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Department of Zoology

Andhra University **Dt. 9th November, 2020**

VISAKHAPATNAM – 530 003

To

The Principal

College of Science and Technology

Andhra University

Visakhapatnam

Sir,

 Sub: Submission of Syllabus (4 units) for M.Sc. Zoology and M.Sc.

 Fishery Science (3rd Semester) courses – reg.

 With reference to the subject mentioned above, I am herewith submitting one soft copy and one hard copy of the Syllabus (syllabus with all four units) for M.Sc. Zoology and M.Sc. Fishery Science (3rd Semester) courses for placing it in the Website of Andhra University, with a note to the students that the last 4th unit in the syllabus is meant for assignment preparation as a part of 2nd Mid-semester examination.

 Thanking You

Yours Sincerely

 (U. Shameem)

 Chairperson, BOS

**ANDHRA UNIVERSITY**

**DEPARTMENT OF ZOOLOGY**

**M. Sc. Zoology – III Semester - SYLLABUS (4 units)**

 **Paper 13: COMPARATIVE ANATOMY AND FUNCTIONAL ORGANIZATION**

 **OF INVERTEBRATES AND VERTEBRATES**

**Unit – I :**

1.0. Origin of coelom

 1.1. Acoelomates, Pseudocoelomates

 1.2. Coelomates: Prostomidia and Deuterostomidia

2.0. Excretion

* 1. Organs of excretion: Coelom, Coelomoducts, Nephridia and Malphigian tubules.
	2. Mechanism of excretion.

**Unit – II :**

3.0. Invertebrate larvae

 3.1. Larval forms of free living invertebrates, Annelida, Arthropoda, Mollusca

 and Echinodermata- structural organization and salient features.

 3.3. Strategies and Evolutionary significance of larval forms.

1. Minor Phyla.

 4.1. Concept & significance

 4.2. Organization and general characters – Rotifera, Chetognatha.

**Unit – III :**

5.0. Vertebrate integument and its derivatives

5.1. Development, general structure and function of skin and its   derivatives

5.2. Glands, scales, horns, claws, nails, hoofs, feathers and hairs

6.0. General plan of circulation in various groups

 6.1. Blood

 6.2. Evolution of heart

 6.3. Evolution of aortic arches and portal systems

**Unit – IV:**

7.0. Nervous system and Urino-genital system.

 7.1. Evolution of urino-genital system in vertebrates.

 7.2. Comparative anatomy of the brain in relation to its functions.

 7.3. Nerves-cranial, peripheral and autonomous nervous systems.

8.0. Electric organs & Receptors.

 8.1. Simple receptors- types of Receptors, Primary and secondary receptors.

 8.2. Chemoreception- Organs of Olfaction and taste

 8.3. Lateral line system and lateral line organs of fish- Neuromast organs.

 8.4. Electric organs & Electroreception- Ampullary and Tuberous receptors.

**Practical:**

1. Nervous system : Sepia / Loligo

2. Mounting: Nephridium and Spermatotheca in Earthworm.

3. Respiratory system : Mounting of Gills in prawns.

4. Appendages- Mounting of appendages in prawns.

5. Dissections : Trichiurus- Lateral line nervous system, VII, IX, X cranial nerves.

6. Scoliodon – Mounting of Placoid scales.

7. Channa-Digestion, Reproductive, Arterial, venous systems.

8. Weberian ossicles of catfish.

9. Museum specimens of minor phyla Phoronis, Dendrostoma, Aurelia – Planula

10. Nauplius, Zoea, Mysis, Phyllosoma, Trilobite larvae of Limulus, Antion, Velliger, Bipinaria, Ophio and Echinopluteus, Auricularia, Tornaria, Trochophore.

11. Types of vertebrae of Procoelus, Opisthocoelus, Amphicoelus, Amphiplatins, Heterocoelus, Axis and atlas vertebrae.

**Suggested Reading Material :**

1. Hyman, L.H. The invertebrates. Vol.2-8 Protozoa through Ctenophora, McGraw Hill Co., New York.

2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London.

