

ANDHRA UNIVERSITY
Department of Zoology
M.Sc. FISHERY SCIENCE (Self-Finance)

A N D H R A U N I V E R S I T Y
DEPARTMENT OF ZOOLOGY



M.Sc. DEGREE IN FISHERY SCIENCE - SYLLABUS
(Effective from 2014-2015 Academic year)

M. Sc. Fishery Science is introduced as a two year post-graduate course in the Department of Zoology. Keeping mainly in view of the large number of job opportunities in government and private sector undertakings in the field of Fisheries and Aquaculture, the course is designed that the student is benefited to take up a job in professional and industrial organizations as well as to teach in Degree and junior colleges where Zoology or Fisheries are offered.

1. Candidates for M.Sc. Fishery Science Degree examination shall be required : (a) To have passed the qualifying examination of this University as detailed in AUCET (Andhra University Common Entrance Test) regulations or an examination of any other University recognized by the Academic Council as equivalent thereto; and (b) To have undergone subsequently a further course of studies extending over a period of two academic years. As the case may be, in this University, each academic year consisting of two semesters ordinarily consecutive.

2. The course and scope of instruction shall be defined in the syllabus prescribed :

3. (a) The candidate shall be required to take at the end of each semester, an examination as detailed in the scheme of examination.

Each paper of the examination shall unless otherwise prescribed be of three hours duration and for a maximum of 100 marks (15 + 85). An external paper setter shall set the question paper. There shall be double valuation. Similarly, there shall be one semester-end examination of 2-3 hours duration in each practical course. Paper-setting and evaluation shall be done jointly by two examiners, one internal and one external. Evaluation of the performance of the candidates in respect of each paper shall be carried out only by the semester-end examination.

(b) A candidate appearing for the whole examination shall be declared to have passed the examination if he/she obtains not less than 50% of the total marks in all papers including practical and records put together. And, also not less than 40% in each paper/practical at the semester-end and 40% marks for a maximum of 100 marks for each paper. All other candidates shall be deemed to have failed in the examination. Candidates who have completed the first semester course and have earned the necessary attendance and progress certificate shall be permitted to continue the second semester course irrespective of whether they have appeared or not at the first semester examination. Such candidates may be permitted to appear for the examination of the earlier semester with the examination of the later semester simultaneously.

Candidates shall put in attendance at the college for not less than 75% of the total number of working days. Condonation of shortage of attendance may be granted on the recommendation of the Principal of the College concerned provided that no condonation shall be recommended in the case of candidates who have not put in attendance at the college for at least 50% of the total number of working days. If a candidate represents the University officially at

games, sports or other officially organized extra curricular activities, it will be deemed that he/she has attended the college on the days he/she is absent for the purpose.

4. The names of the successful candidates at the examination shall be arranged in order in which they are registered for the examination as follows. On the basis of the total marks obtained by the each candidate at the I-IV Semester-end examination put together.

I Class with Distinction : Those who obtain 70% and above I Class

I Class : Those who obtain 60% and above but less than 70%

II Class : Those who obtain 50% and above but less than 60%

Only those candidates who appear and pass examination in all the papers of the four semesters at first appearance are eligible to be placed in the first class with distinction. However, no candidate who has not passed all the papers relating to any semester at the first appearance shall be eligible for any medals, or prizes by the University and to receive certificates of rank, obtained by them in the examination.

Marks Schedule for Each Semester

Semester Duration : 16 weeks (Excluding holidays and time for Semester-end examination)

Theory : Number of periods of theory per paper : 4 – 5 periods per week. Each period of 50 minutes duration.

Practical : Students will be distributed into 4 – 5 batches per practical. Each practical class shall be of 3 periods (3 x 50 minutes) duration/batch.

DEPARTMENT OF ZOOLOGY : ANDHRA UNIVERSITY
M.Sc. FISHERY SCIENCE (SELF-FINANCE)
SCHEME OF EXAMINATION

Semester/ Code No. of paper	Title of the Paper	Max. Marks	Sem end	Mid Sem.	No. of hours/ Week
I Semester :					
THEORY :					
FS 01	Limnology	100	85	15	4
FS 02	Estuarine and Marine Biology	100	85	15	4
FS 03	Taxonomy & Functional Anatomy of Shellfish & Finfish	100	85	15	4
FS 04	Biosystematics and Taxonomy	100	85	15	4
PRACTICALS :					
FS P 01	Practical-1 : Limnology	50	--	--	3
FS P 02	Practical-2 : Estuarine and Marine Biology	50	--	--	3
FS P 03	Practical-3 : Taxonomy & Functional Anatomy of Shellfish & Finfish	50	--	--	3
FS P 04	Practical-4 : Biosystematics and Taxonomy	50	--	--	3
FS – SM	Seminar	50			
II Semester :					
THEORY :					
FS 05	Ichthyology	100	85	15	4
FS 06	Capture Fisheries	100	85	15	4
FS 07	General & Applied Zoology	100	85	15	4
FS 08	Biostatistics, Population Dynamics and Remote Sensing	100	85	15	4
PRACTICALS :					
FS P 05	Practical–5 : Ichthyology	50	--	--	3
FS P 06	Practical–6: Capture Fisheries	50	--	--	3
FS P 07	Practical–7 : General & Applied Zoology	50	--	--	3

FS P 08	Practical-8 : Biostatistics, Population Dynamics and Remote Sensing	50	--	--	3
FS -VV	Viva-Voce	50			

III Semester :

THEORY :

FS 09	Construction and Management of Hatcheries and Fish Farms	100	85	15	4
FS 10	Freshwater Aquaculture	100	85	15	4
FS 11	Coastal Aquaculture	100	85	15	4
FS 12	Finfish and Shellfish Pathology	100	85	15	4

PRACTICALS :

FS P 09	Practical-09 : Construction and Management of Hatcheries and Fish Farms	50	--	--	3
FS P 10	Practical-10: Freshwater Aquaculture	50	--	--	3
FS P 11	Practical-11 : Coastal Aquaculture	50	--	--	3
FS P 12	Practical-12 : Finfish and Shellfish Pathology	50	--	--	3
FS - SM	Seminar	50			

IV Semester :

THEORY :

FS 13	Fish Immunology	100	85	15	4
FS 14	Fish Physiology and Biochemistry	100	85	15	4
FS 15	Genetics, Molecular Biology and Biotechnology	100	85	15	4
FS 16	Fishery Education, Extension and Economics of Aquaculture	100	85	15	4

PRACTICALS :

FS P 13	Practical-13 : Fish Immunology	50	--	--	3
FS P 14	Practical-14 : Fish Pathology, Nutrition and Biochemistry	50	--	--	3
FS P 15	Practical-15 : Genetics, Molecular Biology and Biotechnology	50	--	--	3
FS P 16	Practical-16 : Fishery Education, Extension and Economics of Aquaculture	50	--	--	3
FS- VV	Viva-Voce	50			

I – SEMESTER

PAPER – I: LIMNOLOGY (Code No. FS 01)

Unit – I

1. Origin and classification of water bodies – Rivers, lakes and ponds
2. Major rivers and freshwater lakes of India
3. Ecology of ponds, rivers and lakes – Structure and dynamics - energyflow

Unit – II

4. Physical characteristics of water : Temperature, thermal stratification and thermal exchange – light – total hardness – pH.
5. Chemical characteristics of water : Chlorides – dissolved oxygen – alkalinity and acidity.

