

# COURSE STRUCTURE AND SYLLABI

of  
**Bachelor of Fishery Science**  
**(B.F.Sc.)**

**2017-18 Batch**



**Centurion**  
**UNIVERSITY**

*Shaping Lives... Empowering Communities...*

**M.S.SWAMINATHAN SCHOOL OF AGRICULTURE**  
**CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT**  
**Odisha-761211, INDIA**

Web Site: - [www.cutm.ac.in](http://www.cutm.ac.in)

**B.F.Sc. Degree Programme**  
**M. S. Swaminathan School of Agriculture**  
**Centurion University of Technology and Management**

**Course structure**

**First Semester**

<b>Course No</b>	<b>Course title</b>	<b>Credits</b>
<b>FSAQ 1101</b>	Principles of Aquaculture	2(1+1)
<b>FSRM 1101</b>	Taxonomy of Finfish	3(1+2)
<b>FSRM1102</b>	Taxonomy of Shellfish	2(1+1)
<b>FSEM1101</b>	Meteorology, Climatology and Geography	2(1+1)
<b>FSEE1101</b>	Statistical Methods	3(2+1)
<b>FSAQ1112</b>	Fundamentals of Biochemistry	3(2+1)
<b>FSHM1107</b>	Fundamentals of Microbiology	3(2+1)
<b>FSEM1102</b>	Soil and Water Chemistry	3(2+1)
<b>FSPT1101</b>	Fish in Nutrition	1(1+0)
<b>FSCC1101</b>	Swimming CNC*	1(0+1)
	<b>Total</b>	<b>22(13+9)</b>

\*CNC= Compulsory non-credit course.

**Second Semester**

<b>Course No</b>	<b>Course title</b>	<b>Credits</b>
<b>FSAQ 1202</b>	Fresh Water Aquaculture	3 (2+1)
<b>FSRM 1203</b>	Anatomy and Biology of Finfish	3(2+1)
<b>FSEM 1203</b>	Limnology	3(2+1)
<b>FSEM 1205</b>	Marine Biology	3(2+1)
<b>FSRM 1206</b>	Inland Fisheries	3(2+1)
<b>FSPT 1202</b>	Food Chemistry	3(2+1)
<b>FSEE 1206</b>	Information and Communication Technology	2(1+1)
<b>FSAQ 1207</b>	Aquaculture in Reservoirs	2(1+1)
<b>FSCC 1202</b>	Physical Education, First Aid & Yoga Practices CNC*	1(0+1)
	<b>Total</b>	<b>22(14+8)</b>

\*CNC= Compulsory non-credit course.

## SEMESTER – I

### 1. Principles of Aquaculture

[FSAQ 1101]

2(1+1)

#### **Theory**

Basics of aquaculture, definition and scope. History of aquaculture: Present global and national scenario. Aquaculture vs Agriculture. Systems of aquaculture - pond culture, pen culture, cage culture, running water culture and zero water exchange system. Extensive, semi-intensive, intensive and super intensive aquaculture in different types of water bodies viz., freshwater, brackish water inland saline and marine water. Principles of organic aquaculture. Pre-stocking and post stocking pond management. Carrying capacity of pond, factors influencing carrying capacity. Criteria for selection of candidate species for aquaculture. Major candidate species for aquaculture: freshwater, brackish-water and marine. Monoculture, polyculture and integrated culture systems. Water and soil quality in relation to fish production. Physical, chemical and biological factors affecting productivity of ponds.

#### **Practical**

Aquaculture production statistics- world and India. Aquaculture resources of world and India. Components of Aquaculture farms. Estimation of carrying capacity. Practices on prestocking and post stocking management. Growth studies in aquaculture system. Study on waste accumulation in aquaculture system (NH<sub>3</sub>, Organic matter, CO<sub>2</sub>). Analysis of manure.

#### **References**

1. Aquaculture principles and practices ----TVR Pillay and MN Kutty
2. Encyclopedia of aquaculture ----RR Stickney
3. Hand book fisheries and aquaculture----ICAR New Delhi 2006
4. Sustainable aquaculture ---- BB Jena and Carl D. Webster
5. Hand book of fisheries and aquaculture ---- NIR Board of Consultants (Asia Pacific press)

### 2. Taxonomy of Finfish

[FSRM 1101]

3(1+2)

#### **Theory**

Principles of taxonomy. Nomenclature, types. Classification and interrelationships. Criteria for generic and specific identification. Morphological, morphometric and meristic characteristics of taxonomic significance. Major taxa of inland and marine fishes up to family level. Commercially important freshwater and marine fishes of India and their morphological characteristics. Introduction to modern taxonomic tools: karyotaxonomy, DNA barcoding, protein analysis and DNA polymorphism.