3. Barnes, R.D. Invertebrate Zoology. III Edition. W.B. Sanuders Co., Philadelphia

4. Russel-Hunter, W.D.A. Biology of higher invertebrates. The Macmillan Co. Ltd., London.

5. Sedgwick, A.A. Student textbook of Zoology. Vol.II and III. Central Book Depot. Allahabad.

6. Parker, T.J., Haswell, W.A. Textbook of Zoology, Vol. 1 & 2 Macmillan Co., London.

7. Alexander, R.M. The Chordata. Cambridge University Press,Lond.

8. Barrington, E.J.W. The biology of Hemichordata and protochordata. Oliver and Boyd, Edinborough.

9. Eecles, J.C. The understanding of the brain. McGraw Hill Co., New York and London.

10. Kingsley, J.S. Outlines of comparative autonomy of vertebrates. Central Book Depot, Allahabad.

11. Kent, C.G. Comparative anatomy of vertebrates.

12. Malcom Jollie. Chordata morphology. East-West Press Pvt. Ltd.,

13. Milton Hilderbrand. Analysis of vertebrate structure. IV Ed. John Wiley and Sons Inc., New York.

14. Monieli A.R. The chordates. Cambridge University Press, London.

15. Smith, H.S. Evolution of chordate structure. Hold Rinehart and Winstoin Inc., New York.

16. Sedwick, A.A. Students textbook of Zoology, Vol.II.

17. Tansley, K. Vision in vertebrate. Chapman and Hall Ltd., London.

18. Walters, H.E. and Syles, L.D. Biology of vertebrates. Macmillan & Co., New York.

19. Wolstenholnf, E.W. and Knight, J. (Ed.). Taste and smell in vertebrates. J & A Churchill, London.

20. Romer, A.S. Vertebrate Body, III Ed. W.B. Saunders Co., Philadelphia

21. Young, J.Z. Life of vertebrates. The Oxford University Press, Lond

22. Colbert, E.H., Evolution of the vertebrates. John Wiley and Sons Inc., New York.

23. Messers, H.M. An introduction of vertebrates anatomy

24. Montagna, W. Comparative anatomy. John Wiley and Sons Inc.

25. Waterman, A.J. Chordata structure and function. Macmillan Co., New York.

26. Joysey, K.A. and T.S. Kemp. Vertebrate evolution. Oliver & Boyd, Edinborough.

27. Lovtrup, S. The phylogeny of vertebrate. John Wiley & Sons, London.

**ANDHRA UNIVERSITY**

**DEPARTMENT OF ZOOLOGY**

**M. Sc. Zoology – III Semester - SYLLABUS (Complete)**

**Paper 14: POPULATION ECOLOGY & ANIMAL BEHAVIOUR**

**Unit – I:**

1.0 Population group properties- population dispersion- population density – estimation of fish population density - natality- mortality- age structure- age pyramids- survival ship curves- Biotic potential- environmental resistance – carrying capacity.

1.1 Population regulation- density dependent factors- density independent factors- effects of increased numbers- harmful effects- beneficial effects

1.2 Population – Inter-specific relationships – Positive interactions – Commensalism- Mutualism – Negative interactions – Predation – Parasitism – Antibiosis

**Unit II**

2.0 Population growth – Assumptions of Logistic and exponential growth models – population fluctuations –population cycle- -Lotka- Volterra equations.

* 1. Demography – Life Tables – Net Reproductive rate- Reproductive strategies.
	2. Habitat and Ecological Niche – Ecological Equivalents – Community concept – Community dominance – Ecotone – Community composition.

**Unit – III :**

3.0 Animal psychology – classification of behavioural patterns, analysis of behaviour (ethogram)

3.1. Innate behaviour.

4.0. Ecological & Social aspects of behaviour

4.1. Habitat selection, food selection, Optimal foraging, theory, antipredator defenses.

4.2. Aggression, homing, territoriality, dispersal, Schooling in fishes, flocking in birds, herding in mammals

4.3. Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness

4.4 Social organization in insects and primates

**Unit – IV :**

5. 0. Biological rhythms

 5.1. Circadian and circannual rhythms

 5.2. Orientation and navigation

 5.3. Migrations of fish, turtle and birds

6.0. Perception of the environment & communication

 6.1. Mechanical

 6.2. Chemical

 6.3. Auditory

 6.4. Visual.

**Practical:**

1. Enumeration and identification of phytoplankton & Zooplankton.

 2. Enumeration of phytal fauna & Rocky shore fauna.

 3. Creation of Life Tables

 4. Calculation of net reproductive rate (Ro), Generation time (T), Rate of intrinsic growth and optimal age for sexual maturity.

