

DEPARTMENT OF ZOOLOGY & AQUACULTURE

M.Sc. AQUACULTURE - SYLLABUS

(With effect from 2023-2024 admitted batch)

Objectives of the Course:

- i. To enrich the students' theoretical knowledge in basic, core and specialized papers of zoology and Aquaculture to develop competency in research in the field of zoology and aquaculture.
- ii. To train the students with hands on experience and enhance their critical thinking, constructive planning and analytical skills.
- iii. To train the students to acquire advanced laboratory skills required for placements.

Proposed Regulations:

1. The duration of the course is for two academic years with total four semesters. The nature of the course is full-time.

Candidates for the degree of Master of Science in Zoology & Aquaculture, shall be required to have passed the B.Sc. with zoology as one of the Subjects.

2. Intake for M.Sc. Zoology & Aquaculture each course is 36 (30 Counseling seats + 6 Management seats).
3. Mode of admission is through (APPGCET) common entrance examination and admissions through Counseling.
4. The course and scope of instruction shall be as defined in the syllabus prescribed. (Annexure-III).
5. The course will be conducted on credit system and evaluation will be on Ten point grading system (Annexure-II).
6. Candidate shall be required to take examinations at the end of each semester as specified in Annexure-I.
8. The course will be evaluated and the students will be graded on ten point scale with seven letter grades i.e., **O, A⁺, A, B⁺, B, C, P, and F**. A candidate shall be declared to have passed in any paper if he /she secures not less than 'P' grade in theory and not less than 'C' grade in the practicals provided the result otherwise is withheld .There is no minimum pass marks for internal assessment marks both in theory and practicals.
9. The minimum pass marks for Semester end examination is 28 (40%) and there is no minimum marks for internal examination. Candidate should get a total of 28 marks (40%) in both internal and external examinations put together. Further a candidate has to secure a minimum of 5.0 SGPA for a pass in each Semester.

10. A candidate shall be deemed to have satisfied the minimum requirement for the Award of the M.Sc. Zoology Degree.

i) If he/she is declared to have passed all the papers included in the scheme of examination

ii) If he/she secures 5.0 CGPA by the end of the fourth semester.

Further, a candidate will be permitted to choose any paper(s) to appear for improvement in case the candidate fails to secure the minimum prescribed SGPA/CGPA to enable the candidate to pass at the end of any semester examinations.

There shall not be any provision for the improvement of internal assessment marks in any theory or practical subjects in any year /semester of study.

11. The successful candidates in the M.Sc. degree examination shall be arranged in the order in which they are registered for the examination in two classes on the basis of the CGPA

Distinction – CGPA 7.0 or more

I Class – CGPA 6.0 or more but less than 7.0

II Class/Pass – CGPA 5.0 or more but less than 6.0

12. The Question paper will be set by external paper setters of other Universities and the valuation of the answer scripts will be done by External examiners at the end of each semester.

13. The practical examinations will be conducted and valued by both internal and external examiners at the end of each semester. The Project viva- voce examination will be conducted by both internal and external examiners at the end of the IV semester

14. Each practical paper carries 50 marks for external evaluation process in which both the internal and external examiners conduct the examination.

15. The Minimum attendance of 75% in theory and completion of 90% of the practical prescribed for the course is necessary for a student to qualify to attend the Semester End Examination. The Principal is authorized to condone the shortage of attendance in theory papers in deserving cases on recommendation of the Head of the Department, by collecting prescribed fee. However, the student should have to put in a minimum attendance of 65% in aggregate of the total number of instructional days in theory classes.

Annexure-I

M.Sc. ZOOLOGY & AQUACULTURE

SCHEME OF INSTRUCTION AND EXAMINATION

Semester – I

Paper / Paper Code	Title of the Paper	Instruction Hours Per Week			Credits	Evaluation			Total Marks
		L	T	P		CIA Marks	SEE		
							Marks	Duration	
Paper-I 23ZAQT11	Tools and Techniques for Biology	4	--	--	4	30	70	3 hours	100
Paper-II 23ZAQT12	Biosystematics, Biodiversity and Evolution	4	--	--	4	30	70	3 hours	100
Paper-III 23ZAQT13	Biomolecules	4	--	--	4	30	70	3 hours	100
Paper-IV 23ZAQT14	Molecular Cell Biology	4	--	--	4	30	70	3 hours	100
Practical-I 23ZAQP15	Tools and Techniques for Biology Lab	--	--	3	2	15	35	3 hours	50
Practical-II 23ZAQP16	Biosystematics, Biodiversity and Evolution Lab	--	--	3	2	15	35	3 hours	50
Practical-III 23ZAQP17	Biomolecules Lab	--	--	3	2	15	35	3 hours	50
Practical-IV 23ZAQP18	Molecular Cell Biology Lab	--	--	3	2	15	35	3 hours	50

CIA – Continuous Internal Assessment, **SEE** – Semester End Examination

Semester – II

Paper / Paper Code	Title of the Paper	Instruction Hours Per Week			Credits	Evaluation			Total Marks
		L	T	P		CIA Marks	SEE		
							Marks	Duration	
Paper-I 23ZAQT21	Biostatistics & Bio-informatics	4	--	--	4	30	70	3 hours	100
Paper-II 23ZAQT22	Animal Physiology	4	--	--	4	30	70	3 hours	100
Paper-III 23ZAQT23	Immunology	4	--	--	4	30	70	3 hours	100
Paper-IV 23ZAQT24	Molecular Biology	4	--	--	4	30	70	3 hours	100
Practical-I 23ZAQP25	Biostatistics & Bio-informatics Lab	--	--	3	2	15	35	3 hours	50
Practical-II 23ZAQP26	Animal Physiology Lab	--	--	3	2	15	35	3 hours	50
Practical-III 23ZAQP27	Immunology Lab	--	--	3	2	15	35	3 hours	50
Practical-IV 23ZAQP28	Molecular Biology Lab	--	--	3	2	15	35	3 hours	50

