UNIVERSITY OF CALCUTTA

Notification No. CSR/74/2024

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 the exercise of her powers under 9(6) of the said Act, the Vice-Chancellor has, by an order dated 11.09.2024 approved the syllabus of Industrial Fish & Fisheries (IIFV)- Core – Vocational under CCF, under this University, as laid down in the accompanying pamphlet.

The above shall take effect from Odd semester Examinations, 2024 & onwards.

19/9/24

SENATE HOUSE

Kolkata-700073

19.09.2024

Prof.(Dr.) Debasis Das

Registrar

Outline of four years honours curriculum of Industrial Fish and Fisheries (VIFM) under CCF, University of Calcutta

Part	Semester	Course Name (with code)	Credit	Marks
1	I	DSCC 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	DSCC 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 & managementLab (Practical)	1	25
2	III	DSCC 3: Fish biology (Theory)	3	75
		DSCC 3-P: Fish biology Lab (Practical)	1	25
		DSCC 4: Capture fisheries (Theory)	3	75
		DSCC 4-P: Capture fisheries 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: Brackish water aquaculture & mariculture (Theory)	3	75
		SEC 3-P: Brackish water aquaculture & mariculture Lab(Practical)	1	25
	IV	DSCC 5: Aquatic ecology (Theory)	3	75
		DSCC 5-P: Aquatic ecology Lab (Practical)	1	25
		DSCC 6: Fish seed production technology (Theory)	3	75
		DSCC 6-P: Fish seed production technology Lab (Practical)	1	25
		DSCC 7: Fish genetic engineering & molecular biology(Theory)	3	75
		DSCC 7-P: Fish genetic engineering & molecular biologyLab(Practical)	1	25
		DSCC 8:Fish nutrition & feed technology(Theory)	3	75
		DSCC 8-P: Fish nutrition & feed technology Lab (Practical)	1	25
3	V	DSCC 9: Fishing Craft & gear technology (Theory)	3	75
		DSCC 9-P: Fishing Craft & gear technology Lab (Practical)	1	25
		DSCC 10: Fish Pathology& Immunology(Theory)	3	75
		DSCC 10-P: Fish Pathology& Immunology Lab (Practical)	1	25
		DSCC 11: Fundamental of Microbiology(Theory)	3	75
		DSCC 11-P: Fundamental of Microbiology Lab (Practical)	1	25
		DSCC 12: Fisheries economics & entrepreneurship development (Theory)	3	75
		DSCC 12: Fisheries economics & entrepreneurship development Lab (Practical)	1	25
	VI	DSCC 13: Fisheries post-harvest technology (Theory)	3	75
		DSCC 13-P: Fisheries post-harvest technology Lab (Practical)	1	25
		DSCC 14: Fundamental of biochemistry(Theory)	3	75
		DSCC 14-P: Fundamental of biochemistry Lab (Practical)	1	25
		DSCC 15: Biostatistics, computer application, Remote sensing &GIS (Theory)	3	75
		DSCC 15-P: Biostatistics, computer application, Remote sensing and GIS	1	25

		Lab (Practical)		
		Summer internship	**3**	**75**

Part	Semester	Course Name (with code)	Credit	Marks
4	**VII**	DSCC 16: Tools & techniques in biology(Theory)	**3**	**75**
		DSCC 16-P: Tools & techniques in biology Lab (Practical)	**1**	**25**
		Semester Internship: *To be done from any institute or industries or farm related with fisheries.*	**16**	**400**
	VIII	Project work	**16**	**400**
		Project viva	**4**	**100**

Abbreviations:
DSCC: Discipline Specific Core Course**;** **IDC:** Inter Disciplinary Course**;**
SEC: Skill Enhancement Course

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

PART-I: SEMESTER- I

Core course

DSCC 1 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. Molecular taxonomy-concept and application of genomics and proteomics in taxonomy, DNA barcoding.	8
Unit 3: Concept of Classification: Definition. Approaches in classification- Phenetics: Concept, phenograms; Cladistics: Concept, homology, homoplasy, cladograms; Evolutionary: Concept of monophyly, paraphyly & polyphyly; Component of classification: category, taxon. Linnaean hierarchy. Three kingdom concept of Carl Woese, 1977 and five kingdom concept of Whittaker, 1969.	18
Unit 4: Subphylum Crustacea: General characteristics and classification up to sub-classes with example (Ruppert and Barnes, 1994, 6th Ed.)	2
Unit 5: Phylum Mollusca: General characteristics and classification up to sub-classes (Ruppert and Barnes, 1994, 6th Ed.)	2
Unit 6: Class Chondrichthyes and actinopterygii: General characteristics and classification up to order with example (Nelson, 2010)	4
Unit 7: Species concept: Mechanism, merits and demerits of Biological, typological & Evolutionary species concept. Subspecies, Polytypic species, Sibling species and Ring species	4
Unit 8: Speciation: Modes of speciation – Sympatric, Allopatric and Parapatric, Isolation and its role in speciation (pre mating and post mating)	4
Unit 9: Origin & Evolution of fishes: Geological time scale, Origin & evolution of Chondrichthys, actinopterygii, Sarcopterigii (coelacanth &dipnoi).	6

[*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.***]**

DSCC 1-P: FISH TAXONOMY LAB (Practical)

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

1. Identification (with reasons) of locally available freshwater fish: *Labeo, Gibelion, Cirrhinus, Cyprinus, Hypophthalmichthys, Ctenopharyngodon, Puntius, Heteropneustes, Clarias, Mystus, Ompok, Wallago, Anabas, Notopterus, Pangasius, Rita, Channa* etc

2. Identification (with reasons) of locally available brackish water fish: *Mugil, Liza, Eleutheronema, Daysceiana, Lates* etc.