#### **Practical**

Collection and identification of commercially important inland and marine fishes. Study of their external morphology and diagnostic features. Modern taxonomic tools - Protein analysis and electrophoretic studies; Karyotaxonomy - chromosome preparation and identification. DNA barcoding, DNA polymorphism; Visit to fish landing centres to study commercially important fishes and catch composition.

## References

1. Commercial Sea fishes of India – Talwar and Kicker
2. Inland fishes (Vol 1) ----Jhingram and Talwar
3. Inland fishes (Vol 2) ----Jhingram and Talwar
4. Fresh water inland fishes of India--- K.C.Jayaraman

### 3. Taxonomy of Shellfish

[FSRM 1102]

2(1+1)

## Theory

Study of external morphology and meristic characteristics of crustacea and mollusca. Classification of crustacea and mollusca up to the level of species with examples of commercially important species.

## Practical

Study of external morphology. Collection, preservation and identification of commercially important prawns, shrimps, crabs, lobsters, bivalves, gastropods, cephalopods from natural habitats. Field visits for collection and study of commercially important shellfishes.

## References

1. Identification of shell fishes ----FAO
2. Prawn and prawn fisheries of India -----Kurne and Sabastian
3. Identification of shell fishes and Molluscs --- CMRI Special publication

### 4. Meteorology, Climatology and Geography

[FSEM 1101]

2(1+1)

## Theory

Nature of Atmosphere: weather and climate; composition of atmosphere; structure of atmosphere. Heat energy of atmosphere: process of heat transmission; heating of atmosphere; disposal of insulation; irregular heating of atmosphere. Temperature: Temperature instruments; periodic, horizontal and vertical temperature variations; effects of vertical air motion on temperature. Humidity and water vapour: relationship between temperature and humidity; distribution of water vapour in atmosphere; evaporation, humidity instruments and measurements. Condensation and precipitation: process of conditions of condensation, forms of condensation; precipitation; forms of precipitation, measurement of precipitation; rainfall in India. Clouds and thunderstorms: amount of cloudiness; ceiling; classification of clouds; conditions of cloud formation; reporting and identification of clouds; thunderstorms. Atmospheric pressure: meaning of atmospheric pressure; the laws of Gases; pressure units; pressure instruments; vertical, horizontal and periodic variations; isobars and pressure gradients. Wind: characteristics of wind motion; wind observation and measurement; wind representation; factors affecting wind motion. Terrestrial or planetary winds: ideal planetary wind system; planetary pressure belts. Planetary wind system; secondary winds; monsoon winds; land and sea breeze. Tropical cyclones: storm divisions; pressure and winds; vertical structure of storm centre; hurricane, sea, swell and surge; hurricane warning. Weather forecasting: forecasting process; forecasting from local indications; role of satellite in weather forecasting; synoptic weather charts. Effects of climate change on fisheries sector. Introduction to Geography: shape, size and structure of the earth; concepts

of latitude, longitude and great circles; model globe, maps and different types of projections; cartography; landscape.

### **Practical**

Graphic representation of structure of atmosphere; physical layering and compositional layering. Temperature instruments: simple thermometers; Six's Max-Min Thermometer; thermograph. Isotherms: world mean temperatures-January to July. India mean temperatures - January to July. Humidity measurement: hygrometer; psychrometer; relative humidity; dew point. Condensation: observation and identification of various types of clouds. Depicting sky picture. Precipitation: measurement of rainfall using rain gauge. Mapping Indian monsoons: south-west monsoon and rainfall in June, North-east monsoon and rainfall in December; isohyets. Atmospheric pressure measurement: Fortin's mercurial barometer; Aneroid barometer. Isobars: India mean pressure - Jan to July. Wind observation and measurement: wind vane; cup anemometer. Ideal terrestrial/planetary pressure and wind systems: diagrammatic representation. Geography: The Earth: diagrammatic representation of shape, size, structure, zones, latitudes, longitudes and great circles. Typical landscape mapping; map reading. Geographical terms used in landscape.