Unit – III

6. Major groups of organisms in freshwater bodies other than fish
7. Ecological adaptations of freshwater fauna
8. Productivity of water bodies – Primary, secondary, tertiary - Factors affecting primary production

Unit – IV

9. Plankton of freshwater biotopes – Phyto and Zooplankton, their structural dynamics, seasonal variation
10. Plankton sampling: Methods of collection, preservation and identification
11. Benthos of diverse biotopes

Reference Books:

1. Welch, P.S. Limnology. McGrawHill, NY, 1952.
2. Hutchinson, G.E. A Treatise on Limnology, Vols. I & II. John Wiley & Sons, 1957.
3. Ruttner, F. Fundamentals of Limnology. Translated by D.G. Frey and F.E.Fry. University of Toronto Press, 1968.
4. Wetzel, R.G. Limnology. W.B. Saunders Co., 1975.
5. Reid, G.K. & R.D. wood. Ecology of inland waters and Estuaries. Van Nostrand Company, 1976.
6. Cole, C.A. Textbook of Limnology. The C.V. Mosby Co., 1983.

PAPER – II: ESTUARINE AND MARINE BIOLOGY (Code No. FS 02)

Unit – I

1. Estuaries: Origin of estuaries- structure of an estuary(Physico-chemical features)
2. Some typical estuarine habitats of India (Hoogly- Maltah , Mahanadi, Godavari, Krishna, Cauvery and West- coast estuaries).
3. Aquatic pollution.

Unit –II

1. The sea as biological environment – General characters of populations and primary biotic divisions. Terminology of topographical features of the marine environment.
2. Physical environmental factors (Temperature, light , currents, tides and waves)
3. Chemical environmental factors (oxygen- carbon dioxide, salinity and Hydrogen –Ion –concentration.

Unit-III

1. Phytoplankton composition- adaptations.
2. Biological productivity, Primary Production: Methods of measuring primary production, Productivity in relation to fisheries.
3. Zooplankton- composition, Zoo-phytoplankton relationships,

Unit –IV

1. Nekton – Composition and ecological adaptations.
2. Intertidal zone- zonation pattern.
3. Types of shores-(Rocky – Sandy- Muddy) and their characteristic feature- fauna – adaptations.

Reference Books:

1. Friedrich, H.: Marine Biology
2. Raymont, J.E.C.: Plankton and productivity in the Oceans, Volume 1.
3. Balakrishna Nair. N. and D.M. Thampy: A text book of Marine ecology
4. Broecker, W.S.: Chemical Oceanography
5. Sverdrup, H.V., M.W., Johnson and R.H. Fleming.: The Oceans - Their physics, chemistry and general biology. Prentice-Hall Inc. 1942.

**PAPER – III: TAXONOMY AND FUNCTIONAL ANATOMY OF SHELL FISH
& FINFISH (Code No. FS 03)**

Unit – I

1. General characters of coelenterates, crustaceans, mollusks and echinoderms and fishes..
2. Classification of Crustacea - up to orders
3. Classification of Mollusca - up to sub-class
4. Major groups of Fishes: Major groups of living Fishes and extinct Fishes – Phylogeny of Fishes Classification of fishes up to sub-class.

Unit – II

5. Larval forms of major invertebrate groups.
6. Food, feeding habits and adaptations of cultured crustaceans.
7. Food, feeding habits and adaptations of cultured Molluscs

Unit – III

8. Respiration and circulation in crustaceans and Molluscs
9. Excretion in crustaceans and Molluscs
10. Respiratory organs in fishes – Modification of gills in relation to habit – Structural adaptations of air breathing fishes.

Unit – IV

11. Reproductive patterns in crustaceans, reproductive organs, gonad maturity, spawning and fertilization
12. Endocrine organs in crustaceans and their role in reproduction.
13. Reproductive patterns in Molluscs, reproductive organs, gonad maturity, spawning and fertilization.
14. Reproduction in fishes: Modes of reproduction, reproductive cycle, gonad maturity stages, spawning seasons and grounds, modes of spawning.

Reference Books:

1. Borradile & R.A. Potts. The Invertebrates. Asia Publishing House, 1962.
2. Kaestner, A. Invertebrate Zoology. Vol. I – III, John Wiley & Sons, 1967.
3. Barrington, F.J.W. Invertebrates : Structure and Functions. EIBS, 1971.
4. Kurian, C.V. & V.O. Sabastian. Prawns and Prawn Fisheries of India. Hindustan Pub. Co., 1976.
5. Parker, J. & W.A. Haswell. The Textbook of Zoology. Vol. I. Invertebrates (eds. A.J. Marshall & W.D. Williams), ELBS & McMillan & Co., 1992.
Nikolsky, G.V. Ecology of Fishes. Academic Press, NY, 1963.
6. Howar, W.S. & D.J. Randal. Fish Physiology, Vols. 1–4, Academic Press, NY, 1970.
7. Jhingran, V.G. Fish and Fisheries of India. Hindustan Publishing Co., 1975.
8. Norman, J.R. & P.H. Greenwood. A History of Fishes, 3rd Ed. Ernest Benn Ltd., 1975.
9. Fretter, V. & A. Graham. The functional anatomy of vertebrates. Academic Press Inc. (Lon.) Ltd., 1976.
10. Lagler, K.E. et. Al. Ichthyology. John Wiley, 1977.
11. Carl, B.E. Biology of Fishes. Saunders, 1979.
12. Moyle Peterb, Fishes : An Introduction to Ichthyology. Prentice Hall, 1979.
13. Low, M.S. & G.M. Calliet (eds.). Readings in Ichthyology. Prentice Hall, 1979.
14. Meyer & Ashlock. Principles of systematic Zoology.
15. Turnor. Textbook of endocrinology

PAPER – IV: BIOSYSTEMATICS and TAXONOMY
(Code No. FS 04)

Unit – I

- 1.0. Definition and basic concepts of biosystematics and taxonomy
 - 1.1. Historical resume of systematics.
 - 1.2. Importance and application of biosystematics
 - 1.3. Taxonomic characters – different kinds, origin of reproductive isolation – biological mechanism of genetic incompatibility.

Unit – II :

- 2.0. Trends in biosystematics – concepts of different conventional and newer aspects
 - 2.1. Chemotaxonomy
 - 2.2. Cytotaxonomy
 - 2.3. Molecular taxonomy
- 3.0. Molecular perspective on the conservation of diversity
 - 3.1. Diversity and ecosystem process: Theory, achievements and future directions

Unit – III:

- 4.0. Dimensions of speciation and taxonomy characters
 - 4.1. Dimensions of speciation- types of lineage changes, production of additional lineage
 - 4.2. Mechanisms of speciation in panmictic and apomictic species
 - 4.3. Species concepts – species category, different species concepts: sub-species and other infra specific categories
 - 4.4. Theories of biological classification, hierarchy of categories

Unit – IV :

- 5.0. Procedure keys in taxonomy
 - 5.1. Taxonomic procedures – taxonomic collections,

preservation, curation process of identification

- 5.2. Taxonomic keys – different kinds of taxonomic keys, their merits and demerits
- 5.3. Systematic publications – different kinds of publications
- 5.4. Process of typification and different Zoological types
- 5.5. International Code of Zoological Nomenclature (ICZN) – its operative principles, interpretation and application of important rules, Zoological nomenclature, formation of scientific names of various taxa.

Suggested Reading Material :

1. M. Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise. Molecular Markers. Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson. Biodiversity, Academic Press, Washington.
4. G.G. Simpson. Principle of Animal Taxonomy. Oxford IBH Pub. Co.
5. E. Mayer. Elements of Taxonomy.
6. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
7. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.

Reference Books:

1. Nikolsky, G.V. Ecology of Fishes. Academic Press, NY, 1963.
2. Howar, W.S. & D.J. Randal. Fish Physiology, Vols. 1–4, Acad Press, NY, 1970.
3. Jhingran, V.G. Fish and Fisheries of India. Hindustan Publishing Co., 1975.
4. Norman, J.R. & P.H. Greenwood. A History of Fishes, 3rd Ed. Ernest Benn Ltd., 1975.
5. Fretter, V. & A. Graham. The functional anatomy of vertebrates. Academic Press Inc. (Lon.) Ltd., 1976.
6. Lagler, K.E. et. Al. Ichthyology. John Wiley, 1977.
7. Carl, B.E. Biology of Fishes. Saunders, 1979.
8. Moyle Peterb, Fishes : An Introduction to Ichthyology. Prentice Hall, 1979.
9. Low, M.S. & G.M. Calliet (eds.). Readings in Ichthyology. Prentice Hall, 1979.
10. Meyer & Ashlock. Principles of systematic Zoology

II – SEMESTER

PAPER – V: ICHTHYOLOGY (Code No. FS 05)

Unit – I

- 1.1. Basic fish anatomy – form and function of muscles, gills and gas Bladder. Digestive system.
- 1.2. Skeleton – Endoskeleton – Neurocranium and visceral skeleton.
- 1.3. Nervous system, Sense Organs and Endocrine organs in fishes.