CIA – Continuous Internal Assessment, **SEE** – Semester End Examination

Semester – III

Paper / Paper Code	Title of the Paper	Instruction Hours Per Week			Credits	Evaluation			Total Marks
		L	T	P		CIA Marks	SEE		
							Marks	Duration	
Paper-I 23AQCT31	Concepts Of Aquatic Ecology	4	--	--	4	30	70	3 hours	100
Paper-II 23AQCT32	Principles Of Aquaculture	4	--	--	4	30	70	3 hours	100
Paper-III 23AQCT33	Nutrition And Feed Technology	4	--	--	4	30	70	3 hours	100
Paper-IV 23AQCT34	Water Quality Management Lab	4	--	--	4	30	70	3 hours	100
Practical-I 23AQCP35	Concepts Of Aquatic Ecology Lab	--	--	3	2	15	35	3 hours	50
Practical-II 23AQCP36	Principles Of Aquaculture Lab	--	--	3	2	15	35	3 hours	50
Practical-III 23AQCP37	Nutrition And Feed Technology Lab	--	--	3	2	15	35	3 hours	50
Practical-IV 23AQCP38	Water Quality Management Lab	--	--	3	2	15	35	3 hours	50

CIA – Continuous Internal Assessment, **SEE** – Semester End Examination

Semester – IV

Paper / Paper Code	Title of the Paper	Instruction Hours Per Week			Credits	Evaluation			Total Marks
		L	T	P		CIA Marks	SEE		
							Marks	Duration	
Paper-I 23AQC41	Aquaculture	4	--	--	4	30	70	3 hours	100
Paper-II 23AQCT42	Fish Processing Technology	4	--	--	4	30	70	3 hours	100
Paper-III 23AQCT43	Fish Pathology	4	--	--	4	30	70	3 hours	100
Paper-IV 23AQCT44	Aquaculture Biotechnology	4	--	--	4	30	70	3 hours	100
Practical-I 23AQCP45	Aquaculture Lab	--	--	3	2	15	35	3 hours	50
Practical-II 23AQCP46	Fish Processing Technology Lab	--	--	3	2	15	35	3 hours	50
Practical-III 23AQCP47	Fish Pathology Lab	--	--	3	2	15	35	3 hours	50
Practical-IV 23AQCP48	Aquaculture Biotechnology Lab	--	--	3	2	15	35	3 hours	50
Project 23AQCP49	Project work & Viva				4				100

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

FIRST SEMESTER M.Sc. AQUACULTURE

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(With effect from 2023-24 Admitted batch)

23ZAQT11 TOOLS AND TECHNIQUES FOR BIOLOGY

UNIT – I

Assays- Chemical and Biological assay, Centrifugation, Working Principle and applications of Centrifugation; differential and density gradient centrifugation, Ultrafiltration. Electrophoresis – Electrophoresis, Agarose Gel electrophoresis, 2- D Electrophoresis working Principle, structural components and applications of electrophoresis. pH meter: Operation of pH electrodes, Principles and applications of Ion-selective and gas sensing electrodes.

UNIT-II

Chromatography-Working Principle and applications of chromatography, Chromatography Planar chromatography (paper & TLC), Gas Chromatography (GC-MS), High Performance Liquid Chromatography (HPLC), and LC-MS. Spectrophotometer - UV-visible, fluorescence, circular dichroism, absorption spectrophotometry principles and applications, NMR and ESR spectroscopy.

UNIT – III

Microscopy - Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells. Principle and applications of different types of microscopes - Light, Phase Contrast, Fluorescence microscopy. Electron microscopy: SEM, TEM and Atomic force microscopy (AFM). Image processing methods in microscopy: Image acquisition- 2D image techniques- 3D image techniques- Analysis.

UNIT – IV

Microtomy- Working principle and different types of Microtomes. Knives and Blades. Tissue embedding (paraffin wax), Section cutting, Flootation (water bath), slide mounting, drying (oven or hot plate) and section adhesives. Applications of microtomy in biological studies: Traditional Histology Technique-Frozen section procedure- Electron Microscopy Technique- Spectroscopy Technique. Cryotechniques- History and applications of Cryotechniques for light and electron microscopy. Different fixation and staining techniques for EM, freeze-etch and freeze fracture methods for EM.

UNIT-V:

Media preparation & Sterilization, Inoculation and growth monitoring. Biochemical Mutants and their use, Microbial assays.

Suggested Readings

1. Principles and Techniques of Biochemistry and Molecular Biology, Wilson K and Walker J.M. Cambridge University Press
2. Biophysical & Biochemical Techniques, Wilson K and Walker J.M.,
3. Laboratory Exercises and techniques in Cellular Biology, Anthony Contan to Wiley Publ.2012
4. Histological & Histochemical methods: Theory and Practice, Kiernan J.A. Scion Publ.
5. Histochemistry: Pearse A.G.E, Garfield.
6. Animal cell culture - A practical approach, Ed. John R.W. Masters, IRI Press.
7. Introduction to Instrumental Analysis. Robert Braun. McGraw Hill International Edition.
8. A Biologist Guide to Principles and Techniques of Practical Biochemistry. KWilson & K.H. Goulding, ELBS Edition. Student Learning Outcomes: LO1. Student will learn about the basics of most often used tools, techniques, methodologies and methods of analysis used in biological research.

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23ZAQT12 BIOSYSTEMATICS, BIODIVERSITY AND EVOLUTION

UNIT – I

Definition & basic concepts of biosystematics & taxonomy, Importance and applications of biosystematics in biology, Material basis of biosystematics. Theories of biological classification (Essentialism, Nominalism, Empirism, Cladism). Chemotaxonomy; Cytotaxonomy; Molecular taxonomy; Eco - taxonomy and Behavioral taxonomy

UNIT-II

Taxonomic procedures – taxonomic collections, preservation, curation of animals and Process of identification. Preservation of specimens. Taxonomic Keys - Procedure keys in taxonomy, Types, merits & demerits. Systematic publications – different kinds of publications, Process of typification and different Zoological types. International code of Zoological Nomenclature (ICZN) - Operative principles, Interpretation and application of important rules, Zoological nomenclature, formation of scientific names of various taxa. Interpretation of rules of nomenclature.

UNIT – III

Sustainable utilization of Biodiversity - Origin of biodiversity, Types of biodiversity & ecosystem, Threats of biodiversity. Equitable sharing & conservation of Biodiversity (in-situ & ex-situ & gene banks). Genetic Variations & Non genetic Variations - Molecular perspectives on conservation of Biodiversity, Hierarchy of categories.