3. Identification (with reasons) of locally available marine water fish: *Scoliodon, Scyliorhinus, Sphyrna, Torpedo, Rhonobatos, Dasyatis, Pristis, Sardinella, Harpadon, Hilsa, Rastrelliger, Thunnus, Pampus* etc.

4. Identification (with reasons) of crustacea (prawns, shrimps, lobster, brachyuran crab) and mollusca (bivalves, cephalopods): *Penaeus, Macrobrachium, Scylla, Lamellidens, Sepia, Loligo*, Octopus.

5. 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 (Theory)

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 implantation in freshwater mussel.
4. Visit to 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

DSCC 2 FRESHWATER AQUACULTURE (Theory)

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

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

DSCC 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. Spot identification of aquatic weed: Pistia, Salvinia, Lemna, Chara, Eichhornia, Hydrilla, Ceratophyllum.

3. Spot identification of aquatic insect: Notonecta, Ranatra, Cybister, Lithocerus
4. Training on freshwater aquaculture.
5. 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	4

demand situation. Trade regulations and acts. CITES, Prohibition of fish hunting.

SEC 2-P: ORNAMENTAL FISH PRODUCTION & MANAGEMENT (Practical)
Credit: 1; Marks: 25; Hours: 50

1. Construction of a glass aquarium.
2. Identification of common aquarium fish: Gold fish, Betta, Gourami, Swordtail, Platy, Molly, Tetra, Barbs, Angelfish, Danio, Discus.
3. Identification of common aquarium plants: Vallisneria, Cabomba, Echinodorus, Duckweed, Ceratophyllum.
4. Visit to any ornamental fish farm in West Bengal.
5. 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.

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------

PART-II: SEMESTER- III

Core course

DSCC 3	**FISH BIOLOGY (Theory)**
Credit: 3; Marks: 75; Hours: 50;	**Hours**
Unit 1: External morphology of fish: Structure, function and comparative account of integument, scales, mouth and fin.	2
Unit 2: External morphology of shell fishes: Prawn, Crab, Lobster, Bivalves, Gastropods and Cephalopod.	4
Unit 3:Internal anatomy of fish: Skeletal system- jaw suspension, Structure of branchial& visceral arches in fishes, Digestive system- comparative account of gastro-intestinal tract in herbivorous & carnivorous fishes, Circulatory system- comparative account of heart & aortic arches in teleost & dipnoi fishes, Respiratory system- respiratory & accessory respiratory organs in fishes, Excretory organ-kidney & it's unit, Sense organ-eyes and photoreception, lateral line system, neuromast organ, ampullae of lorenzini, pit organs.	16
Unit 4: Internal anatomy of Prawn: Structure of Digestive system, Respiratory system, Circulatory system, excretory system, reproductive and endocrine system.	10
Unit 5: Fish Physiology: Osmoregulation in 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. Poisonous and venomous fish.	10
Unit 6: Fish Age & Growth: Different food and feeding habit of fishes. Isometric and allometric growth, analysis of age/growth by hard parts(Scale, otolith, vertebrae), Marking and tagging of fish for growth studies, length-weight relationship, ponderal index, the cube law, relative condition factor, gastrosomatic index(GaSI) and gonadosomatic index(GSI).	5
Unit 7: Fish migration: Purpose and types of migration in fish, diadromous migration, physiological factors controlling iono- and osmoregulation, energetics, environmental, factors, anthropogenic impacts.	2
Unit 8: Parental care in fish: Different types of parental care in fish.	1

DSCC 3-P: FISH BIOLOGYL LAB (Practical)

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

1. **Major Dissection**:
   - (i) Urinogenital system of Tilapia/Mrigal.
   - (ii) Swim bladder and weberian ossicles of Carp (Rohu/Mrigal).
   - (iii) Afferent and efferent branchial system in Lata.
2. **Minor Dissection**:
   - (i) Digestive system of Mrigal.
   - (ii) Mounting of appendages of Prawn/Shrimp/crab.
   - (iii) Mounting of the different types of scales (placoid, cycloid, ctenoid) of fishes.