### **References**

1. Meteorology -- Dr S.R. Ghadekar
2. Physical geography ---- Indra Singh
3. Meteorology ---- Dr Jaman Joseph (CIFNET)
4. Tropical meteorology ---- H. Rahil
5. Physical geography (Oceanography) --- K. Bharadwaj

**5. Statistical Methods**

[FSEE 1101]

3(2+1)

### **Theory**

Definition of statistics, Concepts of population, sample, Census and sample surveys, Classification of data, frequency and cumulative frequency table. Diagrammatic and graphical representation of data - bar diagrams, pie-diagram, histogram, frequency polygon, frequency curve and Ogives. Important measures of central tendency - arithmetic mean median and mode. Relative merits and demerits of these measures. Important measures of dispersion, Range, Mean Deviation, Variance and Standard Deviation. Relative merits and demerits of these measures. Coefficient of variation; Normal Curve, Concepts of Skewness and kurtosis.

Definitions of probability, mutually exclusive and independent events, conditional probability, addition and multiplication theorems. Random variable, concepts of theoretical distribution; Binomial, Poisson and Normal distributions and their use in fisheries. Basic concept of sampling distribution; standard error and central limit theorem. Introduction to statistical inference, general principles of testing of hypothesis, types of errors. Tests of significance based on Normal, t, and Chi-square distributions. Bivariate data, scatter diagram, simple linear correlation, measure and properties, linear regression, equation and fitting; relation between correlation and regression, Length weight relationship in fishes; applications of linear regression in fisheries. Methodology for estimation of marine fish landings in India, Estimation of inland fish production in India and problems encountered.

### **Practicals**

Construction of questionnaires and schedules. Diagrams and frequency graphs. Calculation of arithmetic mean, median, mode, range, mean deviation, variance, standard deviation. Exercises on probability, Binomial and Poisson distributions, Area of normal curve, confidence interval for population mean, Test of hypothesis based on normal, t, and chi-square. Computation of Simple correlation and regression. Fitting of length - weight relationship in fishes.

### References

1. Sampling theory of surveys with applications –P.V. Sukhatme and B.V.Sukhatme
2. Statistics , a introducing –D.A.S. Fraser
3. Statistics for biologists --- R.C. Compbell
4. A first coerces in statistics with application ---A.K.P.C. Swain
5. Economics of bio statistics --- S.Prassad
6. Fundamental of mathematics statistics ---S.C.Gupta / V.K.Kapoor
7. Fisheries statstics ----R.C.Biradar

## 6. Fundamentals of Biochemistry

[FSAQ 1112]

3(2+1)

### Theory

A brief introduction to developments in biochemistry and its transformation to molecular biology. Cell structure, water and major molecules of life. Carbohydrate chemistry: Structure, classification, functions (mono, di and polysaccharides) isomerism and mutarotation. Metabolism of carbohydrates: glycolysis, gluconeogenesis, glycogenolysis, glycogenesis, TCA cycle, central role of TCA cycle in metabolism. Protein chemistry: classifications and functions. Classification, structure, function and properties of amino acids. Essential and non essential amino acids. Primary, secondary, tertiary and quaternary structure of proteins. Amphoteric property. Biuret reaction and xanthoproteic reaction. Digestion and absorption of proteins. Classification, structure, functions and properties of lipids. Essential fatty acids and phospholipids. Digestion and absorption of lipids. Lipid autooxidation. Significance of Omega-3 and Omega-6 fatty acids. Enzymes: nomenclature; classification; specificity; mechanism of enzyme action; kinetics and regulation of enzyme activity. Steroid and peptide hormones- chemistry and function. Structure and functions of fat and water soluble vitamins. Vitamins – classification- functions. Minerals– classification – functions. Nucleic acids: Structure function and importance genetic code. Transcription and translation. Protein synthesis. Energy changes in chemical reactions, reversible and irreversible reactions in metabolism.

### Practical

Preparation of normal solution of acid and base, buffers and reagents. Qualitative determination of carbohydrates, proteins and lipids. Estimation of total nitrogen and crude protein of fish tissue. Estimation of carbohydrates in foods. Determination of specific gravity of oil. Extraction and estimation of total lipids in fish tissue. Determination of saponification value, iodine value and free fatty acid value.

### References

1. Biochemistry—A.L. Lehninger
2. Biochemistry -L.Stryer
3. Harper's Biochemistry --- R.K. Murray and others
4. Biochemistry ---D.Voet and J.G.Voet

5. Elements of Bio chemistry--- H.S. Srivastava
6. Howks physiological chemistry B.L.Oser

## 7. Fundamentals of Microbiology

[FSHM 1107]

3(2+1)