Unit – II

Locomotion in fishes: Body form and locomotion, fins and locomotion, swimming and non-swimming locomotion.

- 2.1. Respiration and Respiratory organs of fish.

Age and growth in fishes: Determination of age, length-weight relationship, annual growth marks, bone marks, determination of growth and factors affecting the age and growth

Unit – III

- 3.0 Skin and its derivatives in fish, scales and their significance.
- 3.1. Blood vascular system: Circulation of blood, modification in relation to air breathing
- 3.2 Excretion and Osmo-regulation: Structure and function of the excretory organs – Major excretory products of fishes. Osmotic and ionic regulation – acid base balance – Patterns of nitrogen excretion

Unit – IV

- 4.0. Food and Feeding habits of fish
- 4.1. Electric organs and Electroreception of fish.
- 4.2. Light organs and poison glands of fish
- 4.3. Reproductive organs of fish.
- 4.4. Parental care in fishes.

Reference Books:

1. Sedgewick. A Student's textbook of Zoology, Vol. I & II.
3. Usinger. General Zoology, Vols. I & II.
6. Marshall & Williams. Textbook of Zoology. Vol.I.
7. Parker and Hasswell. Textbook of zoology, Vertebrates. Vol.II.
8. Barnes. General Zoology
9. Day, F. The fishes of India.
10. S.S. Khanna. An introduction to fishes.
11. K.G. Lagler. Ichthyology.

PAPER – VI: CAPTURE FISHERIES (Code No. FS 06)

Unit – I:

1.0. Fish catch statistics of the world

A general survey of inland and marine fish catches of India and the world (Available Fishing Potential, Estimation of Inland fish, Estimation of marine fish landings and Fisheries of different Marine States).

2.0. Craft and Gear used in Inland and Marine Fisheries:

Traditional and mechanized boats and nets used in catching fish

Unit – II :

3.0. Freshwater Fisheries:

Riverine Fisheries : River systems in India, their ecology and fisheries (Ganga, Brahmaputra, East Coast River system and West Coast river system).

Reservoir Fisheries : Development, Exploitation and management of Reservoirs with special reference to India – Dams and their effect on fish migration.

Cold water fisheries: Bio-physico-chemical factors of cold water, cold water fisheries and their importance.

4.0. Estuarine Fisheries:

Major Estuaries of India and their fisheries (Hooghly – Matlah, Mahanadi, Godavari, Krishna, Cauvery and West Coast estuaries)

Brackishwater Fisheries : Chilka lake, Pulicat lake and Kerala back waters.

4.1. Migration of fishes, anadromous and catadromous migrations.

4.2. Hilsa fishery – causes of decline and efforts for revival

Unit – III:

5.0. Fisheries of Indian Seas :

5.1. Marine fish catch in India and fisheries of commercial importance

Fin Fish : 1) Oil Sardines; (2) Mackerels; (3) Tuna and allied fishes; (4) Seer fish; (5) Flat Fish

- 5.2. Shell fish : 1) Crustaceans; (2) Molluscs; (3) Sea weeds; (4) Edible Oysters.
- 5.3. Sea weed fishery
- 6.0. Population Dynamics
 - 6.1. Fish populations and factors affecting the population structures
 - 6.2. Estimation of fish yield and control of over-fishing

Unit – IV :

- 7.0. Preservation and processing
 - 7.1. Methods of preservation of finfish and shell fish and associated problems.
 - 7.2. Rigor mortis and post-mortem changes
- 8.0. Fish products and By-products- different types of by-products from finfish and shellfish. Methods of chitin extraction and preparation- major sources and application. Fish meal and fish oil extraction procedures-industrial application.

Practicals :

Suggested Reading Material :

1. Jhingran, V.G. 1993. Fish and fisheries of India. Hindustan Publishing Corporation (India), New Delhi.
2. Ricker, W.E. 1984. Methods for assessment of fish production in freshwaters. Blackwell Publications.
3. Srivastava, C.B.L. 1985. Textbook of Fishery Science and Indian Fisheries. Kutub Mahal Publications, Allahabad.
4. Bal, D.V. and Veerabhadra Rao, K. 1984. Marine Fisheries. IBH Publications
5. Kurian, C.V. and Sebastian, V.O. 1986. Prawns and prawn Fishery of India. Hindustan Publishing Corporation (India), New Delhi.

PAPER – VII: GENERAL AND APPLIED ZOOLOGY (Code No. FS 07)

Unit - I

1.0. Principles of Genetics

- 1.1. Mendelian inheritance, Monohybrid and dihybrid crosses, Cytological significance.
- 1.2. Gene interactions: Incomplete dominance, Co-dominance, Complementary genes, Epistasis. Polymeric genes and Duplicate genes.
- 1.3. Polygenic inheritance and multifactoral inheritance.
- 1.4. Sex - linked inheritance- Drosophila.

Unit – II :

2.0. Biomembranes.

- 2.1. Molecular composition and arrangement, functional consequences
- 2.2. Transport across cell membrane: diffusion, active transport and pumps, uniports, symports and antiports
- 2.3. Membrane potential
- 2.4. Co-transport by symporters or antiports
- 2.5. Transport across epithelia: Transport of macromolecules

Unit – III :

3.0. Cytoskeleton and Cell cycle.

- 3.1. Microfilaments and microtubules – structure and dynamics
- 3.2. Microtubules and mitosis
- 3.3. Cilia and flagella
- 3.4. Cell cycle.
- 3.5. Cyclins and cyclin dependent kinases
- 3.6. Regulation of CDK-cyclin activity

Unit – IV :

- 4.0. Instrumentation.
 - 4.1. Principles and analytical uses of pH meter & Spectrophotometer.
 - 4.2. Microscopy: Principles of light, darkfield, phase contrast, Fluorescence, Transmission Electron Microscopy and SEM.
 - 4.3. Electrophoresis.
 - 4.4. Centrifugation.

Suggested Reading Material :

1. Molecular Cell Biology, J. Darnell. H. Lodish and D. Baltimore, Scientific American Book INC, USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson Garland Publishing INC, New York.

**PAPER – VIII: BIOSTATISTICS, POPULATION DYNAMICS AND
REMOTE SENSING (Code No. FS 08)**

Unit – I

1. Introduction and scope of biostatistics - Concept of sample and Population Sampling methods - Frequency distribution - Classification and tabulation of data - Diagrammatic and graphical presentation.
2. Measures of central tendency: Mean, Median and Mode.