UNIT – IV

Species Concept - Different species concepts - Typological, Nominalistic, Biological & evolutionary species concept. Sub-species and other infra specific categories, Polytypic species. Speciation – Allopatric, Sympatric & Parapatric speciation, and factors affecting speciation. Concept of Oparin and Haldane. Experiment of Miller. Evolutionary time scale – Eras, Periods and epochs.

UNIT – V

Concepts of evolution – An overview of evolutionary biology, & theories of organic evolution. Concepts of Neutral Evolution, Population genetics- Populations, gene pool, Gene frequency; Hardy Weinberg law. Concepts and rate of change in gene frequency through Natural selection, mutation, migration and random genetic drift. Phylogenetic gradualism, punctuated equilibrium and origin of higher categories.

Suggested Readings

1. M. Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
3. G.G. Simpson, Principle of Animal taxonomy, Oxford IBM Publishing Company.
4. E.O. Wilson. The diversity of Life (The College Edition), W.W. Northern & Co.
5. B.K. Tikadhar, Threatened Animals of India, ZSI Publication Calcutta.
6. Mayr, E. 1969. Principles of Systematic Zoology. McGraw-Hill, N.Y.
7. Mayr, E. 1970. Populations, species and evolution, Cambridge Mass, Harvard Univ. Press.
8. Ferguson, A., 1976. Biochemical systematics and evolution, John Wiley and Sons, N.Y., Toronto.
9. Gote, H.E. 1982. Animal Taxonomy.
10. Mayr, E. & E. Aschhok. 1991. Principles of systematic, McGraw Hill Book Co. London.
11. Minell, A. 1983. Priological systematics, The state of Art champan of Hill, London.
12. Quicke, D.L.J. 1996. Principles and Techniques of contemporary Taxonomy. Blacky Academic and Professional, London, New York.
13. Sebu, R.T. 2000. Biological systematics: Principles & Application, Cornell University Press.

Learning Outcomes: After completion of this course, students are able to

LO1. Classify animals on the basis of their relation to other animals by body structure, external characters,

development and DNA

LO2. Apply the International rules of nomenclature to give a scientific name to animals which are found

during research.

LO3. Understand the gradual development and evolutionary history of different kinds of living organisms

from earlier forms over several generations

LO4. Understand and demonstrate various animals, biodiversity and relate

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23ZAQT13 BIOMOLECULES

UNIT- I

Biomolecules- chemical composition and bonding , chemical reactivity , ionization of water. Weak acids and weak bases (pH) , buffers: buffering in biological systems, Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Principles of bioenergetics – Principles and Laws of thermodynamics, reaction kinetics, colligative properties and their applications in biological system : entropy and enthalpy.

UNIT - II

Chemical foundations of biology, Amino acids – classification, Peptide bond, Proteins – classification, structural organization of proteins, primary structure, secondary structure, tertiary structure, quaternary structure, Conformation of proteins (Ramachandran plot) - domains, motifs and folds. Denaturation & renaturation of proteins.

UNIT - III

Carbohydrates: Definition and classification of carbohydrates, nomenclature, Reaction of Mono-saccharides, Acid derivatives of Mono-saccharides, amino-sugars, Oligo-saccharides, structure and properties, Chemistry and biological roles of homo and hetero-polysaccharides, peptidoglycan, glycosaminoglycans, glycoproteins and other glycoconjugates.

UNIT - IV

Classification of Lipids & Fatty acids and their physicochemical properties, characterization of fats and oil; Structure, properties and biological roles of triacylglycerol, phospholipids, sphingolipids, Gangliosides, Prostaglandins, Thromboxanes, Leukotrienes and steroids.

UNIT - V

Nucleic acids – nitrogen bases, nucleosides, nucleotides, physicochemical properties of nucleic acids, cleavage of nucleic acids by enzymatic and non-enzymatic methods, chemical synthesis of DNA; Nucleic acid sequencing, chromatin structure, Three dimensional structure of DNA; Types of RNA, Structure of RNAs – Secondary and Tertiary structure; DNA denaturation and renaturation.

Suggested Reading Material:1. Nelson.D.L, Cox. M. M. Lehninger's Principle of Biochemistry. Freeman.

2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W. Harper's Biochemistry, McGraw Hill.

3. Fundamentals of Biochemistry by Donald Voet.

4. Textbook of Biochemistry West, E.S., Todd, Mason & Vanbruggen, Macmillian&Co.

5. Biochemistry, Lubert Stryer.

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23ZAQT14 MOLECULAR CELL BIOLOGY

UNIT - I

Biomembranes

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

UNIT - II

Cytoskeleton

Microfilaments and microtubules – structure and dynamics, Microtubules and mitosis Cilia and flagella. Cell movements – intracellular transport, role of kinesin and dynein, signal transduction mechanisms.

UNIT - III

Cell-Cell Signaling

Cell surface receptors, Second messenger system, MAP kinase pathways

Apoptosis: Definition, mechanism and significance

UNIT – IV

Cell-Cell adhesion and communication

Ca⁺⁺ dependent homophillic cell-cell adhesion, Ca⁺⁺ independent homophillic adhesion, Gap junctions and connections, Integrins, Collagen.

Cell cycle : Cyclins and cyclin dependent kinases, Regulation of CDK-cycline activity

UNIT-V

Genome organization, . Hierarchy in organization, Chromosomal organization of genes and non-coding DNA, , Mobile DNA, Morphological and functional elements of eukaryotic chromosomes, Intracellular protein traffic. Protein synthesis on free and bound polysomes, Uptake into ER,

Membrane proteins, Golgi sorting, post-translational modifications, Biogenesis of mitochondria and nuclei, Trafficking mechanisms

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.