### Theory

Milestones in microbiology. Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Flemming, Joseph Lister, Winogradsky. Microscopy- Principle and construction of Brightfield, dark field, phase contrast, stereo, SEM and TEM. Microbial taxonomy –Bergey's and molecular taxonomy. Types of Microorganisms: Prokaryotes– Morphology and ultrastructure of bacterial cell. General features, types and importance of viruses, cyanobacteria, actinomycetes, archae, mycoplasma, rickettsiae. Eukaryotes – Diagnostic features and importance of fungi and protozoa. Microbial Techniques - Types of media, types of sterilization - physical and chemical agents, cultivation of microorganisms, staining techniques – simple, differential, structural staining; enumeration of microorganisms, culture preservation methods. Bacterial metabolism: Nutrient requirements, nutritional types, bacterial photosynthesis and their ecological significance. Microbial growth: Growth phases, measurement of cell growth, factors affecting growth- influence of physico-chemical factors - pH, temperature, moisture, light, osmotic pressure, fermentation- types and significance. Microbial genetics- general principles, genetic recombination, transformation, transduction and conjugation. Plasmids- types and their importance. Mutation–types and significance. Microbial ecology: Introduction and types of interaction, extremophiles and their significance.

Aquatic Microbiology: Introduction and scope of aquatic microbiology, aquatic environment as habitat for microorganisms - bacteria, cyanobacteria, fungi, algae, parasites and viruses; distribution of microorganisms and their biomass in rivers, lakes, sea and sediment. Influence of physical, chemical and biological factors on aquatic microbes. Microbial biofilms. Role of microbes in the production and breakdown of organic matter. Role of microbes in sedimentation and mineralization process. Nutrient cycles- carbon, nitrogen, sulphur, phosphorus, iron, and manganese cycles. Sewage microbiology, self purification in natural waters, sewage treatment, drinking water microbiology, sanitary quality of water for aquaculture, bioremediators. Economic significance of aquatic microbes.

### Practical

Handling of microscopes, Wet mount, smear and hanging drop preparations. Micrometry- Determination of size of micro organisms (ocular, stage micrometers). Tools and techniques in sterilization methods: Filtration, dry heat, moist heat, chemical agents. Cultivation technique: Media preparation, Isolation - pure culture, subculture. Observation of fungi, blue-green algae, and protozoans. Staining techniques for bacteria– simple, differential, structural and Biochemical tests: Indole, methyl red, Voges-Proskauer, citrate test, oxidase test, catalase tests. Collection of water and sediment samples for microbiological analysis, Winogradsky cylinder, Isolation, identification and enumeration of various groups of microorganisms from different water bodies including aquaculture systems.

Study of bacteria involved in nutrient cycles. Biofilms, water testing for potability, enumeration of coliform. Antibiotic sensitivity of bacteria - antibiotic sensitivity test – disc diffusion method.

## References

1. Brock Biology of Micro organisms - Michael T.Madigan, John M.Martnko, Jack Parker
2. Microbiology ----Lancing M.Prescott, John P Harley, Donald A. Klein
3. Microbiology – Michel J pleczar /Jr.E.C.S.Chan, Noel R.Krieg
4. Microbiology essentials and applications ---Larry Mc Kane / Judy Kandel
5. Fundamentals ,principles of bacteriology --- A.J.salle
6. General Microbiology --Hans G.Schlegel
7. Microbiology –A laboratory manual -----James G.Cappuccine, Netelie Sherman

## 7. Soil and Water Chemistry

[FSEM 1102]

3(2+1)

### Theory

Analytical chemistry: principles, applications and types. Classical methods of analytical chemistry, volumetry and gravimetry. Solutions: Standard solutions, titration, indicators, dilute solutions, units of concentration: standard curve; nomograph.

Chemistry of water: the water molecule, properties of pure water, fresh water and sea water. Composition of waters: surface water, ground water and sea water. Dissolved gasses: Factors affecting natural waters. Acid, base, salts: Hydrogen ions, modern concept of pH and buffer.

Water analysis: collection and preservation of water samples. Measurement of temperature, transparency, turbidity, determination of pH, electrical conductivity, salinity, chlorinity, total solids (TDS, TSS, TVS, TVDS), dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, Calcium, Magnesium, Inorganic Nitrogen (Ammonium and Nitrate) and phosphorus. Water quality criteria/ requirements for Aquaculture.

Soil Chemistry: origin and nature of soils. Physical properties of soil; soil colour, texture, structure, pore size, bulk density, water holding capacity. Soil types and their distribution. Soil chemistry: soil colloids, cation exchange, organic carbon, Carbon - Nitrogen ratio, soil fertility. Soil reaction: acidity, alkalinity, conductivity, redox - potential. Submersed soils: wet lands, peat soils, fluxes between mud and water, methane and hydrogen sulphide formation. Saline soils, Alkali soils, acid sulphate soils, iron pyrites, soil reclamation. Soil analysis: collection and preparation of soil samples. Determination of soil texture, water holding capacity, pH, conductivity, organic carbon, nitrogen, phosphorus, lime requirement. Soil and water amendments: lime manures, fertilizers, micronutrients, zeolites, alum, gypsum. Environmental ameliorative: chlorination, deodorizers, bacterial formulation. Soil quality criteria/ requirements for aquaculture.