Unit – II

3. Measures of Dispersion - Coefficient of Variation - Standard Deviation – Variance - Standard Error.
4. Analysis of variance – One way ANOVA and two way ANOVA
5. Correlation and Regression

Unit – III

6. Probability – Concept and types of probabilities
7. Distribution – Binomial, Poisson, Normal distribution
8. Tests of significance – Chi-square test and Student's 't' test

Unit – IV

1. Population attributes-population dispersion- population density- Natality-Mortality-Age structure-Age pyramids- Survivorship curves- Biotic potential.
2. Population growth – Logistic- exponential growth curves- Life tables- Net reproductive rate.
3. Remote sensing- applications in fisheries

Reference Books:

1. Fundamentals of mathematical statistics – Gupta and Kapoor.
2. Fundamentals of Statistics – S.P. Gupta
3. Elementary Statistics – Yule and Kendall
4. Introduction to Biostatistics – Sokal & Rohlf
5. Fundamentals of Biostatistics – By Khan and Khanum

III SEMESTER

PAPER – IX: CONSTRUCTION AND MANAGEMENT OF HATCHERIES AND FISH FARMS (Code No. FS 09)

Unit – I

1. Construction of fish farm: Selection of sites - General considerations - land based and open water farms - quantity and quality of water - Size of the farm unit, division of the farm area - water supply and drainage - Construction of different ponds (Nursery, Rearing and Stocking ponds) - pond structure (size, shape depth etc.).
2. Brackish water pond systems: Introduction, site selection engineering investigations, layout designs, design of water management systems, design of water control structures, viz., sluice gates, peripheral dikes and internal bunds

Unit – II

3. Design, construction and management of Finfish hatcheries
4. Design, construction and management of Prawn Hatcheries

Unit – III

5. Fertilization: Introduction, properties of chemical fertilizers, role of inorganic, organic and bio-fertilizers in aquaculture practices.
6. Liming: Introduction, properties of liming materials, effects of liming on pond ecosystem, exchange of acidity and lime requirements, Application of liming materials of ponds, acid sulfate soils

Unit – IV

7. Feeding methods: Introduction, different methods of feeding, frequency of feeding, fate of nutrients in feed, water quality and feeding rates
8. Aquatic weeds and their control: Introduction, chemical, biological and mechanical control methods.

Reference Books:

1. Pillay, T.V.R. & M.A. Dill. Advances in Aquaculture. Fishing News (Books) Ltd., England, 1979.
2. Stickney, R.R. Principles of Warm water Aquaculture. John Wiley & Sons Inc., 1979.
3. Hopher, B. & Y. Prugim. Commercial Fish Farming. John Wiley & Sons Inc., 1981.
4. Boyd, C.E. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Company, 1982.
5. Jhingran, V.G. Fish and Fisheries of India. Hindustan Publishing Corporation India, 1982
6. Turcker, C.S. (ed.). Channel Catfish Culture. Elsevier, 1985.
7. Bose, A.N. et. Al. Coastal Aquaculture Engineering. Oxford & IBH Publishing Company Pvt. Ltd., 1991.

PAPER – X: FRESHWATER AQUACULTURE (Code No. FS 10)

Unit – I

1. Basics of aquaculture: Scope and definition, history of aquaculture, origin and growth, General principles underlying the practices of aquaculture, cultivable finfish and shellfish, species selection – Productivity of a fishpond.
2. Procurement of Stocking material from natural environment, Bund breeding and Induced breeding - Transportation of fish seed and brood fish (Methods of transporting fish seed – Fingerlings and breeders – Control of mortality and measures for reducing mortality during transportation).

Unit – II

3. Culture of Indian major carps: Major species of carps used for culture, culture systems, spawning and fry production, larval rearing, nursery and grow out pond culture, harvesting and marketing
4. Breeding and culture of exotic carps (grass carp, silver carp, common carp),
5. Polyculture system – Definition and various patterns – Mixed fish farming in India – Composite culture of Indigenous and Exotic fishes.

Unit – III

6. Ecology of swamps and their use for culture of air breathing fishes.
7. Tilapia culture and Eel culture
8. Culture of air breathing fishes- *Heteropneustus*, *Clarius*, *Channa*, *Anabas*.

Unit – IV

8. Freshwater prawn culture with special reference to *Macrobrachium rosenbergii* – Seed procurement from natural resources, breeding and larval rearing of freshwater prawn hatchery and management, management of culture ponds
9. Integrated fish farming: Paddy cum fish culture, Fish cum livestock, Pig cum fish farming, Duck cum fish farming.
10. Culture of Ornamental fishes.

Reference Books:

1. Bardach, et. Al. Aquaculture – The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, NY, 1972.
2. Stickney, R.R. Principles of Water Aquaculture. John Wiley & Sons, NY, 1979.
3. Chondar, C.L. Hypophysation of Indian major carps. Satish Book Enterprise, Agra, 1980.
4. Jhingran, V.G. Fish and fisheries of India. Hindustan Publ. Corporation (India), 1982.
5. Santhanam, R. et. Al. A Manual of Freshwater Aquaculture. Oxford & IBH Publishing Co. Pvt. Ltd., 1987.
6. Pilley, T.V.R. Aquaculture – Principles and Practices. Fishing News (Books) Ltd., London, 1990.
7. Pandey, A.C. Air Breathing Fishes. Reliance Publishing House, New Delhi, 1990.
8. Janardhana Rao, K. & S.D. Tripathi. A Manual of Giant Freshwater Prawn Hatchery. CIFA, Kausalyaganga, Orissa, India, 1993.
9. Iso Matsui. Theory and Practice of Eel Culture. American Publishing Co. Pvt. Ltd., 1980.

PAPER – XI : COASTAL AQUACULTURE (Code No. FS 11)

Unit – I :

1. Concept of Blue revolution, Major Objectives of Blue Revolution in India. Brackish water aquaculture - Principles of pond design – Inland and Coastal pond forms, Tank and raceway farms, cage farms, pens – Types of culture systems. Species selection for coastal aquaculture.
2. Water quality management in Aquaculture, Physico-chemical variables: Salinity, temperature, pH, turbidity, BOD, COD, dissolved oxygen, nitrates, phosphates, ammonia, sulphates and silicates

Unit – II :

4. Design and construction of shrimp culture ponds – Liming and fertilization, Seed procurement of shrimps: Natural seed, hatchery reared seed, production and transportation stocking in nursery ponds, rearing and grow-out ponds, pond harvesting. Traditional, extensive, modified extensive, semi-intensive, intensive and super-intensive culture of shrimps and their management and economics
5. Crab culture- Principles of crab hatchery, brood stock, larval and post-larval management. Packing and transportation of seed - Crab culture: Pond design, management of crab farm. Crab culture and crab fattening process – economics, cage culture and pen culture.

Unit – III

8. Principles involved in seed production of lobsters and mussels. Natural resources of shrimp, crab, brackish water fish, oyster and mussel seed
9. Brackish water fish species for culture, management, traditional culture of brackish water fish. Culture of finfish – Sea-bass, milk fish and mullet culture

Unit – IV:

11. Mariculture: Species identification, Lobster culture, Mussel culture, Pearl oyster and pearl production. Edible Oyster culture, Sea-weed culture
12. Feed management – Feeding schedules, protein requirements at different ages of finfish and shellfish, feed formulations, wet feeds and dry feeds

Reference Text Books :

1. Huet, M. Textbook of Fish Culture – Breeding and Cultivation of Fish. Fishing News (Books) Ltd., England, 1972.
2. Bardach, et. Al. Aquaculture – The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, NY, 1972.
3. Chen, T.P. Aquaculture Practices in Taiwan. Fishing News (Books) Ltd., England, 1976.
4. Takeo Imai. Aquaculture in Shallow Seas – Progress in Shallow Sea Culture. Oxford & IBH Publ. Co., India, 1977.
5. Stickney, R.R. Principles of Water Aquaculture. John Wiley & Sons, NY, 1979.
6. Jhingran, V.G. Fish and fisheries of India. Hindustan Publ. Corporation (India), 1982.
7. Kurian, C.V. & V.O. Sabastian. Prawn and Prawn Fisheries of India. Hindustan Publ. Corp. India, 1982.
8. Brown, E.E. World Fish Farming – Cultivation and Economics. AVI Publishing Co. Connecticut, 1983.
9. Huner Jay V. et. Al. Crustacean and Molluse Aquaculture in United States. AVI Publishing Co. Connecticut, 1985
10. Pilley, T.V.R. Aquaculture – Principles and Practices. Fishing News (Books) Ltd., London, 1990.
11. Bose, A.N. Coastal Aquaculture Engineering. Oxford & IBH Publishing Company Pvt. Ltd., 1991.
12. Turcker, C.S. (ed.). Channel Catfish Culture. Elsevier, 1985.
13. Boyd, C.E. Water Quality Management for pond Fish Culture. Elsevier Scientific Publishing Company, 1982.