I SEMESTER PRACTICALS

23ZAQP15 Tools and Techniques for Biology lab:

1. Spectrophotometer – Estimation of biomolecules
2. Centrifugation – Demonstration and working
3. Separation Techniques - Paper chromatography
4. Electrophoresis – Demonstration and usage
5. PH Meter – Preparation of Phosphate buffer Preparation
6. Microscope –
 - a) Demonstration of oil immersion – WBC & RBC
 - b) Preparation of tissue for SEM & TEM procedure

23ZAQP16 Biosystematics, Biodiversity and Evolution Lab:

1. Invertebrate and Vertebrate Phyla
2. Types of Speciation-Models/Charts
3. Problems on Hardy-Weinberg law
4. Random genetic drift causing change in gene frequency-Practical demonstration.
5. Recent studies in Evolution- Examples

23ZAQP17 Biomolecules lab:

1. Estimation of glycine by formal titration
2. Estimation of proteins by Lowry and Biurett methods
3. Analysis and identification of monosaccharides
4. Estimation of maltose by DNS method
5. Determination of Iodine value of oils
6. Estimation of Cholesterol
7. TLC of Amino acids

23ZAQP18 Molecular cell Biology lab:

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

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SECOND SEMESTER M.Sc. ZOOLOGY & AQUACULTURE

SYLLABUS

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23ZAQT21 BIostatistics & Bioinformatics

UNIT - I

Biostatistics- Introduction and Scope of biostatistics, Sampling. Primary and Secondary data, Frequency distribution, Graphic representation of data- bar diagram, histograms, pie diagram, frequency polygon and Ogive.

UNIT-II

Measures of central tendency- mean, median, mode. Measures of Dispersion- variance, standard deviation, coefficient of variation

UNIT - III

Probability and probability distributions-definition of probability - Bernoulli, binomial, Poisson and normal distributions; Correlation and regression Tests of Significance - hypothesis, critical region and error probabilities, t- test, chi-square test for independence, one way and two- way analysis of variance.

UNIT - IV

Basic components of computers– hardware (CPU, input, output, storage devices), Software (operating systems), Application software; Introduction to MS-EXCEL. Use of bar diagram, histogram, scatter plots, Graphical tools in EXCEL for presentation of data; Introduction to MS- WORD, word processor- editing, copying, moving, formatting, table insertion, drawing flow charts etc; Introduction to Power Point, image and data handling.

UNIT - V

Bio-informatics –Introduction, History, Internet, Knowledge. Review of relevant definitions in molecular biology. Biological Databases –introduction. Examples of databases together with steps involved in use and interpretation of results). Sequence alignment. Phylogenetic analysis with the program PHYLIP, Introduction to computational genomics and proteomics

Suggested Reading Material:

1. Batschelet, E., Introduction to Mathematics for Life Scientists. Springer- Verlag, Berlin.
2. Principles of Biostatistics, Pagano M., Gauvreau, K, (2000), Duxbury Press, USA
3. Murray, J.D. Mathematical Biology. Springer – Verlag, Berlin.
4. T.K. Attwood & D.J. Parry-Smith 1999. Introduction to Bioinformatics. Pearson Education Asia.

5. Stephen Misener & S.A. Krawez 2000. *Bioinformatics: Methods and Protocol*.
6. *Bioinformatics: Sequence and Genome Analysis*, Mount, D. W. (2nd Ed., 2001), Cold Spring Harbor Laboratory Press, New York, USA
7. *Bioinformatics for Dummies*, Claverie J. M., Notredame C., (2nd Ed., 2007), Wiley Publishing, Inc., New York, USA
8. Sokal, R.R. & F.J. Rohlf. *Biometry*. Freeman, San Francisco.
9. Snedecor, G.W. and W.G. Cochran, *Statistical methods for environmental biologists*. John Wiley Sons, New York

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SECOND SEMESTER M.Sc. ZOOLOGY & AQUACULTURE

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23ZAQT22 ANIMAL PHYSIOLOGY

UNIT - I

Muscle: Molecular Structure and properties of Muscle and muscle contraction , Sliding filament theory

Blood and Circulation – Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, Blood groups, Haemoglobin, immunity, haemostasis , factors affecting blood coagulation.

UNIT-II

Nerve impulses , Synaptic transmission & Neurotransmitters, Nervous system : Neurons, action potential, gross neuro anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture

Sensory physiology: Photoreceptors, Auditory, Chemoreceptor, Mechanoreceptors

UNIT - III

Thermoregulation: Comfort zone, body temperature- Physical, chemical, neural regulation, acclimatization.

Osmoregulation in aquatic and terrestrial Environments mechanism of ionic regulation

Stress Physiology: Responses to biotic and abiotic factors: Light, temperature, salts

UNIT – IV

Digestion: absorption, energy balance of BMR

Respiratory system - comparison of respiration in different species, anatomical considerations, transport of gasses, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Excretory System : Comparative physiology of excretion, Kidney, Urine formation, Urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue ECG - its principle and significance, heart as a pump, blood pressure.

UNIT - V

Physiological Adaptation: Marine environment, shores, Estuaries Fresh water and Terrestrial environment

Role of Yoga and meditation on Health.

Suggested Reading Material:

- 1) Eckert, R .Animal Physiology: Mechanisms and adaptation, W .H.Freeman and Company, New York
- 2) Hochackka,P.W. and Somero, G.N.Biochemical adaptation,Princeton,N.J.
- 3) Hoar,W.S.General and comparative Animal physiology prentice Hall of India.
- 4) Schimdt Neisen,Animalphysiology ,Adaptation and Environment,Cambridge.
- 5) Stamd,F.L.Physiology: A regulatory systems approach,Macmillan publishing Co., NewYork.
- 6) Punmer, L.Practical Biochemistry,Tata McGraw-Hill.
- 7) Prosser,C.L. and Brown .Comparative Animal physiology.
- 8) Wilson,K.and Walker, j.Practical Biochemistry.
- 9) Willmer, PIG Sone and I.Johnson, Environmental physiology,BlackWell Science,Oxford, U.K .944p
- 10) Newell,R.C.(ed)1976.Adaptation to environment, Essays on the physiology of marine animals.
Butterworths,London,UK539pp
- 11) Townsend ,C.R and P.Callow, physiological Ecology An evolutionary approach resource use,
Blackwell Sci.publication, Oxford, UK

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

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23ZAQT23 IMMUNOLOGY

UNIT - I

Immunity-innate and acquired, innate immune mechanisms, acute phase reactants, properties of acquired immunity, Immunogens and antigens- Properties, factors governing immunogenicity, haptens, epitopes size and identification. Adjuvants- properties and mechanism of action.

Immunoglobulins- structure, isotypes, allotypes and idiotypes. Functions of antibody in relation to structure

UNIT - II

Antigen-antibody interactions- affinity of antibody, avidity, bonus effect, classical precipitin reaction, antigen-binding site of antibody, forces involved in antigen - antibody complex formation. Lymphoid tissue- primary and secondary lymphoid organs, structure and cellular organization. Lymphocyte traffic. Cells involved in the immune response- T cells, B cells, CD antigens, neutrophils, eosinophils and natural killer cells.