### Practical

Principles of Titrimetry, Gravimetry, Potentiometry, Conductometry, Refractometry, Colourimetry, Turbidimetry, Spectrophotometry (UV, Visible, Flame, AAS), computerized instrument system. Demonstration: demonstration of laboratory glass wares and equipment used in water and soil analysis. Water analysis: measurement of temperature, turbidity, determination of pH and EC. Determination of salinity, Chlorinity, Total solids, Redox potential, DO, Free CO<sub>2</sub>. Determination of total alkalinity,

hardness. Determination of inorganic nitrogen, and phosphorus Soil analysis: Determination of soil texture, soil pH, conductivity, soil available nitrogen, available phosphorus, and organic carbon.

### References

1. Bottom soil, sediment and pond aquaculture --- Claude E. Body
2. Fundamentals of Soil --- V.N. Sahai
3. Text book of Soil science—R.K. Mehra
4. Soil ---- FAO training series
5. Water quality in ponds for aquaculture --Claude E. Body
6. Fresh water fish culture--- V.R.P. Sinha and V. Ramachandran
7. A hand book of soil, fertilizer and manure – P.K. Gupta

## 8. Fish in Nutrition

[FSPT 1101]

1(1+0)

### Theory

Composition of fish with emphasis on nutritional value. Concept of Biological value, Protein Efficiency ratio, Net protein utilization. Amino acids of fish and shellfishes and importance of essential amino acids. Fish lipids: fatty acids, nutritional quality. Role of fish lipids in human nutrition. Non-protein nitrogen substances in fishes. Vitamins in fish: water soluble, fat soluble, significance in human nutrition. Minerals in fish: micro- and macro-elements, trace elements, significance in human nutrition. Other functional bio-molecules in fish – peptides, collagen and squalene. Effect of different kinds of cooking fish i.e. curry, frying, steaming, smoking, fermentation on nutrition value.

### References

7. Biochemistry—A.L. Lehninger
8. Biochemistry -L. Stryer
9. Harper's Biochemistry --- R.K. Murray and others
10. Biochemistry ---D. Voet and J.G. Voet
11. Elements of Bio chemistry--- H.S. Srivastava
12. Howks physiological chemistry B.L. Oser

## 9. Swimming

[FSCC 1101]

1(0+1)

### Practical

History, hazards in water and safety precautions; pool maintenance and water quality control. Learning swimming, understanding and practice of ducking the head, kicking action, holding breath under water and various strokes (free style, breast stroke, butterfly, back stroke); competitive swimming-relays and medleys, lap time practice, swimming and floating aids and their uses; diving-styles of diving, rules, regulations and precautions. Methods of life saving in water; Boating, canoeing and sailing: types, maintenance, skill development, rules and regulations and practice

## SEMESTER – II

Course No	Course title	Credits
<b>FSAQ 1202</b>	Fresh Water Aquaculture	3 (2+1)
<b>FSRM 1203</b>	Anatomy and Biology of Finfish	3(2+1)
<b>FSEM 1203</b>	Limnology	3(2+1)
<b>FSEM 1205</b>	Marine Biology	3(2+1)
<b>FSRM 1206</b>	Inland Fisheries	3(2+1)
<b>FSPT 1202</b>	Food Chemistry	3(2+1)
<b>FSEE 1206</b>	Information and Communication Technology	2(1+1)
<b>FSAQ 1207</b>	Aquaculture in Reservoirs	2(1+1)
<b>FSCC 1202</b>	Physical Education, First Aid & Yoga Practices CNC*	1(0+1)
	<b>Total</b>	<b>22(14+8)</b>