PAPER – XII : FINFISH AND SHELLFISH PATHOLOGY
(Code No. FS 12)

Unit – I :

1. Introduction: Definition, Disease problems in aquaculture, Infectious and non-infectious diseases
2. Viral diseases of fish : Clinical picture, pathology, symptoms and prophylaxis of some common viral diseases – (a) Papillomatosis, (b) Lymphocystis and (c) Infectious Pancreatic Necrosis (IPN)
3. Viral diseases of shrimp : Clinical picture, pathology symptoms and prophylaxis of some common viral diseases – (a) *Monodon baculo* virus (MBV), (b) HPV, (c) YHV) Yellow head virus, (d) IHNV, (e) White spot syndrome (WSSV).

Unit – II :

4. Bacterial diseases of fish : Etiology clinical symptoms, pathology and prophylaxis of some common bacterial diseases – (a) Bacterial Hemorrhagic Septicemia, (b) Bacterial gill disease and (c) Columnaris disease
5. Bacterial diseases of shrimp : Etiology, clinical symptoms, pathology and prophylaxis of some common bacterial diseases – (a) Vibriosis, (b) Shell disease, (c) Black spot disease, (d) Red disease.
6. Fungal diseases of fish : Clinical picture, symptoms and pathology and prophylaxis of (a) Branchiomycosis, (b) Saprolegniasis, and (c) EUS
7. Fungal diseases of shrimp : Clinical picture, symptoms, pathology and prophylaxis of some common shrimp fungal diseases

Unit – III :

8. Protozoan diseases:
Protozoan diseases of fish : Clinical picture, pathology, symptoms and prophylaxis of some common diseases – (a) Nodular coccidiosis, (b) Entero - coccidiosis, (c) Whirling disease, and (d) Ichthyophthirius
Protozoan diseases of shrimp : Clinical picture, pathology, symptoms and prophylaxis of some common viral diseases
9. Metazoan parasites of fish : Clinical picture, pathology, symptoms and prophylaxis of some common diseases – (a) Monogenetic trematode parasites (*Dactylogyrus*, *Gyrodactylus*, *Diplozoan*), (b) Digenetic trematodes (trematode larval and *Neodiplostomum*), (c) Cestode parasites (*Ligula* and *Dibothriocephalus latus*), (d) Nematodes and fish leeches.

Metazoan parasites of shrimp : Clinical picture, pathology, symptoms and prophylaxis of some common diseases

Crustacean parasites of fish : Clinical picture, pathology, symptoms and prophylaxis of some common diseases – (a) *Argulus*, *Ergasilus* and *Lernea*

Unit – IV :

10. Environmental induced diseases of fish. Thermal stress, O₂ deficiency, stress due to pH variations; Gas bubble disease

Nutrition deficiency diseases: Avitaminosis, Mineral deficiency, Starvation.
11. Diseases caused by other factors : Hereditary factors, Tumours of hereditary origin - Hydrocoel, Tumours - benign and malignant

Environmental induced and nutritional deficiency diseases in shrimps.
12. Management practices in fish and shrimp diseases.

Reference Text Books :

1. Cheng, T.C. The Biology of Animal Parasites. Saunders, Philadelphia, 1964.
2. Wedemeyer Environmental stress and Fish Diseases
3. Amlacher, E. Text book of Fish Diseases.
4. Ribelin, W.E. & G. Miguki. The Pathology of Fishes. The Univ. of Wisconsin - Press Ltd., Great Russel st., London, 1975
5. Schaperclaus, W. Fish Diseases. Vol. I & II.
6. Lightner, D.V. Shrimp Disease Diagnosis, 1998.
7. Sinderman. Fish Diseases, Vol. I. Shell Fish Diseases, Vol. II.

IV SEMESTER

PAPER – XIII: FISH IMMUNOLOGY (Code No. FS 13)

Unit – I: Introduction

1. Background and History of Immunology
2. Application to the Fishery Resource
3. Fish Health and Management
4. Lymphoid system: Lymphoid organs and Cells
5. Crustacean immune system

Unit – II: Factors of Immune Response

6. Cellular components of the Immune System
7. Antigen – Haptens : Carriers – adjuvants - Complement – other serum factors
8. Antibody : Structure and function of Ig M_h its properties and diversity
9. Antigen – Antibody interactions

Unit – III: Immune Response

10. Types of Immune Response in various Representative fish groups
11. Non – Specific and Specific Defense Mechanisms
12. Cell mediated immunity and Humoral immunity
13. Immunotoxicology in Fish – Immuno-suppression & Immuno-modulation in response to various toxicants.

Unit – IV: Immunization and Immuno-diagnostic techniques

14. Immunization: Routes of immunization – Principles of vaccination, Vaccines: Types of Vaccines – Live and Attenuated vaccines, peptide vaccines and DNA vaccines.
15. Disease diagnosis using Immuno-diffusion, Agglutination, Blotting techniques and ELISA.
16. Hybridoma Technology: Monoclonal antibodies and their application in fisheries.

Reference Text Books:

1. Douglas P Anderson: Text Book of Fish Immunology
2. Nandini Shetty. Immunology - Introductory Textbook.
3. Kuby Immunology
4. Swin and Sahoo: Fish and Shellfish Immunology – An Introduction
Instant Notes in Immunology - P.M. Lydyard, A. Whelam
and M.W. Fanger

PAPER – XIV : FISH PHYSIOLOGY AND BIOCHEMISTRY
(Code No. FS 14)

Unit – I :

1. Physiological adaptations of fishes and shellfishes with reference to temperature, pressure, Osmo-regulation and pH, Bio-luminescence – electric organs - echolocation
2. Water and electrolyte regulation in freshwater, brackish water and marine environment
3. Biological oxidation, nature of oxidation, reduction reactions, release of energy during oxidation and reduction reactions

Unit – II

4. Neuro-secretory system of invertebrates with special reference to crustaceans, Molluscs and echinoderms – synthesis of hormones and release, non-neural endocrine glands and neurohemal organs in crustaceans
5. Role of Y- organ in the control of molting and growth in crustacean. Androgenic gland in crustacean and its roles in reproduction and sex determination. Importance of eyestalk ablation in growth and reproduction. Hormonal control of reproduction in Molluscs and echinoderms.

Unit – III :

6. Different endocrine glands of fish – thyroid, adrenal, pituitary and other glands, their structure and physiology
7. Nutritive value of fish and shellfish – Fish as food, food commodity, nutritive value of fish and shellfish, composition of raw fish & shellfish

Unit – IV :

8. Carbohydrates – Chemistry and classification – simple and compound sugars – polysaccharides – Carbohydrate metabolism
9. Proteins – chemistry and classification – simple proteins – fibrous proteins – collagen – elastin and carotenes – Albumins and

- Globulins – conjugated and nucleoproteins – glycoproteins – nucleotides – purines and pyrimidines
10. Lipids – chemistry and classification – simple lipids – glycerides – fats and waxes – compound lipids – phospholipids – glycol and sphingolipids – fatty acids - cholesterol
 11. Enzymes – classification and kinetics

Reference Text Books :

1. Prosser & Brown. Comparative Physiology
2. Hoar. Comparative Physiology
3. Hoar & Randall. Fish Physiology
4. Lockwood. Physiology of Crustacea
5. Watermann. Physiology of Crustacea
6. Leninger. Principles of Biochemistry
7. Harper. Physiological Chemistry
8. Bell Patterson & Smith. Textbook of Physiology & Biochemistry
9. Wilson. Textbook of animal Physiology.