UNIT-III

Antigen presentation - pathways of antigen processing and presentation of intracellular and extracellular antigens.

Antibody response - Primary and secondary antibody response, antibody response to haptens, enumeration of antibody-forming cells, T- dependent and T- independent antigens. Macrophage- role in immune response and activation.

UNIT-IV

Cell mediated immunity- helper, cytotoxic, suppressor T cells. In vivo and in vitro assays for assessment of cell mediated immunity

Complement- classical and alternative pathways of activation. Regulation of complement activation and functions.

Antigen receptors -On T and B cells. Generation of receptor diversity.

UNIT - V

Development of immune system- T cell ontogeny in thymus, thymic hormones, cell development. Immunological tolerance - pathways of tolerance and mechanisms of tolerance in T and B cells. Immunological tests- Immunodiffusion, immunoelectrophoresis, immunofluorescence, radioimmunoassay and enzyme-linked immunosorbent assay.

Suggested Reading Material:

1. Immunology and Immunopathology by Stewart.
2. Cellular and Molecular Immunology by Abul K. Abbas et. al.
3. Textbook of Immunology by Barret.
4. Essential Immunology by Roitt, Brostoff, Male, Harcourt Brace & Company (5th Ed),
Mosby (6th Ed).
5. Immunology by Kuby, Richard A. Goldsby, Thomas, J. Kindl, Barbara A. Osborne,
Freeman & Company, Mosby publishers.
6. Immunobiology – The immune system in Health disease by Janeway and Travers.
7. Immunology – An introduction by Tizard.
8. Text book of Immunology by Unani and Benacerraf.
9. Fundamentals of Immunology by Paul.
10. Immunology – A short course by Benjaini, Sunshine and Lesrowitz.

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23ZAQT24 MOLECULAR BIOLOGY

UNIT - I

History and scope of Molecular Biology DNA Structure and Replication Prokaryotic and Eukaryotic DNA Replication Mechanics of DNA Replication Enzymes and accessory proteins involved in DNA Replication

UNIT - II

Transcription Prokaryotic Transcription Eukaryotic Transcription RNA Polymerases Post-transcriptional modifications in RNA Cap formation Transcription Nuclear Export of m-RNA

UNIT - III

Translation Genetic Code Prokaryotic and eukaryotic Translation Mechanisms of initiation, elongation and termination Regulation of translation Antisense and Ribozyme technology Molecular mechanisms of antisense molecules Inhibition of splicing, polyadenylation and translation

UNIT – IV

DNA damage - DNA damaging agents, Physical, chemical and biological mutagens; types of damage caused by endogenous and exogenous agents, Molecular mechanisms of mutagenesis – Transition, Transversion, Frame Shift, mis-sense and non-sense mutations

Recombination and Repair Holiday junction, gene targeting and gene disruption RecA and other Recombinases DNA repair mechanisms

UNIT-V

Molecular mapping of genome Genetic and physical maps Physical mapping and map-based cloning

Southern fluorescence insitu hybridization (FISH) for genome analysis

Suggested Reading Material:

1. 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.

2. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular

Biology of the Cell. Garland Publishing Inc., New York.

3. Benjamin Lewin, Gene IV, Oxford University Press, U.K.

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

5. Sambrook, J., E.F. Fritch and T. Maniatis. Molecular cloning : A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.

6. Daber, P.D. Introduction to practical Molecular Biology. John Wiley & Sons Ltd., New York.

7. Brown, T.a. (Eds.). Molecular Biology Lab Fax. Bios Scientific Publishers Ltd., Oxford

II SEMESTER PRACTICALS

23ZAQP25 Biostatistics & Bioinformatics lab:

1. Sampling and Frequency distribution
2. Graphical presentation of the data
3. Measures of Central Tendency – Mean, median and mode
4. Measures of Dispersion – Standard deviation and Coefficient of variation
5. Correlation and Regression
6. Nucleic acid and protein databases.
7. Retrieval and analysis of DNA or protein sequence from NCBI
8. Sequence Alignment in excel sheet for data processing.

23ZAQP26 Animal Physiology lab:

1. Digestive enzymes
2. Effect of body size vs oxygen consumption
3. oxygen consumption vs temperature
4. Osmotic regulation
5. Ion concentration measurements
6. Spotters
7. Dissection- Pituitary gland of fish
8. Dissection- Nervous system of prawn.

23ZAQP27 Immunology lab:

1. Blood grouping
2. Widal test for detection of typhoid bacteria
3. VDRL Test
4. SRID
5. Ouchterlony DID
6. Immunoelectrophoresis
7. Blood clotting time and bleeding time.
8. RIA -Demonstration
9. ELISA - Demonstration

23ZAQP28 Molecular Biology Lab:

1. Estimation of DNA (Colorimetric method)
2. Estimation of RNA in tissue (Colorimetric method)
3. Fulgen reaction method for DNA localization
4. Localization of RNA by methyl green pyronin – ‘Y’
5. SDS PAGE of serum proteins.
6. Testing purity of DNA 19

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

THIRD SEMESTER M.Sc. AQUACULTURE

SYLLABUS

(With effect from 2023-24 Admitted batch)

23AQCT31 CONCEPTS OF AQUATIC ECOLOGY

UNIT – I

Introduction: Definition of ecology, organism and environment; features of organism - environment relations; living and non - living environments; the ecosystem or habitat. **Aquatic Ecosystems :** Freshwater ecosystems - Lotic and Lentic ecosystems; Marine ecosystems - oceans and seas, zonation of the seas - rocky, sandy and muddy shores; classification of marine habitat - pelagic, benthic, neretic, oceanic, littoral and abyssal.

UNIT – II

Physical Characteristics of Water: Light - penetration of sunlight into aquatic media, effect of light on productivity, photoperiodicity in animals; Temperature - annual temperature cycles, thermal stratification of water bodies, water movements, periodic and aperiodic current systems; Turbidity - causes, variations and effects.