### 1. Fresh Water Aquaculture

[ **FSAQ 1202** ]      **3(2+1)**

#### Theory

Major species cultured, production trends and prospect in different parts of the world. Freshwater aquaculture resources-ponds, tanks, lakes, reservoirs etc. Nursery, rearing and growout ponds preparation and management-control of aquatic weeds and algal blooms, predatory and weed fishes, liming, fertilization/manuring, use of biofertilizers, supplementary feeding. Water quality management. Selection, transportation and acclimatization of seed. Traits of important cultivable fish and shellfish and their culture methods-Indian major carps, exotic carps, air breathing fishes, cold water fishes, freshwater prawns, mussels. Wintering ponds, quarantine ponds and isolation ponds. Sewage-fed fish culture. Principles of organic cycling and detritus food chain. Use of agro-industrial waste and biofertilizer in aquaculture. Composite fish culture system of Indian and exotic carps-competition and compatibility. Exotic fish species introduced to India. Culture of other freshwater species. Medium and minor carps, catfish and murrels. Species of fish suitable for integrated aquaculture. Integration of aquaculture with agriculture/ horticulture. Integration of aquaculture with livestock. Cultivation of aquatic macrophytes with aquaculture (makahana). Paddy cum Fish/Shrimp Culture.

#### Practicals

Preparation and management of nursery, rearing and grow-out ponds. Study on effect of liming, manuring and fertilization on hydrobiology of ponds and growth of fish and shellfishes. Collection, identification and control of aquatic weeds, insects, predatory fishes, weed fishes and eggs and larval forms of fishes. Algal blooms and their control. Estimation of plankton and benthic biomass. Study of contribution of natural and supplementary feed to growth. Workout of economics of different culture practices.

Estimation of live stock requirement / Unit in integrated aquaculture Design of paddy plot for paddy-cum-fish culture. Design of Fish and Shrimp Culture, livestock shed on pond embankment, Economics of different integrated farming systems.

## References

1. Fish and fisheries of Indian ---- VG Jhingram
2. Fresh water fish culture Vol I and II---- SK Sarkar
3. Text book of fish culture Marcle Huet
4. Aquaculture----Jhon E. Bardasch and Others
5. Aquaculture principles and practices ----TVR Pillay and MN Kutty
6. Encyclopedia of aquaculture ----RR Stickney
7. Fresh water aquaculture----RK Rath

## 2. Anatomy and Biology of Finfish

[FSRM 1203 ]

3(2+1)

### Theory

Study of external and internal anatomy of important groups of finfish. Study of oral region and associated structures. Digestive system and associated digestive glands. Food and feeding habits of commercially important fishes. Qualitative and quantitative methods of analysis of gut contents. Circulatory system, respiratory system, nervous system, urino-genital system, endocrine system, skeletal systems and sensory organs. Reproductive biology – maturity stages, gonado-somatic index, ponderal index, fecundity, sex ratio and spawning. Eggs and larval stages and developmental biology. Age and growth determination by direct and indirect methods. Fish migration - type and significance. Tagging and marking.

### Practicals

Study of internal organs – digestive, respiratory, circulatory, urino-genital system, nervous, skeletal systems and endocrine system. Study of food and feeding habits. Analysis of gut contents. Estimation of age and growth by direct and indirect methods. Classification of maturity stages. Estimation of fecundity. Study of developmental stages. Tagging and marking.

## References

1. Commercial Sea fishes of India – Talwar and Kicker
2. Inland fishes (Vol 1) ----Jhingram and Talwar
3. Inland fishes (Vol 2) ----Jhingram and Talwar
4. Fresh water inland fishes of India--- K.C.Jayaraman

## 3. Limnology

[FSEM 1203 ]

3(2+1)

### Theory

Introduction to limnology: inland water types, their characteristics and distribution; ponds and lakes; streams and rivers; dynamics of lentic and lotic environments. Lakes - their origin and diversity. Famous lakes of the world and India; nature of lake environment; morphometry, physical and chemical conditions and related phenomena; biological relations: influence of physical and chemical

conditions on living organisms in inland waters. Plankton: planktonic organisms; classification of plankton; distribution of plankton: geographic, vertical, horizontal and seasonal distribution of phytoplankton and zooplankton; seasonal changes of body form in planktonic organisms; food of planktonic organisms; primary productivity: Aquatic plants: characteristics, classification, zonation, seasonal variations, quantity produced chemical composition distribution in different waters, limnological role. Nekton: composition, distribution, movements. Benthos: classification; periphyton; zonation; distribution; movements and migration; seasonal changes in benthos, profundal bottom fauna. Biological productivity: circulation of food material; classification of lakes based on productivity; laws of minimum; biotic potential and environmental resistance; quantitative relationships in a standing crop; trophic dynamics; successional phenomena; indices of productivity of lakes; artificial enrichment. Lotic environments: running waters in general; physical conditions; classification of lotic environments, biological conditions; productivity of lotic environments. influence of currents; plant growth; plankton; nekton; benthos; temporary and head waters streams; ecological succession.