**PAPER – XV: GENETICS, MOLECULAR BIOLOGY AND BIOTECHNOLOGY
(Code No. FS 15)**

Unit – I :

1. Principles of cell and molecular biology – Cell structure, Structure of DNA & RNA – Composition and properties
2. DNA replication. Transcription in prokaryotes and eukaryotes
3. Gene structure and function – Gene complementation, cistron , mutan, recon, molecular recombination, gene regulation

Unit – II :

4. Principles of genetic engineering – Isolation of DNA & RNA and characterization of DNA, recombinant DNA technology, cloning, plasmids, cosmids, Bacteriophages, Transformation and Transduction, in vivo packaging, construction of genomic library
5. Applications of Recombinant DNA technology
 1. Molecular hybridization - Labeling of nucleic acids, molecular markers. Amplification of DNA, Blotting techniques – Southern, Northern and Western blotting, DNA Sequencing

Unit – III :

7. Chromosomal types and composition in fish. Chromosome manipulation in fish, Herwig's effect, Hybridization.
8. Animal vaccine development and production – Production of Vaccines (killed & attenuated)

Unit – IV :

9. Application of genetic engineering in fisheries : Genomic manipulation, hybridization, interspecific, intergeneric gynogenesis and androgenesis, polyploidy.
10. Transgenic fish production – Selection of fish species, gene selection, advantages and gene transfer technology – Microinjection technique, electroporation, detection of transgenic fish by PCR applications in transgenic fishes and Biotechnology.

Reference Text Books :

1. Hephher, B. and Y. Pruginin. Commercial fish farming. John Wiley & Sons Inc., 1981.
2. Jhingran, V.G. Fish and Fisheries of India, 1982.
3. Bhattacharya, S. Hormones in Pisciculture. Biology Education. Vol.9, No.1, pp.31-41, 1992.
4. Subramonium, T. Endocrine regulation of reproduction and molting in crustacean and its importance in shrimp aquaculture development.
5. Summer School Manuals of CIFE. Recent Developments in Biotechnology. CIFE, 1998.
6. Genetics and Biotechnological tools in Aquaculture and Fisheries, CIFE, 1998.
7. I.C.A.R. Biotechnology in Aquaculture – Training Manual. CIKA, Bhubaneswar, 1992.
8. Darnell. Molecular Cell Biology.

**PAPER – XVI : FISHERY EDUCATION, EXTENSION AND ECONOMICS
OF AQUACULTURE (Code No. FS 16)**

Unit – I :

1. Fisheries training and education in India : Training Institutes, Universities Research Organisations, etc.
2. Institutional funding to fisheries and aquaculture sector. Importance of aquaculture in Indian economy, farm management- scope and importance. Basic principles of economics applied to aquaculture. Scope and characteristics of farming business.

Unit – II :

3. Socio-economic conditions of fishermen and fish farmers- Housing pattern, literacy and employment of fisher folk. Ownership pattern of production, capital investment of fishery equipment, expenditure pattern, edness and credit facilities, general socio-economic patterns.
4. Fishermen Co-operative Societies and their role.

Unit – III :

5. Role of government agencies – Role of NABARD and other central government agencies in the upliftment of fisher folk. Role of state government agencies in various fishery activities – Loans and credits, policies
6. Integrated coastal zone management (ICZM), ocean policy, role of NGO's.
 - 6.1. Coastal Regulatory Zone (CRZ). Conservation of endangered species.

Unit – IV :

7. Economics of aquaculture – fish culture and shellfish culture.
8. Economic viability, data requirement, analysis of data
9. Financial and economic feasibility, risk and insurance.
- 10.0. Fishery Management
 - 10.1. Yield and optimum catch
 - 10.2. EEZ and its strategy
 - 10.3. Fish transport and marketing including fishery co-operatives

Reference Text Books :

1. Bond, et. al. Fish Inspection and Quality Control. Fishing News (Books), England, 1971.
2. Allen, et. al. Eds. Bio-Economics of Aquaculture, Elsevier, 1984.
3. Chaston, I. Business Management in Fisheries and Aquaculture, Fishing News (Books) Ltd., 1984.
4. Govindan, T.K. Fish Processing Technology, Oxford-IBH, 1985.
5. Meade, J.W. Aquaculture Management, Van Nostrand, New York, 1989.
6. Hephher, B. and Y. Pruginin. Commercial Fish Farming. Wiley-Interscience, 1989.
7. Shang, Y.C. Aquaculture Economic Analysis – An Introduction. 1990.
8. Pillay, T.V.R. Aquaculture Principles and Practices. Fishing News (Books) Ltd., London, 1990.

M.Sc. FISHERY SCIENCE (SELF-FINANCE)

SYLLABUS FOR PRACTICALS

I SEMESTER:

PRACTICAL – I: LIMNOLOGY (Code FS P 01)

1. Phytoplankton and zooplankton – Identification of major groups up to genus level
2. Estimation of phytoplankton and zooplankton
3. Predaceous freshwater insects
4. Identification of common freshwater benthic organisms
5. Estimation of benthic organisms – Micro, meo and macro benthos
6. Macrophytes in freshwater

PRACTICAL – II: ESTUARINE AND MARINE BIOLOGY (Code FS P 02)

1. Identification of rocky, sandy and muddy shore fauna
2. Phytoplankton and zooplankton estimation
3. Phytoplankton from estuaries
4. Zooplankton from estuaries
5. Enumeration of Zooplankton
6. Phytoplankton and zooplankton from the seawater

PRACTICAL – III : TAXONOMY AND FUNCTIONAL ANATOMY OF SHELL FISH & FINFISH (Code FS P 03)

1. Dissection and display of the visceral organs of freshwater mussels
2. Dissection and demonstration of digestive system of pila
3. Dissection of digestive system of shrimp, prawn and crab
4. Identification and mounting of different appendages of shrimp and prawn
5. Dissection of nervous system of prawn, shrimp and crab
6. Dissection of nervous system of sepia.
7. Methods of food analysis and a study of the guts in fish with different feeding habits
8. Dissection of digestive system of different cultivable species.
Dissection of Weberian ossicles in cat fish
9. Lateral line nerve of Trichiurus.

PRACTICAL – IV : BioSystematics and Taxonomy

Practical :

1. A practical approach towards Biosystematics and taxonomy
2. Examples representing the different taxa in the order of evolution
3. Molecular perspective of diversity – Identification of species by molecular separation of proteins by examples
4. Diversity and similarity index.
5. Methods of collection, preservation and identification of plankton and representative forms of terrestrial and aquatic fauna

II SEMESTER :

PRACTICAL – V : ICHTHYOLOGY (Code FS P 05)

1. Identification of fishes with suitable examples from each class
2. Dissection of fish for internal anatomy – External characters. Types of scales, fins, types of teeth, structure of alimentary canal, gill rakers
3. Ecology of fishes – identification characters of pelagic, mid pelagic, benthic and migratory fishes
4. Determination of growth in fish

PRACTICAL – VI : CAPTURE FISHERIES (Code FS P 06)

1. Identification of freshwater and brackish water fish.
2. Identification of fish by Morphometric and Meristic characters.
2. Observing different boats, nets and other instruments used in fishery
3. Biological analysis of fish samples for gut contents, maturity stages and fecundity
4. Fieldwork : Visit to fish landing and processing centres

PRACTICAL – VII : GENERAL AND APPLIED ZOOLOGY (Code FS P 07)

1. Light microscopic examination of tissues
2. Preparation of different cell – types Hepatic parenchymal cells, adipocytes, macrophages, neuronal cells, epithelial cells
3. Stages of Mitosis and Meiosis
4. Squash preparation
5. Sub-cellular fractionation – separation of macromolecules

**PRACTICAL – VIII: BIOSTATISTICS, POPULATION DYNAMICS AND
REMOTE SENSING (Code FS P 08)**

Data collection - Organization – calculation of the following

1. Mean, Median, Mode
2. Standard deviation, Standard error
3. Correlation and regression
4. t-test and Chi-square
5. Problems on population dynamics

III SEMESTER :

**PRACTICAL – IX : CONSTRUCTION AND MANAGEMENT OF
HATCHERIES AND FISH FARMS (Code FS P 09)**

1. Design and estimates of area and construction of freshwater fish/shrimp farm
1. Estimation of soil quality, sand, silt, clay.
2. Estimation of soil pH.
3. Design and estimates of fish and shrimp and prawn hatcheries.
5. Design and estimates of cages rafts, race way farm
6. Ash and elemental analysis of soils.