Chemical Characteristics of Water: Atmosphere and atmospheric gases dissolved in water; Oxygen - oxygen and life, hypoxia, anoxia and hyperoxia, adaptations of animals to varying oxygen tensions; Carbon dioxide - sources of Co₂, its ecological effects; pH or hydrogen ion concentration - its significance. Ecological effects of salinity; effect of salinity on animals

UNIT – III

Biogeochemical Cycles: Nitrogen cycle; phosphorus cycle; sulfur cycle; carbon cycle; trace elements - manganese and copper.

Organic Matter : Aquatic vegetation – zones of aquatic vegetation; Plankton - classification of plankton, factors affecting plankton distribution, plankton counting and sampling; phytoplankton - zooplankton relationship, plankton productivity; Benthos - phytobenthos and zoobenthos.

UNIT – IV

Productivity: Concept of productivity – standing crop, rate of production and rate of removal; primary and secondary productivity; classification of water bodies on the basis of productivity.

UNIT – V

Dynamics of Aquatic Ecosystem: Principal steps and components – niches, trophic levels and relations; producers, consumers, decomposers and transformers; food chain and food web; pyramid of biomasses; pyramid of numbers; energy transfer in the ecosystem.

Suggested Reading Material:

1. Santhanam, R. 1993. A Manual of Fresh Water Ecology: An Aspect of Fishery

Environment. Daya Publishing House, New Delhi.

2. Pillai, N. K. 1993. Marine Biology and Ecology. Daya Publishing House, New Delhi.
3. Reid, G. K. and R. D. Wood. 1976. Ecology of Inland Waters and Estuaries D. Van Nostrand Company.
4. Kormondy, E. J. 1996. Concepts of Ecology. Prentice Hall of India Pvt. Ltd. New Delhi.
5. Cole, G. L. 1954. Text Book of Limnology. The C. V. Mosloy Co.,
6. Odum, E. P. 1996. Fundamentals of Ecology. 3rd Edn. Natraj Publishers, Dehradun.
7. Santhanam, R. and A. Srinivasan. 1994. A Manual of Marine Zooplankton. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Pillai, N. K. 1986. Introduction to Planktonology. Himalaya Publishing House, Mumbai.
9. Balakrishnan Nair, N and D. M. Thampy. 1980. A Text Book of Marine Ecology. Mc Millan Co. of India Ltd.

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

THIRD SEMESTER M.Sc. AQUACULTURE

SYLLABUS

(With effect from 2023-24 Admitted batch)

23AQCT32 PRINCIPLES OF AQUACULTURE

UNIT – I

Aquaculture Systems And Methods: Scope and definition; origins and growth of aquaculture; biological and technological basis; Traditional, extensive, semi - intensive and intensive culture; monoculture, polyculture, composite culture, mixed culture, monosex culture; cage culture, pen culture, raft culture, race way culture, culture in recirculatory systems; warm water and cold water aquaculture; sewage – fed fish culture,

Selection of Sites: Survey and location of suitable site – topography; soil characteristics; acid sulphate soils; water source; hydrometeorological data.

UNIT – II

Aquaculture Engineering: Design and construction of pond, lay out and design of aquaculture farm, construction, water intake system, drainage system; aeration and aerators; recent advances in aquaculture engineering; tips for better aquaculture practices; design and construction of hatcheries.

UNIT – III:

Hydrology of Ponds: Types of ponds; sources of water – precipitation, direct run off, stream inflow, ground water inflow, regulated inflow; losses of water– evaporation, seepage, outflow, consumptive use, water budgets of embankment ponds; water budget of an excavated pond; water exchange.

UNIT – IV:

Selection of Species: Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation.

Pre Stocking Management: Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes.

Stocking: Acclimatization of seed and release; species combinations; stocking density; ratio.

UNIT – V:

Post Stocking Management: Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms; specific food consumption, food conversion ratio (FCR), protein efficiency ratio, true net protein utilization, apparent net protein utilization, biological value of protein.

Growth: Measurement of growth; length - weight relationship; methods of determination of age in fishes and shellfish based on length data and growth checks; ponderal index; growth hormones.

Suggested Reading Material:

1. Mathew Landau. 1995. Introduction to Aquaculture. Daya Publishing House, New Delhi.
2. Pillay, T. V. R. 1993. Aquaculture: Principles and Practices. Fishing News Books. Black Well Scientific Publications.
3. MPEDA, 1991. Hand Book on Shrimp Farming, Kochi, India.
4. Jhingran, V. G. 1982. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi. Chakrabarti, N. M. 1998. Biology, Culture and Production of Indian Major Carps. Narendra Publishing House, New Delhi.
5. Coche, A. G. and J. F. Muir. 1996. Pond Construction and Fresh Water Fish Culture – Pond Farm Structures and Layouts – Simple Methods for Aquaculture. FAO. Daya Publishing House, New Delhi. Upadhyay, A. S. 1995. A Hand Book on Design, Construction and Equipments in Coastal Aquaculture (Shrimp Farming). Daya Publishing House, New Delhi.
6. Wheaton, F. W. 1985. Aquaculture Engineering. MPEDA, Cochin.
7. MPEDA 1990. Aquaculture Engineering and Water Quality Management. Cochin, India.

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

THIRD SEMESTER M.Sc. AQUACULTURE

SYLLABUS

(With effect from 2023-24 Admitted batch)

23AQCT33 NUTRITION AND FEED TECHNOLOGY

UNIT-I

Fish Nutrition: Principles of fish nutrition and terminologies; Nutritional requirements of cultivable finfish and shellfish.

Nutritional Biochemistry: Classification of nutrients, nutrient quality and evaluation of proteins, lipids and carbohydrates.

UNIT – II

Nutritional Bioenergetics: Energy requirement of fishes, protein to energy ratio, digestible energy, nitrogen balance index, protein sparing effect, high energy feeds, isocaloric diets. Metabolic rate; Energy budgets; Energy efficiency of fish production.

UNIT – III

Natural food: Importance in aquaculture; Fish food organisms – Bacterioplankton, phytoplankton and zooplankton and their role in larval nutrition.

Supplementary feeds: Types of feeds - Wet feed, moist feed, dry feed, mashes, pelleted feeds - floating and sinking pellets, microencapsulated diets.

UNIT – IV

Feed manufacture: Feed formulation and processing; Feed machinery units: Pulverizer, grinder, mixer, pelletizer, crumbler, drier, extruder/expander, vacuum coater and fat sprayer.

Feed additives: Binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants; use of preservatives.

UNIT – V

Feeding strategies: Feeding devices, feeding schedules and ration size.