### **Practicals**

Morphometry of lakes, ponds and streams. Determination of physical characteristics of lentic water bodies. Determination of chemical characteristics of lentic water bodies. Determination of physical characteristics of lotic water bodies. Determination of chemical characteristics of lotic water bodies. Collection and identification of fresh water phytoplankton. Enumeration and biomass estimation of freshwater phytoplankton. Estimation of primary productivity in fresh water bodies. Collection and identification of fresh water zooplankton. Enumeration and biomass estimation of fresh water zooplankton. Collection and identification of benthos from lakes and ponds, streams and canals. Collection and identification of nekton/aquatic insects from freshwater bodies. Collection and identification of aquatic plants from different fresh water bodies. Field visit to lotic and lentic water bodies.

### **References**

1. Meteorology -- DrS.R.Ghadekar
2. Physical geography ---- Indra Singh
3. Meteorology ----DrJaman Joseph (CIFNET)
4. Tropical meteorology ----H.Rahil
5. Physical geography (Oceanography) --- K.Bharadwaj

## **4. Marine Biology**

**[FSEM 1205]**

**3(2+1)**

### **Theory**

Introduction to Marine Biology: Divisions of marine environment- pelagic, benthic, euphotic, aphotic divisions and their subdivisions. Life in oceans - general account of major groups of phytoplankton, sea weeds, major zooplankton groups. Environmental factors affecting life in the oceans-salinity, temperature, light, currents, waves, tides, oxygen, and carbon dioxide. Vertical migration of zooplankton, Phytoplankton-Zooplankton relationship, geographical and seasonal variation in plankton production, plankton and fisheries. Inter tidal ecology: Rocky shore, sandy shore and mud flats, zonations, communities, and the adaptation. Mud banks: formation, characteristics. Estuaries: Classification, Physico-chemical factors, Biota and productivity, examples

of some Indian Estuaries. Boring and fouling organisms. Nekton outline, composition of nekton, habitats of nekton. Bioluminescence and indicator species, Blooms, Red tides: cause and effects.

### **Practicals**

Study of common instruments used for collection of phytoplankton, zooplankton and benthos. Collection, preservation and analysis of phytoplankton, zooplankton, sea weeds, Collection preservation and analysis of inter tidal organisms.

### **References**

1. Commercial Sea fishes of India – Talwar and Kicker

## **5. Inland Fisheries**

**[FSRM 1206]**

**3(2+1)**

### **Theory**

Freshwater fishery regions of the world and their major fish species composition. Global inland fish production data. Capture fishery resources of India. Potential of inland water bodies with reference to respective state. Problems in the estimation of inland fish catch data. Fishing crafts and gears. Major riverine and estuarine systems of India. Major brackish water lakes and their fisheries. Fisheries of major reservoirs / natural lakes of India. Flood-plain capture fishery present status of their exploitation and future prospects. Cold water fisheries of India.

### **Practicals**

Analysis of species composition of commercial catches at landing and assembling centers, sampling and familiarization of commercially important groups. Observations and experimental operations of selected fishing crafts and gears in inland / estuarine waters. Maintenance of records on catch data. Visit to Dept. of fisheries, lakes and reservoirs, net making yards.

### **References**

1. Fresh water inland fishes of India--- K.C.Jayaraman
2. Identification of shell fishes ----FAO
3. Prawn and prawn fisheries of India -----Kurine and Sabestian
4. Identification of shell fishes and Molluscs --- CMRI Special publication

## **6. Food Chemistry**

**[FSPT 1202]**

**3(2+1)**

### **Theory**

Composition of food and nutritional value. Moisture in foods. Biological oxidation, electron transport chain, P/O ratio; oxidative phosphorylation. Carbohydrates: Naturally occurring polysaccharides in foods. Seaweed polysaccharides – sources and uses. Browning reactions – enzymatic and non-enzymatic. Lipids: metabolism of lipids, oxidation of fatty acids, lipoproteins; VLDL and HDL and their importance. Proteins: metabolism, deamination, decarboxylation, metabolic fate of amino acids, nitrogen balance. Deamination reactions and nitrogen excretion with special reference to fish. Fish muscle proteins, chemical changes in muscle during contraction. Proteins in foods, role in hydration- native and denatured proteins, gel formation, functional properties of proteins, changes during heat treatment and processing, texturized proteins. Chemistry of taste, flavour and odour components in foods, flavour intensifiers, synthetic flavouring

substances. The taste of fish and shellfish. Food additives - types and their chemical nature, emulsifiers and antimicrobial additives, sequestrants, flavour potentiators surface active agents; non-nutritive sweeteners, colour additives in food. Assessment of quality of food by instrumental and chemical methods. Nutritive value of foods. Energy value and energy requirements and their estimation. Water, electrolytic and acid-base balance. Nutritive value of proteins PER, BV digestibility coefficient, NPU values, pepsin digestibility. Role of fibre in human nutrition.