(iv) Otolith of Tilapia.
(v) Accessory Respiratory organs of singi, magur, and koi.
(vi) Pharyngeal teeth of carp

1. RLG, Gut content analysis of Tilapia, Mrigal.
2. Estimation of fecundity
5. Laboratory Note Book.

***Suggested readings**:*

- Ganguly B.A.,Sinha A.K., Adhikari S., Goswami B.C.B.(2018). Biology of Animals(Vol I& II). NCBA
- Khanna S.S.(214). Introduction to Fishes. Silver Line
- Srivastava C.B.L.(2014). Fishery Science and Indian Fisheries.
- Reinecke , 2006. *Fish Endocrinology*, Vol. 2": Enfield "Science Publishers, Inc.: "xx, 441-871pp" ISBN: 978-1-57808-415-9Jayaram 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.

Core course

DSCC 4 CAPTURE FISHERIES (Theory)

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

	Hours
Unit 1: Riverine fisheries: Major river system in India with special emphasis on morphometrics, characteristic ichthyofauna and threat. Prospect, problem and development of riverine fisheries in India. Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.	8
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.	8
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. Morphometrics of reservoirs and lake.	18
Unit 4: Estuarine fisheries: Definition and classification of estuaries, capture fisheries-resident and migrant species. Fisheries of brackish water lake and backwaters. Problem of brakish water fishery in India.	12
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 Oil sardine, Hilsa, Pomfret, Bombayduck, Mackerel, ribbon fish, sole fish, eel, catfishes, prawns, lobsters, mollusks.	10

DSCC 4-P: CAPTURE FISHERIES (Practical)

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

1. Analysis of Data, Drawing of Graphs- Line diagram, Bar diagram, Pie diagram & Histograms in relation to abundance and catch particular of fish.

2. Visit to a fish landing centre to study commercially important fishes and catch composition, and institute visit.
3. Laboratory Note Book.

***Suggested readings**:*

- Bal DV and Rao KV. 1990. Marine Fishes of India. 1st Revised Ed. Tata McGraw Hill.
- Blaber JM. 1997. Fish and Fisheries in Tropical Estuaries Chapman and Hall.
- FAO. Technical Papers on Freshwater Fisheries.
- Jhingran VG. 1991. Fish and Fisheries of India. 3rd Ed. Hindustan Publ.

Skill enhancement course

SEC 3 BRACKISHWATER AQUACULTURE & MARICULTURE (Theory)

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

	Hours
Unit 1: Introduction: An overview of sea farming and shore-based aquaculture in different parts of the world. Present status&resources for shore-based aquaculture and sea farming in India. Physicochemical parameters of brackish water. Selection of site, general planning and design of brackish water fish farms.Tide fed, pump fed farms.	4
Unit 2: Mariculture (Open sea farming): Scope and species cultured. Selection of site for sea farming. Different designs of open sea farming structures – construction of cages, rafts, racks, poles & ropes – bioengineering problems and solutions.Shore based aquaculture system: traditional (pokkali, bheries), semi- intensive, intensive aquaculture practice of commercially important species of fish and shellfish.	6
Unit 3: Brackish water Finfish Culture: Cultivable species- Seabass, mullet, milkfish, grouper, cobia, snappers, pearlspot culture in brackish water systems. Culture system– monoculture and polyculture. Management of Brackish water fish pond, cages and pens-Nursery, rearing and grow out.	12
Unit 4: Culture of Molluscan, Echinoderms: Present status and future prospects in India.Molluscan culture- edible oysters, mussels and clams, Echinoderms culture-distribution, practices followed in India and other Asian countries, farming methods–different types and culture methods; Problems.	4
Unit 5: Seaweed farming: Major seaweed species of commercial importance; tissue culture of seaweeds, methods of culture; farming of agar, algin and carragenan yielding species; emerging trends in their farming in open seas; Integration with other coastal and marine farming systems.	6
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.	8

SEC 3-P: BRACKISHWATER AQUACULTURE & MARICULTURE (Practical)

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

1. Analysis of Soil parameters: Determination of pH, available nitrogen, phosphorus and organic Carbon.
2. Visit to any brackish water fish farm.
3. 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
- Thomas P.C. Breeding and seed production of fin fish and shellfish. Daya publishing house.

Interdisciplinary Course

IDC 3 Anyone to be selected from other Subjects [Except Major and Minor Subject as provided by the College

PART-II: SEMESTER- IV

Core course

DSCC 5 AQUATIC ECOLOGY (Theory)

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

	Hours
Unit 1: Introduction: Definition of Ecology and Ecosystem, Subdivision of ecology- autecology and synecology.	2
Unit 2: Species and the individual in the ecosystem: Concept of habitat and ecological niche, ecological equivalents, character displacements- sympatry and allopatry, Biological clocks.	8
Unit 3: Population (Structure and dynamics): Population characteristics, theories of population growth, population interactions.	6
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, hydrocere.	8
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.	6
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.	6
Unit 7: Marine ecology: The marine environment, the marine biota, Zonation in the sea, communities of the marine environment.	4
Unit 8: Estuarine ecology: Definition and types, biota and productivity.	2
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.	8

DSCC5-P: AQUATIC ECOLOGY LAB (Practical)

