No.CSR/27/2023

It is notified for information of all concerned that in terms of the provisions of Section 54 of the Calcutta University Act, 1979, (as amended), and, in exercise of her powers under 9(6) of the said Act, the Vice-Chancellor has, by an order dated 11.08.2023 approved the syllabus for "Industrial Fish & Fisheries" (Core Vocational) semester wise Four-year (Honours with core Vocational) programme of U.G. courses of studies, as applicable under CCF,2022, under this University, as laid down in the accompanying pamphlet.

The above shall take effect from the academic session 2023-2024.

16/8/2023

Prof.(Dr.) Debasis Das

Registrar

SENATE HOUSE

Kolkata-700073

The 16th August, 2023

# UNIVERSITY OF CALCUTTA

## NEP Curriculum

*For*

## Industrial Fish and Fisheries

**(Effective from 2023)**

**FOUR YEAR UNDERGRADUATE PROGRAMME**

## 1. Distribution of courses under NEP (2020)

**(a)Discipline Specific Course/Core Courses (DSC/CC): Credit 4[**Theory: 3; Practical:1**]**

| | | | |
|---|---|---|---|
| 1. Fish Taxonomy | 2. Freshwater aquaculture | 3. Anatomy & biology of fishes | 4. Fish physiology |
| 5. Capture fisheries | 6. Fish seed production technology | 7. Fish genetic engineering & molecular biology | 8. Fish nutrition & feed technology |
| 9. Fishing Craft & gear technology | 10. Fisheries entrepreneurship development | 11. Fisheries economics & extension | 12. Brackishwater aquaculture & mariculture |
| 13. Fisheries post-harvest technology | 14. Quality assurance of fish & fishery products | 15. Fundamental of biochemistry | 16. Fish Biodiversity & Conservation biology |
| 17. Bio-statistics & computer application | 18. Fish Pathology & Immunology | 19. Fundamental of Microbiology | 20. Aquatic ecology |
| 21. Aquatic pollution & toxicology | 22. Tools & techniques in biology | | |

**(b)Interdisciplinary Course(IDC): Credit 3[**Theory: 2; Practical:1**]**

**(c)Skill enhancement course(SEC): Credit 4 [**Theory: 3; Practical: 1**]**

| | | |
|---|---|---|
| 1. Crab & Pearl culture | 2. Ornamental fish production & management | 3. Prawn culture |

**(d)Summer Internship.**

**(e) Dissertation and Research work.**

**(f)Minor courses.**

**(g)Ability enhancement courses (AEC).**

**(h) Value added courses (CVAC).**

## Outline structure of NEP curriculum for Industrial Fish and Fisheries, CU

| Part | Semester | Course Name (with code) | Credit | Marks |
|---|---|---|---|---|
| 1 | I | CC 1:Fish Taxonomy (Theory) | 3 | 75 |
| | | CC 1-P:Fish Taxonomy Lab(Practical) | 1 | 25 |
| | | IDC 1: *Anyone to be selected from other Subjects [Except Major and Minor Subject] as provided by the College* | 2 | 50 |
| | | IDC 1-P | 1 | 25 |
| | | SEC 1: Crab & Pearl culture (Theory) | 3 | 75 |
| | | SEC 1-P: Crab & Pearl culture Lab (Practical) | 1 | 25 |
| | II | CC 2: Freshwater aquaculture (Theory) | 3 | 75 |
| | | CC 2-P: Freshwater aquaculture Lab (Practical) | 1 | 25 |
| | | IDC 2: *Anyone to be selected from other Subjects [Except Major and Minor Subject] as provided by the College* | 2 | 50 |
| | | IDC 2-P: | 1 | 25 |
| | | SEC 2: Ornamental fish production & management (Theory) | 3 | 75 |
| | | SEC 2-P: Ornamental fish production & management Lab (Practical) | 1 | 25 |
| 2 | III | CC 3: Anatomy & biology of fishes (Theory) | 3 | 75 |
| | | CC 3-P: Anatomy &biology of fishes Lab (Practical) | 1 | 25 |
| | | CC 4: Fish physiology (Theory) | 3 | 75 |
| | | CC 4-P: Fish physiology Lab (Practical) | 1 | 25 |
| | | IDC 3: *Anyone to be selected from other Subjects [Except Major and Minor Subject] as provided by the College* | 2 | 50 |
| | | IDC 3-P: | 1 | 25 |
| | | SEC 3: Prawn culture (Theory) | 3 | 75 |
| | | SEC 3-P: Prawn culture Lab(Practical) | 1 | 25 |
| | IV | CC 5: Capture fisheries (Theory) | 3 | 75 |
| | | CC 5-P: Capture fisheries Lab (Practical) | 1 | 25 |
| | | CC 6: Fish seed production technology (Theory) | 3 | 75 |
| | | CC 6-P: Fish seed production technology Lab (Practical) | 1 | 25 |
| | | CC 7: Fish genetic engineering & molecular biology(Theory) | 3 | 75 |
| | | CC 7-P: Fish genetic engineering & molecular biology Lab(Practical) | 1 | 25 |
| | | CC 8:Fish nutrition & feed technology(Theory) | 3 | 75 |
| | | CC 8-P: Fish nutrition & feed technology Lab (Practical) | 1 | 25 |
| 3 | V | CC 9: Fishing Craft & gear technology (Theory) | 3 | 75 |
| | | CC 9-P: Fishing Craft & gear technology Lab (Practical) | 1 | 25 |
| | | CC 10: Fisheries entrepreneurship development(Theory) | 3 | 75 |
| | | CC 10-P: Fisheries entrepreneurship development Lab (Practical) | 1 | 25 |
| | | CC 11: Fisheries economics & extension (Theory) | 3 | 75 |
| | | CC 11-P: Fisheries economics & extensionLab (Practical) | 1 | 25 |
| | | CC 12: Brackish water aquaculture & mariculture (Theory) | 3 | 75 |
| | | CC 12: Brackish water aquaculture & maricultureLab (Practical) | 1 | 25 |
| | VI | CC 13: Fisheries post-harvest technology (Theory) | 3 | 75 |
| | | CC 13-P: Fisheries post-harvest technology Lab (Practical) | 1 | 25 |
| | | CC 14: Quality assurance of fish & fishery products (Theory) | 3 | 75 |
| | | CC 14-P: Quality assurance of fish & fishery productsLab (Practical) | 1 | 25 |
| | | CC 15: Fundamental of biochemistry (Theory) | 3 | 75 |
| | | CC 15-P: Fundamental of biochemistryLab (Practical) | 1 | 25 |
| | | Summer internship: *To be done from any institute or industries or farm related with fisheries.* | 3 | 75 |