Feed evaluation: Feed conversion efficiencies and ratios. Feed storage methods.

Suggested Reading Material:

1. ADCP (Aquaculture Development & Co-ordination Program).1980.*Fish Feed Technology*.ADCP/REP/80/11FAO
2. Cyrino EP, Bureau D & Kapoor BG. 2008. *Feeding and Digestive Functions in Fishes*. Science Publ.
3. D' Abramo LR, Conklin DE & Akiyama DM. 1977. *Crustacean Nutrition: Advances in Aquaculture*. Vol. VI. World Aquaculture Society, Baton Rouge.
4. De Silva SS & Anderson TA. 1995. *Fish Nutrition in Aquaculture*. Chapman & Hall Aquaculture Series.

5. Elena M. 2003. *Nutrition, Physiology and Metabolism in Crustaceans*. Science Publishers.
6. Guillame J, Kaushik S, Bergot P & Metallier R. 2001. *Nutrition and Feeding of Fish and Crustaceans*. Springer Praxis Publ.
7. Halver J & Hardy RW. 2002. *Fish Nutrition*. Academic Press.
8. Halver JE & Tiews KT. 1979. *Finfish Nutrition and Fish feed Technology*. Vols. I, II Heenemann, Berlin.
9. Hertrampf JW & Pascual FP. 2000. *Handbook on Ingredients for Aquaculture Feeds*. Kluwer.
10. Houlihan D, Boujard T & Jobling M. 2001. *Food Intake in Fish*. Blackwell.
11. Jobling M. 1994. *Fish Bioenergetics*. Chapman & Hall.
12. Lavens P & Sorgeloos P. 1996. *Manual on the Production and Use of Live Food for Aquaculture*. FAO Fisheries Tech. Paper 361, FAO.
13. Nelson DL & Cox MM. 2005. *Lehninger Principles of Biochemistry*. WH Freeman.

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

THIRD SEMESTER M.Sc. AQUACULTURE

SYLLABUS

(With effect from 2023-24 Admitted batch)

23AQCT34 WATER QUALITY MANAGEMENT

UNIT – I

Water quality: Constituents of water, Water quality parameters – optimal levels and their management in freshwater fish and brackish water shrimp culture.

Fertilizers and manures: Different kinds of fertilizers and manures, fertilizer grade, source, rate and frequency of application; Ecological changes taking place after fertilizing;

UNIT – II

Biofertilizers; Role of inorganic, organic and biofertilizers in aquaculture practices; Utilization of bioactive compounds by microorganisms.

Liming: Properties of liming materials, lime requirements and application of liming materials to ponds, effects of liming on pond ecosystem.

UNIT – III

Dynamics of dissolved oxygen: Daily changes in dissolved oxygen concentration, oxygen budget of culture ponds; algal die-off, overturns, identification of oxygen problems.

Aeration: Principles of aeration, emergency aeration, destratification and practical considerations.

UNIT – IV

Hatchery management: Fish hatchery - Hatchery protocols, seed rearing technology; Packaging and transport of seed. Shrimp hatchery – Larval rearing; culture and use of different live feed; different chemicals and drugs used; water quality and feed management. Water discharge standards; Effluent treatment in hatcheries.

Aquatic weed management: Common weeds and problems in culture ponds; Chemical, biological and mechanical control methods; Algal bloom control.

UNIT – V

Chemical treatments: Potassium permanganate, hydrogen peroxide, calcium hydroxide; Chlorination and De chlorination; piscicides, methods of applying chemicals. Waste water discharge, waste water analysis and toxicity assessment, Pollution in relation to aquaculture practices.

Suggested Reading Material:

1. Adhikari S & Chatterjee DK. 2008. *Management of Tropical Freshwater Ponds*. Daya Publ.
2. Boyd CE and Tucker CS. 1992. *Water Quality and Pond Soil Analyses for Aquaculture*. Alabama Agricultural Experimental Station, Auburn University.
3. Boyd CE. 1979. *Water Quality in Warm Water Fish Ponds*. Auburn University
4. Boyd, CE. 1982. *Water Quality Management for Pond Fish Culture*. Elsevier Sci. Publ. Co.
5. Hopher B & Pruginin Y. 1981. *Commercial Fish Farming*. John-Wiley & Sons Inc.
6. Jhingran VG. 1982. *Fish and Fisheries of India*. Hindustan Publishing Corporation, India.

7. Midlen & Redding TA. 1998. *Environmental Management for Aquaculture*. Kluwer.
8. Pillay TVR & Dill WMA. 1979. *Advances in Aquaculture*. Fishing News Books, Ltd. England.
9. Rajagopalsamy CBT & Ramadhas V. 2002. *Nutrient Dynamics in Freshwater Fish Culture*
10. Sharma LL, Sharma SK, Saini VP & Sharma BK. 2008. *Management of Freshwater Ecosystems*. Agrotech Publ. Academy.
11. Stickney RR. 1979. *Principles of Warm water Aquaculture*. John-Willey & sons Inc.
12. Tucker C.S. 1985. *Channel Catfish Culture*. Elsevier.

III SEMESTER PRACTICALS

23AQCP35 Concepts of Aquatic Ecology Lab:

1. Identification of phytoplankton and zoo plankton – Fresh water and Brackish water.
2. Predaceous freshwater insects.
3. Identification of common fresh water benthic organisms Macrophytes in freshwater.
4. Shore fauna.
5. Estimation of Primary Productivity
6. Estimation of Co₂

23AQCP36 Principles of Aquaculture Lab:

1. Design and layout of fresh water and brackish water farms, fish and shrimp hatcheries
2. Visit to farms and hatchery.
3. Estimation and calculations of production costs of fish/shrimp farm.
4. Different types of filters.
5. Length weight relationship
6. Ponderal index.
7. Cultivable importance of fish & Shell fish Species

23AQCP37 Nutrition and Feed Technology Lab:

1. Methods in feed formulation
2. Proximate composition of aquaculture feeds – Proteins, carbohydrates, lipids, moisture, ash content
3. Qualitative determination of carbohydrates proteins and lipids.
4. Calculation PER, FCR. SGR.