 5. Calculation of logistic and exponential growth of a given Population.

 6. An introduction to animal behaviour – Animal Psychology – Classification of behavioural patterns

 7. Perception of the environment – Examples

 8. Communication – Examples from invertebrates and vertebrates (Terrestrial, Aerial, Aquatic habitats)

 9. Ecological aspects – Food selection, optimal foraging, prey and predator.

 10. Social behaviour – Aggregations – Examples from fishes, birds and mammals, social organization - insects

 11. Reproductive behaviour – mating systems, sexual selection, parental care

 12. Biological rhythms – examples – migration of fish, turtle and bird.

**Suggested Reading Material :**

1. Begon, M., J.L. Harper and C.R. Townsend. Ecology, Individuals, Populations and Communities. Blackwell Science, Oxford, UK.

2. Koromondy, E.J. Concepts of ecology. Prentice Hall, New Delhi.

3. Clarke, G.L. Elements of Ecology, John Wiley & Sons, New York.

4. Odum, E.P. Fundamentals of Ecology. W.B. Saunders, Philadelphia.

5. Krebs, C.J. Ecology. Harper & Row, New York.

6. Jorgensen, S.E. Fundamentals of Ecological modeling. Elsevier, New York.

7. Alocock, J. Animal behaviour : An evolutionary approach. Sinauer Assoc., Sunderland, Mass, USA

8. Bradbury, J.W. and S.I. Vehrencamp, Principles of animal communication.

9. Clutton-Brock, T.H. The evolution of parental care. Princeton Univ. Press, Princeton, N.J., USA.

10. Eibl-Eibesfeldt, I. Ethology. The biology of behaviour. Holt, Rinehart & Winston, New York.

11. Gould, J.L. The mechanisms and evolution of behaviour.

12. Hauser,M. The evolution of communication. MIT Press, Cambridge, Mass, USA.

13. Hinde, R.A. Animal behaviour : A synthesis of ethology and comparative psychology. McGraw Hill, New York.

14. Krebs, J.R. and N.B. Davies. Behavioural ecology. Blackwell, Oxford, UK.

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**DEPARTMENT OF ZOOLOGY**

**M. Sc. Zoology – III Semester - SYLLABUS (Complete)**

**Paper 15: Immunology and Immuno-Technology**

**Unit I**

1. **Immune System**

1.1 Historical perspective, Scope and over view of Immune System

1.2 Cells and Organs of the Immune System

1.3 Primary and Secondary Lymphoid organs

* 1. Cells of the Immune system
1. Types of Immunity
	1. Innate Immunity
	2. Acquired Immunity
2. Antigens and Super-antigens
	1. Immunogenecity, Antigenecity and factors effecting immunogenecity
	2. Epitopes and Haptens and Super-antigens.

**Unit II**

**4. Antibodies – Structure and Function**

 4.1 Gross and Fine structure of Immunoglobulin molecule

 4.2 Antibody Classes and their effector functions

 4.3 Monoclonal antibodies - Hybridoma Technology

 **5.** Antigen – Antibody reactions and Diagnostic Procedures

 5.1 Ag. – Ab. binding mechanisms

5.2 Ag. – Ab. reactions – Precipitation, Agglutination, Immuno-

 diffusion, ELISA, RIA, Immuno- - fluorescence.

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**Unit III**

 **6.0** Major Histocompatibility Complex

 **6**.1 MHC - Haplotypes

 6.2 MHC molecules – Class I and Class II types, their Molecular Structure and function.

6.3 MHC – Immune responsiveness and disease susceptibility

 **7.0 T**- Cells - Maturation, activation and differentiation

 7.1 T-Cell maturation and Thymus

 7.2 TH – Cell activation and differentiation

 7.3 Effector Cells and Mechanism of Action: TDTH, CTLs and NK cells

 **8.0** B- Cells: Development, Activation and Differentiation

 9.1 B-Cell activation and Proliferation

 9.2 TH – B- Cell interaction

9.3 Humoral Immune response – Kinetics

**Unit – IV**

**10.0 Hypersensitivity Reactions**

 10.1 Gell and Coombs Classification

 10.2 IgE Mediated (Type I) and Ab - mediated (Type II) Hypersensitivity Reactions

* 1. Immune - complex mediated (Type III) and TDTH mediated (TypeIV) Hypersensitivity Reactions.