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

1. Estimation of BOD and COD from any water body

2. Estimation of productivity in water bodies.

3. Collection, fixation and Identification of living phytoplankton and zooplankton from the water bodies.

4. Identification of phyto-and zooplankton using permanent slide.

5. Laboratory Note Book.

Suggested readings*:*

- E.P. Odum (1971) Fundamental of Ecology. W.B Sounders,
- Sharma P.D.- Ecology And Environment. Rastogi Publications

Core course

DSCC 6 FISH SEED PRODUCTION TECHNOLOGY (Theory)

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

	Hours
Unit 1: Endocrine aspect of fish reproduction: Control of fish reproduction by brain peptide, regulation of gonadal function by pituitary gonadotropin, endocrine control of gonadal development and maturation by steroid hormones, Histology of Pituitary, Testis and Ovary. Hormonal regulation of spermatogenesis and oogenesis. Environmental regulation of reproduction.	5
Unit 2: Broodstock management: Factors affecting the maturation and spawning of cultivable fishes, Nutritional and environmental requirement for brood stock. Criteria for the selection of brood stock, selective breeding strategies, Transportation of broodstock, use of anestheticsand therapeutics for health management of brood stock.	8
Unit 3: Induced Breeding of Fishes: History of induced breeding of fishes, Methods of pituitary extract preparation, dosage determination, and injection to the brood fishes, spawning and hatching. Use of different synthetic hormones and analogues for induced spawning. Stripping and fertilization.	12
Unit 4: Hatchery Technology & freshwater fish seed production: Bundh breeding, types of bundh breeding techniques and problems of bundh breeding. Design and function of different hatchery system-incubators, glass jar hatchery, Chinese circular hatchery and other hatchery systems. Seed production of Indian Major Carps, Mahaseer and Trout using hatchery.	11
Unit 5: Marine fish seed production: Sea bass, milkfish, mullets, Cobia and Silver pompano.	10
Unit 6: Seed production in shell fishes: Hormonal control of reproduction. Developmental stages. Seed production and nursery rearing of *Penaeus monodon* and *Macrobrachium rosenbergii.* Various components, equipments and infrastructures facilities required.	3
Unit 7: Collection of fish seed from natural resources: Riverine seed production techniques, different stages of seed: spawn, fry and fingerlings.	1

DSCC6-P: FISH SEED PRODUCTION TECHNOLOGYLAB (Practical)

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

1. Tissue fixation, embedding in paraffin, microtomy and slide preparation from testis and ovary of fish.

2. H-E staining of Histological slides

3. Dissection and collection of fish pituitary gland, preservation, extract preparation, doses Determination and injection to the brood fishes.

4. Visit to any Govt. / Pvt. Hatchery farm (Fresh water fish/Brackish water fish/Aquarium fish/Prawns)

5. Laboratory Note Book

Suggested readings*:*

- 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.

- Rath RK. 2000. Freshwater Aquaculture. Scientific Publ.
- Thomas PC, Rath SC &Mohapatra KD. 2003. Breeding and Seed Production of Finfish and Shellfish. Daya Publ.

Core course

DSCC 7	**FISH GENETIC ENGINEERING & MOLECULAR BIOLOGY(Theory)**
	Credit: 3; Marks: 75; Hours: 50

	Hours
Unit 1: Nucleic acids: Chemical composition of DNA and RNA; Watson and Crick Model of DNA, Secondary structure (Cloverleaf model) of tRNA. Griffith's experiment: DNA as genetic material-	3
Unit 2: DNA Replication: Enzymes of DNA replication, Mechanism of DNA replication in Prokaryotes, prove that replication is semi-conservative. Fidelity of DNA replication.	3
Unit 3:Transcription: Mechanism of Transcription in prokaryotes. transcription factors, difference between prokaryotes and eukaryotic transcription.	2
Unit 4: Translation: Mechanism of translation in Prokaryotes. Genetic code, Degeneracy of the genetic code, wobble hypothesis, inhibitors of protein synthesis, difference between prokaryotic and eukaryotic translation.	4
Unit 5: Post Transcriptional modifications and processing of eukaryotic RNA: Capping, splicing and polyadenylation.	3
Unit 6: DNA Repair mechanism: Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair.	3
Unit 7: **Molecular techniques:** PCR, Western, Southern and Northern Blot, Sanger DNA sequencing.	3
Unit 8: Gene structure and Function: Gene complementation, Cistron, muton, recon,molecular recombination, gene regulation, Operon concept- lac operon.	6
Unit 9: Principle of Genetic Genetic Engineering: Isolation of DNA and RNA, Recombinant DNA Technology, Cloning, Plasmids, Cosmids, Bacteriophages, Transformation and Transduction. Construction of genomic and cDNA library.	6
Unit 10: **Molecular hybridization:** Labelling of Nucleic acid, molecular markers, amplification of DNA, Blotting techniques- Southern, Northern and Western blotting, DNA sequencing.	8
Unit 11: Chromosomal types and composition in fish. Chromosomal manipulation in fish, Hybridization. Polyploidy, androgenesis and gynogenesis.	3
Unit 12: Transgenic fish production. Cryopreservation of gametes. Production of monosex and sterile fishes and their significance in aquaculture.	6

DSCC7-P: FISH SEED PRODUCTION TECHNOLOGYLAB (Practical)
Credit: 1; Marks:25; Hours: 50;

1. Estimation of DNA by diphenylamine method.
2. DNA isolation from fish liver.
3. Differential centrifugation of an artificially prepared mixture.
4. Histological staining of DNA & RNA in prepared slide.