**Contd…**

| Part | Semester | Course Name (with code) | Credit | Marks |
|---|---|---|---|---|
| 4 | VII | CC 16: Fish biodiversity & Conservation biology (Theory) | 3 | 75 |
| | | CC 16-P:Fish biodiversity & Conservation biologyLab (Practical) | 1 | 25 |
| | | CC 17: Bio-statistics & computer application (Theory) | 3 | 75 |
| | | CC 17-P: Bio-statistics & computer applicationLab (Practical) | 1 | 25 |
| | | CC 18: Fish Pathology& Immunology(Theory) | 3 | 75 |
| | | CC 18-P: Fish Pathology & ImmunologyLab (Practical) | 1 | 25 |
| | | CC 19: Fundamental of Microbiology(Theory) | 3 | 75 |
| | | CC 19-P: Fundamental of MicrobiologyLab (Practical) | 1 | 25 |
| | | Dissertation/Research work.: Research Methodology and Communication, experimental work, field sampling, analyses, presentation | 4 | 100 |
| | VIII | CC 20: Aquatic ecology (Theory) | 3 | 75 |
| | | CC 20-P: Aquatic ecologyLab (Practical) | 1 | 25 |
| | | CC 21: Aquatic pollution & toxicology (Theory) | 3 | 75 |
| | | CC 21-P: Aquatic pollution & toxicologyLab (Practical) | 1 | 25 |
| | | CC 22: Tools & techniques in biology (Theory) | 3 | 75 |
| | | CC 22-P: Tools & techniques in biologyLab (Practical) | 1 | 25 |
| | | Dissertation/Research work.: Research Methodology and Communication, experimental work, field sampling, analyses, presentation | 8 | 200 |

**Abbreviations:**
**CC:** Core Course**; IDC:** Inter Disciplinary Course**; SEC:** Skill Enhancement Course

***NOTE: Marks = 25 marks per credit**

***Candidates who will not pursue Dissertation/Research have to submit 1 Review paper along with Seminar Presentation at the end of Semester-7 and 2 review paper along with Seminar Presentation at the end of Semester-8.*