 **11.0 Immunology and Health**

11.1 Immunodeficiency Diseases

11.2 Autoimmunity

**Practical:**

1. Lymphoid organs in Rat and chick - Dissection

2. Lymphoid organs – Histology slides

3. Cells – Differential count of blood cells – Staining with Giemsa

4. Lymphocyte separation – Gradient methods

5. Antigen – Antibody reactions – Kits

 a) Determination of blood groups

 b) Diagnostic test for typhoid/ Test for HBS Ag

 c) Quantitative precipitin assay teaching kit

**Suggested Reading Materials :**

1. Kuby, W.H., Freeman, Immunology, USA

2. W. Paul, Fundamentals of immunology

3. I.M. Roitt, Essential immunology, ELBS ion.

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**DEPARTMENT OF ZOOLOGY**

**M. Sc. Zoology – III Semester - SYLLABUS (Complete)**

**Paper 16: MOLECULAR BIOLOGY AND CYTOGENETICS**

**Unit – I :**

1. **Biology of chromosomes**
	1. Molecular anatomy of eukaryotic chromosomes
	2. Metaphase chromosome: centromere, kinetechore, telomeres and its maintenance.
	3. Heterochromatin and euchromatin
	4. Giant chromosomes: polytene and lampbrush chromosomes.

1. **DNA structure, Replication and Repair**

2.1. Structure of DNA

2.2. Prokaryotic and Eukaryotic DNA replication – mechanism.

2.3. Enzymes and accessory proteins involved in DNA replication.

**Unit – II :**

3.0. Transcription

 3.1. Prokaryotic Transcription

 3.2. Eukaryotic Transcription.

 3.3. Types and Molecular structure of RNA – m RNA, t RNA, r RNA.

3.4. RNA Polymerases

3.5. Post-transcriptional modifications

4.0. Translation

 4.1. Genetic Code

 4.2. Prokaryotic and eukaryotic Translation

 4.3. Mechanism of initiation, elongation and termination.

 4.4. Regulation of translation.

 4.5. Antisense and Ribozyme technology

**Unit – III :**

1. Linkage map & Cytogenetic mapping.
	1. Physical maps and molecular maps.
	2. Strategies of different levels of genome mapping.
2. **Genetics of cell cycle.**
	1. Genetic regulation of cell division in Eukaryotes.
	2. Molecular basis of Neoplasia.

**Unit – IV :**

1. **Human cytogenetics**
	1. Human karyotype-banding-nomenclature – molecular cytogenetic approach.
	2. Numerical and structural abnormalities of human chromosomes- syndromes- cytogenetic implications.
2. **Techniques in human chromosome analysis - Molecular cytogenetic techniques.**
	1. FISH
	2. DNA finger printing.
	3. Flow cytometry.

**Practical :**

1. Fuelgen reaction method for DNA localization
2. Localization of RNA by methylgreen pyronin – ‘Y’
3. Polytene chromosomes, Lampbrush chromosomes – banding *–*slides.
4. Human chromosomes – karyotyping
5. Numerical and structural abnormalities of human chromosomes- syndromes.
6. Polymerase chain reaction – demonstration.
7. RELP analysis- demonstration.

**Suggested Reading Material :**

1. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular Biology of cell. Garland Publishing Inc., New York

2. Meyers, R.A. (Eds.) Molecular Biology and Biotechnology : A comprehensive desk reference. VCH Publishers Inc. New York.

3.David Freifeldes, “Molecular Biology”, publishing Jones and Bartlett publishers, Inc.

4.Brown, T. A (eds) Molecular Biology lab Fax. Bioscientific publishers Ltd., Oxford.

5. Daber, P.D. Introduction to practical Molecular Biologyu. John Wiley & Sons, Ltd,

6.Atherly A.G., J.F. Girton and J.F. Mc Donald. The Science of genetics. Saunders college publishing. Harcourt Brace College publishers,NY.

7.Fairbanks, D. J. and W. R. Anderson. Genetics – the continuity of life. Brooks/ Cole Publishing Company, TTP, NY, toranto.