Suggested readings*:*

- Russel P.J. iGenetics : A molecular approach.
- Allison LA. 2007. Fundamental of Molecular Biology. Blackwell Publishing. W.H.Freeman
- Lodish, B, Matsudaira, KB, Plough, A, and Martin, 2016. Molecular Cell Biology. W.H.Freeman
- Cooper GM, Hausman RE, 2009. The Cell: A molecular approach. ASM

Core course

DSCC 8	**FISH NUTRITION & FEED TECHNOLOGY (Theory)** **Credit: 3; Marks: 75; Hours: 50**	**Hours**
Unit 1: Fundamental of aquaculture nutrition: Sources and importance of major nutrients (proteins, fats, carbohydrate, vitamins and minerals) for cultivable fin fish and shell fish.		2
Unit 2: Natural fish feed: Diversity, management and importance of natural fish feed organisms- algae, protozoa, crustaceans and annelids.		8
Unit 3: Feed formulation: Method of feed formulation and manufacturing- Pearson's methods, quadratic, linear programming; Forms of aqua feed- wet feeds, moist feed, dry feed, masses, pelleted feed, floating and sinking pellets; Common equipments-pulverizer, grinder, mixer, pelletizer, crumbler, drier, extruder, vacuum coater, fat sprayer; Proximate composition of fish feed.		12
Unit 4: Feed additives: Dietary supplements, growth promoter, feed stimulants, binders, pigments, antioxidants, enzymes.		5
Unit 5: Feed ingredients: Utility and proximate composition of fish meal, soybean meal, ground nut oil cake, mustard oil cake, rice bran; Non-conventional feed ingredients.		5
Unit 6: Feed evaluation: Definition, measurement and significance of Feed Conversion Ratio (FCR), Feed Efficiency Ratio (FER), Protein Efficiency Ratio (PER), Net Protein Utilization (NPU), Specific Growth Rate(SGR), Weight Gain Percentage(WG%), Gross Energy(GE).		4
Unit 7: Non nutrient dietary component: Antinutritional factors, Digestive enzymes and their roles in digestion, Feed digestibility- Measurement of digestibility, Factors affecting digestibility.		2
Unit 8: Culture of live fish food organisms: Candidate species of phytoplankton and zoo-plankton as live food organisms of freshwater and marine species. Tropic potentials- proximate composition of live feed. Biology and culture requirements of important live food organisms. Green algae, blue-green algae, spirulina, diatoms, infusoria, rotifers, cladocerons, tubifex, brine shrimp, chironomids. Culture of earthworms.		12

DSCC8-P: FISH NUTRITION &FEED TECHNOLOGYLAB (Practical)

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

1. Fish feed formulation and manufacturing using locally available materials
2. Estimation of moisture content in fish feed using drying oven.
3. Estimation of crude protein content in fish feed using xjeldahl apparatus.
4. Estimation of crude lipid content in fish feed using soxlet apparatus.
5. Visit to an aquafeed manufacturing industry.

***Suggested readings**:*

- 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.
- De Silva, S. S. and Anderson, T. A. 1995. Fish Nutrition in Aquaculture. Chapman and Hall Aquaculture Series, London.
- Halver, J.E. 2002. Fish Nutrition. Academic Press, San Deigo, C.A.

------END OF 2ND YEAR------

PART-III: SEMESTER- V

Core course

DSCC 9	**FISHING CRAFT & GEAR TECHNOLOGY (Theory)** **Credit: 3; Marks: 75; Hours: 50;**	**Hours**
Unit 1: Fishing crafts: 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.		12
Unit 2: Fishing gear: Classification of fishing gear (A. Von Brandt, Hameed and Boopendranath, 2000). 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. Traditional fishing gears of West Bengal. Catch per unit effort of fishing gear.		12
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.		18
Unit 4: Responsible Fisheries and Fisheries Legislation: Concept of Responsible Fisheries; Monsoon trawl ban, closed season, mesh size regulations, juvenile fishing, Coastal Regulation Zone (CRZ), Integrated Coastal Zone Management (ICZM). MSY, MEY, Over fishing, Recruitment over fishing, Aqua-ranching.		8

DSCC9-P: FISHING CRAFT AND GEAR TECHNOLOGYLAB (Practical)
Credit: 1; Marks: 25; Hours: 50;

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. Mounting of fishing net.
3. Submission of a model fishing crafts/gears.
4. Laboratory Note Book.

***Suggested readings**:*

- Biswas K.P. Advancement in fish, fisheries and technology. Narendra Publishing House.
- Badapanda K.C. Fishing Crafts and Gear technology. Narendra Publishing House.
- Hameed M.S. and Boopendranath M.R., Modern Fishing Gear Technology. Daya publishing house Delhi (2000).