### **Practicals**

Estimation of moisture, crude protein, fat, ash (including acid soluble) in fish sample. Determination of energy value of fish. Estimation of glucose and salt content in foods. Colorimetric method of estimation of proteins and carbohydrates. Use of pH meter. Estimation of freshness quality indices such as TVBN, TMA, alpha-amino nitrogen, PV, FFA, TBA value of fish. Estimation of fibre in foods.

### **References**

1. Biochemistry—A.L.Lehninger
2. Biochemistry -L.Stryer
3. Harper's Biochemistry --- R.K.Murray and others
4. Biochemistry ---D.Voet and J.G.Voet
5. Elements of Bio chemistry--- H.S. Srivastava
6. Howks physiological chemistry B.L.Oser

## **7. Information and Communication Technology [FSEE 1206] 2(1+1)**

### **Theory**

IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; word and character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming- algorithms and flowcharts; Operating systems (OS) - definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP; Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of A.V aids; video conferencing. Communication process, Berlo' s model, feedback and barriers to communication.

### **Practicals**

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of fisheries data using MS Excel. Handling of audio visual equipments. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual programme.

## **8. Aquaculture in Reservoirs**

**[FSAQ 1207]**

**2(1+1)**

### **Theory**

Definition of reservoirs in India; nature and extent of reservoirs, topography and species diversity; importance of morpho-edaphic index in reservoir productivity and classification; factors influencing fish production; trophic phases in reservoir; pre-impoundment and postimpoundment stages and their significance in establishment of reservoirs fisheries.

Salient features of reservoir limnology and their significance to fisheries development; management of small, medium and large reservoirs; present status and future prospects in reservoirs fish production.

Fisheries of some important reservoirs; recent advances in reservoirs fisheries management; conservation measures in reservoir fisheries. Fish stocking in Reservoirs Role of cage and pen culture in site of cage culture; cage materials, designs, shape, size and fabrication; cage frames and supporting system. Integration of cage culture with other farming systems.

History of pen culture, pen materials, fabrication; breeding of fish in pen; rearing of spawn in pen; grow-out from pens. Suitable species for culture in cages and pens; constraints in cage and pen culture; economics of cage and pen culture.

### **Practicals**

Preparation of charts on the present situation of reservoirs fisheries productivity; detailed case studies of selected reservoirs on the changing trends in capture fisheries profile; drawing inferences from the analysis of data; suggestions for the sustainable development of reservoirs fisheries. Case studies on cage and pen culture; field visit to cage and pen culture site to acquaint with construction details and operation.

### **References**

1. Aquaculture principles and practices ----TVR Pillay and MN Kutty
2. Encyclopedia of aquaculture ----RR Stickney
3. Hand book fisheries and aquaculture----ICAR New Delhi 2006
4. Sustainable aquaculture ---- BB Jena and Carl D.Webster
5. Hand book of fisheries and aquaculture ---- NIR Board of Consultants (Asia Pacific press)

## **9. Physical Education, First Aid & Yoga Practices**

**[FSCC 1202]**

**1(0+1)**

### **Practicals**

Introduction to physical education: definition, objectives, scope, history, development and importance; physical culture; Meaning and importance of Physical Fitness and Wellness; Physical fitness components -speed, strength, endurance, power, flexibility, agility, coordination and balance; Warming up - General & Specific & its Physiological basis; Test and measurement in physical education; Training and Coaching - Meaning & Concept; Methods of Training; aerobic and an aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory & Digestive systems; Balanced

Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems & its Management; Posture; Postural Deformities; Exercises for good posture.

Yoga; Introduction to - Asanas, Pranayam, Meditation and Yogic Kriyas; Role of yoga in sports; Governance of sport in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipments, skill, technique, style and coaching of major games( Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics

Need and requirement of first aid. First Aid equipments and up keep. Handling and transport of injured traumatized persons. Emergency procedure for suffocation, demonstration of artificial respiration. Treatment of injuries (wounds and bleeding)–methods of dressing and bandages; first-aid procedure for injured bones. Handling unconsciousness; Treatment of burns and scalds. Emergency procedure for poisoning with special references to snakebite. Injuries I accidents in fishing, fish processing factories, chemical laboratories and their treatments. Shock injuries to muscles and joints and treatments. Sports injuries and their treatments.