PRACTICAL – X : FRESHWATER AQUACULTURE (Code FS P 10) :

1. Estimation of Dissolved oxygen.
2. Estimation of pH, Alkalinity & Total Hardness.
3. Primary productivity, Estimation by Light and Dark Bottle method
4. Spotters : Cultivable species of finfish and shellfish based on the theory
4. Dissecting out the pituitary gland and preparing the extract
5. Visit to aquaculture farms, finfish and shellfish hatcheries

PRACTICAL – XI : COASTAL AQUACULTURE (Code FS P 11) :

1. Estimation of metabolic rate of fish/ shellfish.
2. Estimation of Q10
3. Turbidity estimation by Secchi disk.
4. Estimation of Salinity of different brackishwater samples.
5. Estimation of BOD.
6. Estimation of COD.
7. Spotters : Cultivable species of finfish and shellfish based on the theory.
8. Visit to aquaculture farms, finfish and shellfish hatcheries

**PRACTICAL – XII : FINFISH AND SHELLFISH PATHOLOGY
(Code FS P 12) :**

1. Examination of normal and diseased fish - Thorough examination of external surface
2. Autopsy of the diseased fish
3. Host examination – Collection of parasites
4. Slide preparation - fixing - staining and mounting of parasites
5. Histopathology of organs of diseased fish (Sectioning – Staining and Mounting)
6. Slides of fish parasites (Protozoan – Helminth and Copepod)

IV SEMESTER :

PRACTICAL – XIII : FISH IMMUNOLOGY (Code FS P 13) :

1. Immunization - Routes of Immunization
Preparation of Inoculum
Immunization Schedule
2. Bleeding of Fish - Different methods adopted
3. Blood film preparation (Giemsa Staining)
4. Differential Count of WBC
5. Cell Viability Test
6. Quantification of Antibody - Agglutination, Precipitation and Immuno – Diffusion (Kit based)

PRACTICAL – XIV : FISH PHYSIOLOGY AND BIOCHEMISTRY

(Code FS P 14)

1. Qualitative determination of carbohydrates, proteins and lipids. Paper Chromatography
2. Quantitative determination of glucose, glycogen and proteins
3. Demonstration of enzyme action in crustacean hepatopancreas. Estimation of pH in the alimentary canal of fish
4. Experiments on osmosis. Methods in Feed formulations by using different raw materials

PRACTICAL – XV : GENETICS, MOLECULAR BIOLOGY AND BIOTECHNOLOGY (Code FS P 15)

1. Location of endocrine glands – Fish pituitary, thyroid, adrenals, gonads
2. Isolation and preparation of pituitary gland extract
3. Reproductive systems of selected fish, prawn and crab
4. Nervous and endocrine system of prawn and crab, androgenic gland, sinus gland.
5. Eyestalk ablation experiments
6. Estimation of nucleic acids, DNA & RNA.

PRACTICAL – XVI : FISHERY EDUCATION, EXTENSION AND ECONOMICS OF AQUACULTURE (Code FS P 16)

1. Visiting CIFE, CIFA, FSI, CMFRI etc.,
2. Collecting data of the Fishermen in the nearby fishing villages.
3. Collecting the particulars of Farming practices and its economics.
4. Economics of Freshwater aquaculture, Brackishwater fish culture.
5. Economics of shrimp culture.
6. Economics of freshwater prawn farming.

M.Sc. FISHERY SCIENCE
(Model Question Papers)

M.Sc. Fishery Science

Paper-I Limnology (FS 01) (Model Question Paper)

Answer all questions.
All questions carry equal marks

Time: 3hrs.

Maximum marks: 85

1. Describe the origin of lakes
- Or
2. What are the major rivers in India
3. Give an account on Physical characters of water
- Or
4. Give an account on Chemical characters of water
5. Write an account on Ecological adaptations of Freshwater Fauna
- Or
6. What are the factors effecting primary production? Explain.
7. Write an essay on seasonal variations of Zooplankton of Freshwater
- Or
8. Describe the Methods of collection and preservation of Plankton.

M.Sc. Fishery Science

Paper- II : ESTUARINE AND MARINE BIOLOGY (FS02)

(Model Question Paper)

Time: 3 hrs

Max.Marks: 85

Answer ALL questions
All questions carry equal marks

1. Define estuary. Discuss physico- chemical features of typical estuary and add a note on Hoogly-Maltah estuary.

Or

2. Write an account on aquatic pollution.

3. Justify sea as a biological environment.

Or

4. Discuss in detail chemistry of the marine environment.

5. Discuss in detail methods of measuring primary production and comment on productivity in relation to fisheries.

Or

6. Explain zooplankton and phytoplankton relationships with suitable theories.

7. Explain adaptations of Nekton with suitable examples.

Or

8. Answer any two

1. Intertidal zonation
2. Adaptations of sandy shore fauna
3. Adaptions of muddyshore fauna

M.Sc. FISHERY SCIENCE

**PAPER -III Taxonomy and Functional Anatomy of Shellfish
and Fin Fish (FS-03)**

(Model Question Paper)

Time: 3 hrs

Max.Marks: 85

Answer any four questions

1. Write an account on the General characters of mollusks with suitable examples.

Or

2. Classification of crustacean up to orders.

3. Write an essay on food and feeding habits of cultured crustaceans.

Or

4. With suitable diagrams describe the Anatomy and histology of digestive system in fishes.

5. Describe the Respiratory organs and mechanism of respiration in Crustacea

Or

6. Structural adaptation of air breathing fishes.

7. Describe the Endocrine organs in crustaceans and their role in reproduction.

Or

8. Reproduction cycle in fishes with reference to spawning seasons and grounds.

M.Sc. Fishery Science

Paper-IV Biosystematics & Taxonomy (FS 04) (Model Question Paper)

Answer all questions.
All questions carry equal marks

Time: 3hrs.

Maximum marks: 85

1. Give an account on basic concepts of Biosystematics

Or

2. Describe the importance and application of Biosystematics

3. What are the new trends in Biosystematics? Explain in detail.

Or

4. What are the future directions in the conservation of diversity ?

5. Give a detailed account on species concepts.

Or

6. Describe the theories of Biological classification.

7. Explain the procedural keys in Taxonomy.

Or

8. What are the operative principles of ICZN ?

M.Sc. Fishery Science

**Paper-IV ICHTHYOLOGY (FS 05)
(Model Question Paper)**

Answer all questions.
All questions carry equal marks

Time: 3hrs.

Maximum marks: 85

1. Describe the structure of neurocranium and visceral skeleton
OR
- 2 Write notes on :
 - i) Form and function of muscles
 - ii) Gas Bladder
3. Describe the different methods of age determination in fishes
OR
- 4 Write an essay on body form and locomotion in fishes
5. Give an account of the process of excretion and osmoregulation in fishes
OR
- 6 Write notes on the following :
 - i) Heart in fishes (ii) Fish blood
7. Describe the parental care in fishes
OR
- 8 Write short notes on :
 - a) Bio-geochemical cycles
 - b) Ecological factors that impinge on lives of fishes

M.Sc. Fishery Science

Paper – VI Capture Fisheries (FS-06) (Model Question Paper)

Time : 3 Hrs.

Max. Marks : 85

Answer All Questions

1. a) Give a detailed account of craft and gear used in both Inland and Marine Fisheries

OR

- 2 b) Write a brief note on :
- i) Fish catch statistics
 - ii) Fisheries of different maritime states of India

3. a) Describe the major river systems of India and add a detailed note on Fish & Fisheries of Ganga river system

OR

- 4 b) Write an account on reservoir fisheries of Andhra Pradesh

5. a) Explain the causes of decline and efforts for revival of Hilsa Fishery

OR

- 6 b) Write a brief account on :
- i) Hoogly – Matlah Estuary
 - (ii) Godavari Estuary

7. a) Give a comparative account of Sardine and Mackerel fishery

OR

- 8 b) Write a brief account on :
- i) Seaweed fishery
 - (ii) Molluscan fishery

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M.Sc. Fishery Science

Paper-VII General and Applied Zoology (FS 07)
(Model Question Paper)

Answer all questions.
All questions carry equal marks

Time: 3hrs.