Core course

DSCC 10 FISH PATHOLOGY & IMMUNOLOGY (Theory)

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

	Hours
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(Myxozoan, Dactylogyrus, Gyrodactylus, Hirudinea, Lernaea, Argulus).	10
Unit 2: Morphology, life cycle and control of fish pathogen: Myxozoan parasites, Dactylogyrus, Gyrodactylus, Hirudinea, Lernaea, Argulus. Viral diseases (IPN, IHN, VHs, CCVD), EUS.	9
Unit 3: Shell Fish Pathology: Some common diseases of prawns – pathogens, symptoms and control- IHNV, Baculovirus, Black gill disease, brown spot disease.	6
Unit 4: Introduction of Immune system: Concept of health and disease**,** Cells and organs of immune system in fish.	4
Unit 5: Antigen: Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes	4
Unit 6: Immunoglobulin: Structure and function of different classes of immunoglobulins	2
Unit 7: Immunity: Innate and adaptive immunity. Humoral and Cell mediated immunity. Complement proteins – pathways and activation (classical, alternative and lectin mediated pathway, MAC formation	6
Unit 8: Major Histocompatibility Complex: Structure and functions of MHC molecules. Structure of T cell Receptor and its signalling, T cell development & selection, Antigen presentation.	5
Unit 9: Vaccine: Different types of vaccine, strategies of vaccine development - subunit vaccine, mRNA vaccine and others.	4

DSCC 10-P: FISHING CRAFT AND GEAR TECHNOLOGYLAB (Practical)

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

1. Identification of fish disease- gill rot, fin and tail rot, dropsy, EUS.
2. Collection, preservation and identification of myxozoan/trichodinid/crustacean parasites in carps.
3. Preparation of stained blood film to study various types of blood cells.
4. Laboratory Note Book.

***Suggested readings**:*

- Cornoy D.A, Herman R.A. Text book of fish diseases.
- Kindt T.J. and Osborne B.A., Kuby Immunology.

Core course

DSCC 11	**FUNDAMENTAL OF MICROBIOLOGY (Theory)**
	Credit: 3; Marks: 75; Hours: 50

	Hours
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. .	2
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.	12
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.	18
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.	5
Unit 5: Bacteria in culture pond: Health significant bacteria in culture ponds. Culture characteristics and epidemiology of *E. coli*, pathogenic *Vibrio*, *Salmonella*, *Aeromonashydrophila*, and *Pseudomonas*.	2
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.	7
Unit 7: Bacterial genetics: Transformation, Conjugation and Transformation in bacteria	4

DSCC11-P: FUNDAMENTAL OF MICROBIOLOGYLAB (Practical)
Credit: 1; Marks:25; Hours: 50;

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. Biochemical tests for characterization: Catalase, nitrate reduction, indole production, methyl red and Voges–Proskauer test
5. Laboratory Note Book.

***Suggested readings**:*

- Fernandes R. Microbiology Handbook: Fish and Seafood. Leatherhead Food Research Association; 2nd New edition edition.
- Harry W. Seeley, Paul J. Vandemark, and John J. Lee- Microbes in Action: A Laboratory Manual of Microbiology. W. H. Freeman
- Pawar and Diganawala- General Microbiology – Vol. I and Vol. II
- Frobisher et al- Fundamentals of Microbiology

Core course

DSCC 12	**FISHERIES ECONOMICS & ENTREPRENEURSHIP DEVELOPMENT (Theory)**
Credit: 3; Marks: 75; Hours: 50	**Hours**
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	2
Unit 2: Economy of fishermen: Fishermen populations, GDP from fisheries sector, foreign exchange earnings and employment potential of fishing industry. Role of MPEDA in exports of fish and fishery products.	4
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.	10
Unit 4: Fishery co-operatives & Extension: Functions, financial assistance, input supplies, marketing of fish. Socio-economic development. Role of fisheries corporations and Missionary Organizations in fisheries development. Extension education- objective and principles. Role of extension in community development. Integrated rural development strategies.	4
Unit 5: Entrepreneurship Building: Meaning, Importance, Psychological, Sociological factors and distinctive competence. Need, scope, characteristics and types of Entrepreneurship. STED. 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.	8
Unit 6: Market & Marketing Management : 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. Marketing management- Elements of marketing & sales management. Nature of product and market strategy – Packing & advertising – After sales service. Analyzing marketing opportunities, Planning marketing strategy, Forecasting, Marketing mix, Advertising the marketing programme & sales management, market survey techniques.	8

Unit 7: Technology Management: Criteria for principles of product, selection and development. Choice of technology, plant and equipment. Critical Path Method (CPM) & Project Evaluation Review Techniques (PERT) as planning tools for establishing SSI. Production Management- Elements of production process, Planning and control, Product development, Testing facilities, Patents, Quality Assurance, Time control and Cost control, Total Quality Management. Materials Purchasing Management: Material Planning and Budgeting, Value engineering, Value analysis, Economic ordering quantity, Inventory control.	14

DSCC12-P: FISHERIES ECONOMICS & ENTREPRENEURSHIP DEVELOPMENT LAB (Practical)
Credit: 1; Marks:25; Hours: 50;