8.Gardner, E.J., M.J.Simmons & D.P.Snustads. Principles of genetics, John Wiley & sons

9.Griffith, A.J.f., J.H. Miller, D.T. Suziki, R.C. lewontin and W.M. Gellbart. An inrtodution to genetic analysis. W.H. Freeman and Company, New York.

10. J. D. Watson, N. h. Hopkins, J. W. /Roberts, J. A. Steitz and A. M. Weiner. Molecular Biology of Gene. The Benjamin/ Cummings Pub. Co. Inc., California.

11.Benjamin Lewin. Genes VI. Oxford University Press, U.K.

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**DEPARTMENT OF ZOOLOGY**

**M. Sc. Fishery Science – III Semester - SYLLABUS (Complete)**

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

**Unit – I**

1. Construction of fish farm: Selection of sites – Criteria and 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. Hepher, 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.

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**DEPARTMENT OF ZOOLOGY**

**M. Sc. Fishery Science – III Semester - SYLLABUS (Complete)**

**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, criteria involved in species selection for Aquaculture, Productivity of

 fishponds.

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.

**ANDHRA UNIVERSITY**

**DEPARTMENT OF ZOOLOGY**

**M. Sc. Fishery Science – III Semester - SYLLABUS (Complete)**

**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.

**ANDHRA UNIVERSITY**

**DEPARTMENT OF ZOOLOGY**

**M. Sc. Fishery Science – III Semester - SYLLABUS (Complete)**

**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) IHHNV, (e) White spot syndrome (WSSV), Taura Syndrome virus (TSV), Early Mortality syndrome (EMS) and other viral diseases of lower incidence.

**Unit – II:**

4. **Bacterial diseases of fish**: Etiology clinical symptoms, pathology and prophylaxis of common bacterial diseases – (a) Bacterial Heamorrhagic Septicemia, (b) Bacterial gill disease and (c) Columnaris disease.

5. **Bacterial diseases of shrimp**: Etiology, clinical symptoms, pathology and prophylaxis of common bacterial diseases – (a) Vibriosis, (b) Shell disease, (c) Black spot disease, (d) Red disease.

6. **Fungal diseases of Fish**: Clinical picture, clinical symptoms and pathology and

 prophylaxis of (a) Branchiomycosis, (b) Saprolegniasis (c) EUS.

7. **Fungal diseases of shrimp**: Clinical picture, symptoms, pathology and prophylaxis of some common shrimp fungal diseases.

**Unit – III:**

8. **Protozoan diseases of Fish**: Morphology, life cycle, Clinical picture, pathology,

 symptoms and prophylaxis of common protozoan diseases (a) Nodular

 coccidiosis, (b) Entero - coccidiosis, (c) Whirling disease, (d) Ichtythyophthirius

 **Protozoan diseases of shrimp**: Morphology, life cycle, Clinical picture, pathology,

 Symptoms and prophylaxis of common protozoan diseases

9. **Metazoan parasites of Fish**: Morphology, life cycle, Clinical picture, pathology, symptoms and prophylaxis of common metazoan diseases (a) Monogenetic parasites (Dactylogyrus and Gyrodactylus); (b) Digenetic trematodes (trematode larvae and Diplostomid metacercaria), (c) Cestode parasites (*Ligula* and *Dibothriocephalus latus*), (d) Nematode parasites (Gastro -intestinal ascaridatosis) (e) Fish leeches- Hiridinosis - Piscicolidae

**Metazoan parasites of shrimp**: Morphology, life cycle, Clinical picture, pathology, symptoms and prophylaxis of some common diseases

**Crustacean parasites of Fish**: Morphology, life cycle, Clinical picture, pathology, symptoms and   prophylaxis of common diseases – (a) *Argulus, Ergasilus* and  *Lernea*

**Unit – IV:**

10. Diseases of fish due to Environmental stress: Thermal stress; O2 deficiency stress due to pH variations; Gas bubble disease

Diseases of fish due to Nutritional Imbalance: Avitaminosis, Protein deficiency, Starvation, Inflammation of the stomach and Intestine.

11. Diseases caused by other factors: Hereditary factors, Tumors’ – benign and malignant tumors, Epithelial tumors and Mesenchymal tumors.

12. Environmentally induced and nutritional deficiency diseases of shrimps.

**Reference Text Books:**

1. Cheng, T.C: The Biology of Animal Parasites. Saunders, Philadelphia, 1964.

2. Wedemeyer: Enivironmental 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.