Maximum marks: 85

1. Explain complementary gene and epistatic gene interactions with suitable examples

Or

2. Explain multi-factorial inheritance with a suitable example

3. Explain the principle and technique of Transmission Electron Microscopy

Or

4. Explain the principle and mechanism of centrifugation

5. Explain the mechanism of transport across cell membranes

Or

6. What is membrane potential - Discuss

7. Give an account of structure and dynamics of microfilaments and microtubules

Or

8. Give an account of regulation of CDK – Cycline activity.

M.Sc. Fishery Science

Paper – VIII Biostatistics, Population dynamics and Remote Sensing (FS-08) (Model Question Paper)

Time : 3 Hrs.

Max. Marks : 85

Answer All Questions
All Questions carry equal marks

1. What is sampling? Explain various sampling methods.

OR

2. What is measure of central tendency? Calculate mean to the following data

X	5 – 10	10 – 15	15 – 20	20 – 25	25 – 30
Y	10	12	15	18	10

3. Explain standard deviation. Calculate standard deviation and coefficient of variation to the following data:

x	5	6	8	10	12
f	10	12	15	18	11

OR

4. Explain correlation. Calculate correlation coefficient to the given data :

X	5	10	15	20	25
Y	3	5	7	9	10

5. What are tests of significance? Explain chi-square test with suitable examples

OR

6. Write notes on the following :

a) Normal distribution (b) Permutations and combinations

7. Write an account on population attributes controlling the population

OR

8. Explain importance of remote sensing in the fishery applications

M.Sc. Fishery Science

**Paper – IX Construction and Management Hatcheries and
Fish Farms (FS-09)**

(Model Question Paper)

Time : 3 Hrs.

Max. Marks: 85

Answer All Questions
All Questions carry equal marks

1. Write an account on construction methods of Nursery, rearing and stocking ponds

Or

2. Write notes on
 - a) Design of Water management system
 - b) Designing sluice grades
3. Write an account on Fifth Hatchery management

Or

4. describe the methods involving construction of Frown Hatcheries
5. describes the use bio fertilizers in Aquaculture practices

Or

6. Describe the role of lime in aquaculture practices
7. Write an account on feeding schedules in Shrimp culture practices

Or

8. Write an account on aquatic weeds and their control.

M.Sc. Fishery Science

Paper – X Freshwater Aquaculture (FS-10) (Model Question Paper)

Time: 3 Hrs.

Max.Marks: 85

Answer All Questions
All Questions carry equal marks

1. Write an account on productivity of Fish ponds
- Or
2. Compare the methods of bund breeding and induced breeding in Finfish.
3. Describe the various methods of culture of Indian major crops
- Or
4. Write an account on the breeding and culture of exotic carps
5. Describe the culture techniques of freshwater Eel
- Or
6. Describe the life cycle and breeding behavior of Heteropneustis and Clarius
7. Describe the natural seed resources of freshwater prawn with a note on its life cycle
- Or
8. What is meant by integrated farming? describe the method with reference to paddy cum fish culture in India..

M.Sc. Fishery Science

Paper – XI Coastal Aquaculture (FS-11) (Model Question Paper)

Time: 3 Hrs.

Max.Marks: 85

Answer All Questions
All Questions carry equal marks

1. Compare different types of shrimp culture practices in India
- Or
2. Describe the role of salinity, temperature and PH in brackish water shrimp and fish culture
3. Describe the methods involved in transportation of shrimp seed
- Or
4. Write an account on Crab culture practices
5. Describe the methods involved in Seed production of lobsters
- Or
6. Describe the methods involved in brackish water fish culture
7. Write an account on Pearl oyster culture and pearl production
- Or
8. Describe the protein requirements and its role in feed formulation in shrimps

M.Sc. Fishery Science

Paper – XII Fin fish and Shellfish Pathology (FS-12 (Model Question Paper)

Time: 3 Hrs.

Max.marks: 85

Answer All Questions
All Questions carry equal marks

1. Explain disease problems which we commonly encounter in aquaculture field
- Or
2. Give an account of pathology, clinical signs, symptoms and prophylaxis of Infections Pancreatic Necrosis
3. Give an account of Etiology, clinical symptoms and prophylaxis of columnaris disease in fishes
- Or
4. Give an account of clinical symptoms and prophylaxis of shrimp fungal diseases
5. Give an account of clinical signs, pathology and prophylaxis of whirling disease
- Or
6. Give an account of infections caused by monogenetic trematodes in fishes
7. Give an account of diseases caused by the deficiency of nutrition
- Or
8. Explain various management practices adopted for managing disease problems in shrimps and fishes.

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Paper – XIII Fish Immunology (FS-13) (Model Question Paper)

Time: 3 Hrs.

Max. Marks : 85

Answer All Questions
All Questions carry equal marks

1. Give an account of immunological organs with suitable diagrams
- Or
2. Explain fish pathogens interactions with suitable examples
3. Explain the mechanisms of specific and non-specific immunity with suitable diagrams
- Or
4. Explain the structure of and function of Ig M molecular with appropriate diagrams
5. Explain cell – mediated immune response with suitable diagrams
- Or
6. How toxicants modulate immune responses in fishes - Explain.
7. Give an account of various immunization procedures adopted for immunization
- Or
8. Give an account of the various types of vaccines used to maintain fish health.

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Paper-XIV Fish Physiology, Nutrition and Biochemistry (FS-14) (Model Question Paper)

Answer all questions.

All questions carry equal marks

Time: 3hrs.

Maximum marks: 85

1) Explain osmoregulation in fishes.

Or

2) What is biological oxidation? Describe the oxidation reduction reactions in electron transport system.

3) Write an account on neurosecretory system of crustaceans.

Or

4) Describe the structure and physiology of pituitary gland of fish.

5) Discuss the nutritive value of fish.

Or

6) Explain various types of nutrition among invertebrates.

7) Give an account on the classification of proteins and add a note on their functions.

Or

8) What are lipids? Classify them giving suitable examples and their presence in different organs.

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**Paper-XV: Genetics, Molecular Biology and Biotechnology
(FS-15)
(Model Question Paper)**

Answer all questions.

All questions carry equal marks

Time: 3hrs.

Maximum marks: 85

1) Explain the structure of DNA and add a note on its replication.

Or

2) Describe the gene structure and discuss its functions in detail.

3) What is recombinant DNA technology? Explain its applications.

Or

4) Write a detailed account on blotting techniques.

5) What is induced breeding? Describe the application of the technique in fishes.

Or

6) Give an account on vaccine production and development in animals.

7) Discuss the application of genetic engineering in fishes with particular reference to gene transfer and hybridization.

Or

8) What are transgenic fish? Explain microinjection technique in fishes.

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PAPER -XVI: Fishery Education, Extension and Economics of Aquaculture (FS XVI)

(Model Question Paper)

Answer any four questions

MaxMarks: 85

1. Write an account on Fisheries training institutes and Research organizations in India.

Or

2. Give an account on Institutional funding to aquaculture.
3. Describe in detail about a the Socio – economic conditions of fishermen.

Or

4. In which way co-operative societies are useful in uplifting fisherman
5. Define and describe the central government upliftment of fishes folk through NABARD.

Or

6. Ocean role of NGO's CRZ.
7. Write an account on Economics of aquaculture.

Or

8. Short notes:
 - a. Institutional funding to fisheries
 - b. Role of state government agencies in fishery activities.
 - c. ICZM (Integrated Coastal Zone Management)