1. Submission of a report on fish market survey.

2. Submission of a report on socio-economic status of fishermen of any fishing villages in West Bengal.

Suggested readings*:*

- Saxena A. Fisheries Extension.
- Ry G.L. Extension, commercial and management. Naya Prakash Pawar and Diganawala- General Microbiology – Vol. I and Vol. II

PART-III: SEMESTER- VI

Core course

DSCC 13 FISHERIES POST HARVEST TECHNOLOGY (Theory)

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

	Hours
Unit 1: Post Harvest Technology: Principles and importance of fish preservation. Fish spoilage- post mortem changes and rigor mortis, post rigor spoilage. Methods of fish preservation- Freezing, Drying, Salting, Smoking, Canning, Fermentation and Fish Pickling.	12
Unit 2: Fish product and Byproduct: Fish Oil, Fish liver oil, Fish meal, Fish manure, Fish flour, fish glue and isinglass, traditional fermented fish products of northeast India.	6
Unit 3: Quality control: Basic concepts of quality and quality control; pre-shipment inspection, IPQC, MIPQC, HACCP and ISO Series in seafood industry.	8
Unit 4: Plant hygiene and sanitation: Principles of plant hygiene and sanitation, Pest control, Sanitation procedures in seafood processing plants. Waste management in fish processing industries. Risk factors in seafood bio toxins, seafood pathogens, endogenous parasites. Planning and layout, equipment construction and design.	8
Unit 5: Methods of evaluating fish freshness and quality: Organoleptic, physical, chemical, microbiological and instrumental methods.	6
Unit 6: Quality standards: Quality standard in India and major importing countries like USA, Japan and EU.	4
Unit 7: Export of fishery products from India: Major countries, important products, export documents and procedures. Traceability, Quality certifications, Eco-labelling.	6

DSCC13-P: FISHERIES POST HARVEST TECHNOLOGYLAB (Practical)

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

1. Quality control of fishes: Crude protein analysis of fish muscle by micro xjeldhal method.
2. Determination of anti-oxidative properties of any fish product using spectrophotometers.
3. Detection of organoleptic changes in fish.
4. Laboratory Note Book.

***Suggested readings**:*

- Biswas K.P. Fish Processing and Preservation. Daya Pub. House.
- Govindan T.K. Fish Processing Technology. Oxford & IBH Pub. Co.
- Badapanda K.C. Fish processing and preservation technology. Narendra Publishing House.

DSCC 14 FUNDAMENTAL OF BIOCHEMISTRY (Theory)

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

	Hours
Unit 1: Structure of carbohydrate: Monosaccharides-aldoses, ketoses, stereoisomers, epimers, anomers, mutarotation, reducing sugar; Disaccharides- maltose, lactose, sucrose; polysaccharides- starch, glycogen,cellulose, glycogen, chitin; proteoglycan, glycoprotein and glycolipid	6
Unit 2: Structure of amino acid and proteins: Peptide pond, Concept of Ramachandran plot, Primary, secondary, tertiary and quaternary structure of protein, classification of protein, structure and classification of amino acids.	4
Unit 3: Structure of fatty acids and lipid: Structure of saturated and unsaturated fatty acids, triacylglycerols, glycerophospholipids, sphingolipids and cholesterol**,** importance of ω 3 and ω 6 fatty acids.	4
Unit 2: Carbohydrate metabolism: Process of Glycolysis, TCA cycles, Glycogenolysis, Glycogenesis, Gluconeogenesis. Inhibitors of TCA cycle. Pentose phosphate pathway or HMP shunt	8
Unit 3: Oxidative phosphorylation: Redox systems; Mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System	6
Unit 4: Lipid metabolism: Synthesis of a saturated fatty acid (Palmitic acid), Beta oxidation of a saturated (Palmitic acid) and an unsaturated fatty acid (Linoleic acid).	4
Unit 5: Protein Metabolism: Transamination, Deamination and urea cycle.	8
Unit 6: Enzymes: Classification, Kinetics (Michelis-Menten Concept), Factors affecting enzymatic action.	10

DSCC14-P: FUNDAMENTAL OF BIOCHEMISTRY LAB (Practical)

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

1. Qualitative tests of functional groups in carbohydrates and proteins: Qualitative tests for carbohydrate (starch, sucrose, fructose, glucose), protein (albumin). Test to be performed- Molisch's test, Iodine test, Fehling's test, Benedict's test, Barfoed test, Seliwantof's test, Biuret test.
2. Quantitative estimation of water soluble protein following Lowry Methods.
3. Laboratory Note Book.