# PART-I: SEMESTER- I

*Core course*

| **CC1** | **FISH TAXONOMY (Theory)** |
|---|---|
| **Credit: 3; Marks: 75; Hours: 50Hours** | |
| **Unit 1: Systematics:** Definition, component, importance. | 2 |
| **Unit 2: Taxonomy:** Definition, component, importance, micro & macro taxonomy, stages of taxonomy, Zoological Nomenclature: Requisites, ICZN, type concept. New trends in taxonomy- Biochemical, Cytological & Molecular. | 8 |
| **Unit 3: Classification**: Definition. Approaches in classification- Cladistics, Phenetics& DNA barcoding. Component of classification: category, taxon. Linnaean hierarchy. Classification of subphylum crustacean upto subclass with example, classification of phylum molluscaupto subclass with example, classification of class chondricthyesupto order with example, classification of class actinopterygiiupto order with example. Construction of phylogenetic tree of fishes. | 18 |
| **Unit 4: Species concept:** Biological, typological & Evolutionary. Mechanism of Speciation. Subspecies and other intraspecific categories. | 12 |
| **Unit 5: Origin & Evolution of fishes:** Geological time scale, Origin & evolution of Chondrichthys, actinopterygii, Sarcopterigii (coelacanth &dipnoi). | 10 |

**[Note:**Classification of Sub phylum Crustacea and Phylum Mollusca according to Ruppert& Barnes (1994) should be followed. On the other hand classification of Class chondricthyes and actinopterygii as per Nelson (2010) should be followed.**]**

## CC 1-P: FISH TAXONOMY LAB (Practical)

**Credit: 1; Marks: 25; Hours: 50**

1. Identification(with reasons) of freshwater, brackish water and marine water fishes.
2. Identification (with reasons) of crustacea (prawns, shrimps, lobster, brachyuran crab) and mollusca (bivalves, cephalopods).
3. Laboratory Note Book.

***Suggested readings**:*


- Kapoor V.C. (2017) Theory and Practical of Animal Taxonomy diversity. Oxford & IBH Publishing Co. Pvt. Ltd.
- Simpson G.G.(2012). Principles of Animal Taxonomy. Scientific publishers (India).
- Jayaram K.C(2010). Fish Taxonomy. NPH
- Jayaram K.C(2010). Fishes of the Indian region. NPH
- Nelson J.S.(2010). Fishes of the world.
- Ruppert E.E & Barnes R.D.(1994). Invertebrate Zoology.

*Skill enhancement course*

## SEC 1 CRAB & PEARL CULTURE

**Credit: 3; Marks: 75; Hours: 50**

| | Hours |
|---|---|
| **Unit 1: Introduction:** Present status of crab& pearl culture in India. Prospect and problem of crab and pearl culture in West Bengal. | 04 |
| **Unit 2: Biology of Crabs:** Morphology(external and internal), Sexual dimorphism, Reproductive biology & Life cycle, Habit (living, feeding, breeding)& Habitat of brachyuran crab (freshwater and brackish water). Ecological importance of crabs. | 08 |
| **Unit 3: Crabs culture:** Cultivable species of crabs in India. Seed production techniques of mud crabs, crab hatchery, seed transportation & larval rearing. Different culture practices- Grow-out system, Crabs fattening(procedure, biochemical events), harvesting & marketing. | 08 |
| **Unit 4:Biology of Pearl oyster:** Cultivable species of pearl oyster in India. Morphology (external and internal), habit and habitat, and life cycle of pearl oyster. | 08 |
| **Unit 5:Anatomy of Pearl oyster:**Histology of mantle. Natural Process of Pearl formation. Chemical composition of Pearls. Economic importance of pearls. | 06 |
| **Unit 6: Pearl oyster culture:** Techniques of pearl oyster culture (Fresh water and Marine water) for artificial production of pearls- Rafts, long lines, Pearls 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. | 16 |

### SEC 1-P: CRAB & PEARL CULTURE LAB (PRACTICAL)

**Credit: 1; Marks: 25; Hours: 50**

1. Identification(with reasons) of Pearl oyster.
2. Identification(with reasons) of freshwater and brackish water crabs.
3. Preparation of graft tissue, nuclei & surgical implantationin freshwater mussel.
4. Submission of a field report after visiting of a crab /pearl culture unit.
5. Laboratory Note Book.

***Suggested readings:***


- Mcvey JP. 1983. Handbook of Mariculture. CRC Press.
- Pillay TVR &Kutty MN. 2005. Aquaculture- Principles and Practices. Blackwell.
- Thomas PC, Rath SC &Mohapatra KD. 2003. Breeding and Seed Production of Finfish and Shellfish. Daya Publ.
- Southgate P. and Lucas J. 2008. The Pearl Oyster 1st Edition. Elsevier Science


## IDC 1 **Anyone to be selected from other Subjects [**Except Major and Minor Subject**] as provided by the College**

# PART-I: SEMESTER- II

*Core course*

## CC2 FRESHWATER AQUACULTURE (Theory)

**Credit: 3; Marks: 75; Hours: 50Hours**

| | |
|---|---|
| **Unit 1: Scope and present status of aquaculture:** Selection of site, general planning and design of fresh water fish farms- quality and productivity of water, soil characteristics and other parameters. | 06 |
| **Unit 2: Carp Culture:** Pre -stocking, Stocking and Post stocking management of Nursery, Rearing and Stocking pond. | 08 |
| **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. | 08 |
| **Unit 4: Aquaculture diversification-** Aquaponics system, Biofloc culture, IMTA and periphyton culture. | 08 |
| **Unit 5: Sewage fed fish culture:** Selection of species, methods of culture, advantage and disadvantage. | 06 |
| **Unit 6: Culture of Catfishes and Murrels:** Culturable species of catfishes and murrels, Spawning and fry production and grow out. | 06 |
| **Unit 7: Culture of Tilapias:** Cultivable species of tilapia, Culture systems, Grow out and feeding. | 04 |
| **Unit 8: Culture of coldwater fishes:** Cultivable coldwater fishes, culture systems, Grow out and feeding. | 04 |

## CC 2-P: FRESHWATER AQUACULTURE LAB (Practical)

**Credit: 1; Marks: 25; Hours:50**

1. Analysis of physicochemical water parameters (River/pond/lake water) by Standard Methods(APHA) : D.O, Free $CO_2$, Total alkalinity, Total Hardness, Salinity, Phosphorus, Nitrite
2. Submission of field/training report after completion of training on freshwater aquaculture.
3. Submission of Laboratory Note Book.

***Suggested readings**:*


- Pillay T.V.R. and Kutty M.N. Aquaculture: Principles and Management. Willey India Pvt. Ltd
- Bardach J.E. Aquaculture. Willey
- Badapanda K.C. Aquaculture. Wiley


*Skill enhancement course*

## SEC 2 ORNAMENTAL FISH PRODUCTION &MANAGEMENT (Theory)

**Credit: 3; Marks: 75; Hours: 50**

| | Hours |
|---|---|
| **Unit 1: Basics of aquarium:** Inception of the concept of aquarium; Different types and designs of aquarium: Design and construction of home and public aquaria (freshwater and marine), oceanarium. Aquarium accessories - aerator, diffuser, filters, lighting, thermostat and thermometer, feeding cup and feeding cone, light, internal and external decors. | 4 |
| **Unit 2: Aquarium Management:** Setting up of aquarium (selection of site, selection of fish, selection of substrate and filters, temperature acclimatization, quarantine measures), plants, 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. | 6 |
| **Unit 3: Freshwater Ornamental Fishes:** Indigenous and exotic ornamental fishes in West Bengal. Biology (maturation, secondary sexual characters, breeding habits, spawning, parental care, fertilization and development of eggs) of Gold fish, Gourami, Barbs and Tetras, Angel fish, Cichlids. | 12 |
| **Unit 4: Freshwater aquarium plants:** Common aquarium plants, morphology and multiplication. | 4 |
| **Unit 5: Ornamental fish Breeding:** Hatchery management, breeding & larval rearing of live bearer (Guppies, Mollies, Sword tail and Platy), egg layers- (Gold fish, Angel fish, Zebra fish and Neon tetra) fishes. | 6 |
| **Unit 6: Commercial Production:** Requirements and design for the commercial production of ornamental fishes: Goldfish, live bearers, gouramies, barbs and tetras, angel fish. Natural ponds for the mass production of ornamental fishes. Mass production of aquarium plants. | 8 |
| **Unit7: Ornamental Feed and feeding management:** Introduction of aquarium feeds. Live food organisms and their culture. Feeding methods and frequency. Formulation of artificial feeds | 4 |
| **Unit 8: Common aquarium fish diseases and control measures:** Some common diseases of ornamental diseases – pathogens, symptoms and control. Health management in Ornamental Fish Farming. | 2 |
| **Unit 9: Ornamental fish trade, its regulations and wildlife act:** Indian scenario, supply and demand situation. Trade regulations and acts. CITES, Prohibition of fish hunting. | 4 |

## SEC 2-P: ORNAMENTAL FISH PRODUCTION & MANAGEMENT (Practical)

**Credit: 1; Marks: 25; Hours: 50**

1. Construction of a glass aquarium.
2. Identification(with reasons) of aquarium fishes.
3. Identification of aquarium plants.
4. Submission of Field report.
4. Laboratory Note Book.

***Suggested readings**:*

- Saxena A. Aquarium Management.
- Hunnam P., Milne A., Stebbing P. The living aquarium.
- CIFE. 1993. Training Manual on Culture of Live Food Organisms for AQUA Hatcheries. Central Institute of Fisheries Education, Versova, Mumbai.
- Paulraj R. 1997. Aquaculture Feed: Handbook on Aquafarming. MPEDA Publ.


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*Interdisciplinary Course*

**IDC 2 Anyone to be selected from other Subjects [**Except Major and Minor Subject**] as provided by the College**

**------END OF 1ST YEAR------**