***Suggested readings**:*

- Das D. Biochemistry. Academic publishers.
- Nelson D.L.& Cox M.M. Lehlinger Principles of Biochemistry. Mac Millan Worth Pub.
- Voet D &Voet J Biochemistry

DSCC 15 BIO-STATISTICS, COMPUTER APPLICATION, REMOTE SENSING & GIS (Theory)

Credit: 3; Marks: 75; Hours: 50

	Hours
Unit 1: Basic concept: Variable, population, data, sample and application of Biostatistics. Classification of data, frequency and cumulative frequency table.	2
Unit 2: Measure of central tendency: Mean, Median, Mode. Relative merits and demerits of these measures.	6
Unit 3: Measure of variation: Range, mean deviation, standard deviation coefficient of variation. Relative merits and demerits of these measures. Concepts of Skewness and kurtosis.	12
Unit 4: Testing of hypothesis: general principles of testing of hypothesis, types of errors. Tests of significance based on Normal, t, and Chi-square distributions. Chi-square test and student T-Test.	8
Unit 5: Probability theory, correlation, regression. Relation between correlation and regression. Applications of linear regression in fisheries.	4
Unit 6: Analysis of variance (ANOVA)	2
Unit 7: Basics of computer: Basic components of computers – Hardware (CPU, input, output storage devices), Software (operating systems).	2
Unit 8: MS-EXCEL Introduction to MS EXCEL – use of worksheet to enter data, edit data, copy data, move data and Graphical tools in EXCEL for presentation of data.	2
Unit 9: MS WORD: MS WORD – editing, copying, moving, formatting, table insertion, drawing flow charts etc	2
Unit 10: MS POWER POINT: Introduction to Power Point, image, data handling and Graphical tools in PPT for Presentation	2
Unit 11: Basics of Internet: Concept of Internet and its application in information collection. Searching Tools – World Search Engines, Search Directories and Encyclopedias. Online safety – spywares and viruses.	4
Unit 8: 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	4

DSCC15-P: BIOSTATISTICS & COMPUTER APPLICATION LAB (Practical)

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

1. Computation of arithmetic mean, median, mode, standard deviation, Simple correlation and regression using MS EXCEL/IBM SPSS.
2. Preparation of chart, graphs using MS EXCEL/SPSS.
3. Power point presentation on remote sensing & GIS

***Suggested readings**:*

- B Antonisamy, Prasanna S. , Premkumar, Christopher S- Principles and Practice of Biostatistic, Elsevier India
- Rao. Biostatistics a Manual of Statistical Methods for Use in Health, Nutrition and Anthropology- Jaypee Brothers Medical Publishers; second edition.

------END OF 3RD YEAR------

PART-IV: SEMESTER- VII

Core course

DSCC 16 TOOLS AND TECHNIQUES IN BIOLOGY (Theory)

Credit: 3; Marks: 75; Hours: 50

	Hours
Unit 1: Microscopy: Basic principles, image forming mechanism and application of bright field, phase contrast, fluorescencent and electron microscopy microscopy. Processing of specimen for electron microscopy	8
Unit 2: Centrifugation: Basic principles of centrifugation, Different types of centrifugation-differential, density gradient, density gradient materials, Ultracentrifugation and separation of cellular organelles.	8
Unit 3: Electrophoretic techniques: Vertical gel electrophoresis (native and SDS-PAGE), IEF and 2-D Gel Electrophoresis.	8
Unit 4: Immunological Technique: ELISA-principles, types and application, Flow cytometry-working principles and application.	8
Unit 5: Radioisotope Techniques: Autoradiography and Radioimmunoassay- principles and application. Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.	4
Unit 6: Spectrophotometers: Principles and application of spectrophotometers.	2
Unit 7: Chromatography: Principle and application of paper, gel filtration, ion exchange, affinity and thin layer chromatography	6
Unit 8: Nucleic acid sequencing: Chain terminator method	2
Unit 9: Histochemical techniques: Tissue processing, microtomy, fixatives (types and function), staining.	4

DSCC16-P: TOOLS AND TECHNIQUES IN BIOLOGY LAB (Practical)

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

1. Protein profiling of any fish product by SDS-PAGE.
2. Paper chromatography of essential amino acids.
3. Demonstration of ELISA.
3. Laboratory Note Book.

***Suggested readings**:*

- Wilson K. and Walker J. Principles and Techniques of Biochemistry and Molecular Biology
- Biochemistry Laboratory: Modern Theory and Techniques, 2nd Edition, ISBN-13: 9780136043027
- Sharma V.K. (1991), Techniques in microscopy and cell Viology, Tata-Mc Craw Hil.

Core course- Internship

SEMESTER INTERNSHIP

Credit: 16; Marks: 400; Hours: 2016;

Every student should pursue an internship of 12 weeks in any fisheries institute of national importance/fish farm/fish processing industries/fish feed manufacturing industries or similar organization as decided by the Department of Industrial Fish and Fisheries, Asutosh College. After the end of the internship an exclusive report to be submitted.

PART-IV: SEMESTER- VIII

Core course- Project Work

PROJECT WORK

Credit: 20; Marks: 500;

The objectives of this paper are to develop a preliminary idea in pursuing research in future and learning to write a research article. Every student should pursue a project work/research work in a potential topic related to taxonomy/fish biology/aquaculture/fisheries or other relevant areas under the supervision of a teacher in the Department of Industrial Fish and Fisheries, Asutosh College. After the end of the project work, a project report having word count not less than 10,000 words excluding references to be submitted.

Marks division:

1. Submission project report: 400
2. Project Viva: 100

------END OF 4TH YEAR------