23AQCP38 Water Quality Management Lab:

1. Determination of Temperature, pH, Salinity, Turbidity.
2. Total Alkalinity and total Hardness.
3. Dissolved Oxygen, Phosphates, CO₂ and BOD
4. Nitrites and Nitrates.
5. Estimation of soil organic carbon
6. Estimation of nitrogen in soil.

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

FOURTH SEMESTER M.Sc. AQUACULTURE

SYLLABUS

(With effect from 2023-24 Admitted batch)

23AQCT41 AQUACULTURE

UNIT – I

Major cultivable species for aquaculture; A knowledge of inland water bodies suitable for culture in India.

Culture of Indian Major Carps: exotic carps of Fish Hatcheries and their management.

UNIT -II

Bundh breeding and Induced breeding of carp by hypophysation and use of synthetic hormones.

Preparation and Management of Indian major carp culture ponds – nursery, rearing and production ponds.

UNIT – III

Culture of Giant fresh water prawn, *Macrobrachium rosenbergii* - seed collection formation sources. Hatchery management.

Culture of tiger shrimp, *Penaeus monodon* and *Litopenaeus Vannamei*

UNIT – IV

Culture of brackish water fish – *Chanos* and *Lates*, *Osteobrama belangeri*.

Culture of pearl oysters.

UNIT – V

Culture of sea weeds: Major commercial importance seaweed species.

Methods of Crab culture

Culture of ornamental fishes.

Culture of air-breathing fishes in India.

Culture of Molluscs,

Suggested Reading Material:

1. Bardach, JE *et al.* 1972. *Aquaculture – The farming and husbandry of freshwater and marine organisms*. John Wiley & Sons, New York.
2. Chakraborty C & Sadhu AK. 2000. *Biology Hatchery and Culture Technology of Tiger Prawn and Giant Freshwater Prawn*. Daya Publ. House. FAO. 2007. *Manual on Freshwater Prawn Farming*.
3. Huet J. 1986. *A text Book of Fish Culture*. Fishing News Books Ltd.
4. ICAR. 2006. *Hand Book of Fisheries and Aquaculture*. ICAR.

5. Jhingran V.G. 1991. *Fish and Fisheries of India*. Hindustan Publ. Corporation, India.
6. Landau M. 1992. *Introduction to Aquaculture*. John Wiley & Sons.
7. Mcvey JP. 1983. *Handbook of Mariculture*. CRC Press.
8. MPEDA: *Handbooks on culture of carp, shrimp, etc.*
9. New MB. 2000. *Freshwater Prawn Farming*. CRC Publ.
10. Pillay TVR. 1990. *Aquaculture- Principles and Practices*. Fishing News Books Ltd.,
11. London. Pillay TVR & Kutty MN. 2005. *Aquaculture- Principles and Practices*. 2nd Ed.
12. Blackwell Rath RK. 2000. *Freshwater Aquaculture*. Scientific Publ.
13. Stickney RR. 1979. *Principles of Warmwater Fish Culture*. John Wiley & Sons.

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

FOURTH SEMESTER M.Sc. AQUACULTURE

SYLLABUS

(With effect from 2023-24 Admitted batch)

23AQCT42 FISH PROCESSING TECHNOLOGY

UNIT – I

Process Biochemistry

Major and minor constituents of fish, their distribution and function - moisture, proteins, lipids, carbohydrates, vitamins and minerals.

Post-mortem biochemical changes in fish - rigor mortis, autolysis, auto-oxidation and their significance.

Toxins and toxic substances in fish.

UNIT – II

Microbiology

Biochemical and microbial spoilage of fish; factors affecting spoilage of fish.

Role of bacteria and moulds in fish preservation - pathogenic organisms encountered in fish products, faecal indicator organisms.

UNIT – III

Handling and Fish Preservation

Handling, storage and transport of fresh fish, sanitary and phyto-sanitary requirements for maintenance of quality.

Principles of fish preservation; preservation of fish by curing, drying, salting and smoking; chilling and freezing of fish; canning of fish and fish products.

UNIT - IV

Modern techniques employed in fish preservation: Accelerated Freeze Drying (AFD), Irradiation.

Fishery by-products and waste utilization.

UNIT – V

Quality Management and Certification

HACCP (Hazard Analysis and Critical Control Points) and Good Manufacturing Practices: HACCP Principles, Practical aspects of planning and implementation, Verification, Validation and Audit. Development of value add products.

National and International Standards - ISO 9000 Series, 2000 Series of Quality Assurance System, Codex Alimentarius Commission, Food Safety and Standards Act of India 2006.

Suggested Reading Material:

1. Balachandran KK. 2001. *Post-harvest Technology of Fish and Fish Products*. Daya Publ.

2. Bond, et al. 1971. *Fish Inspection and Quality Control*. Fishing News Books, England.
3. Clucas IJ. 1981. *Fish Handling, Preservation and Processing in the Tropics*. Parts I, II. FAO.
4. Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR.
5. Govindan, TK. 1985. *Fish Processing Technology*, Oxford-IBH.
6. Hall GM. (Ed). 1992. *Fish Processing Technology*. Blackie.
7. Huss HH, Jakobsen M & Liston J. 1991. *Quality Assurance in the Fish Industry*. Elsevier.
8. John DEV. 1985. *Food Safety and Toxicity*. CRC Press.
9. Krenzer R. 1971. *Fish Inspection and Quality Control*. Fishing News.
10. Larousse J & Brown BE. 1997. *Food Canning Technology*. Wiley VCH.
11. Nambudiri DD. 2006. *Technology of Fishery Products*. Fishing Chimes.
12. Regenssein JM & Regenssein CE.1991. *Introduction to Fish Technology*. Van Nostrand Reinhold.
13. Rudolf K. 1969. *Freezing and Irradiation of Fish*. Fishing News (Books).
14. Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ.

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

FOURTH SEMESTER M.Sc. AQUACULTURE

SYLLABUS

(With effect from 2023-24 Admitted batch)

23AQCT43 FISH PATHOLOGY

UNIT – I Viral diseases

Fish Diseases: Clinical symptoms, pathology and control measures of Viral Hemorrhagic Septicemia (VHS) and Infectious Hematopoietic Necrosis (IHN).

Shrimp Diseases: Pathology, clinical symptoms, prevention and treatment of Monodon Baculoviral disease (MBV), Infectious Hypodermal and Hematopoietic Necrosis (IHHN), Hepato Pancreatic Parvovirus disease (HPPV), Yellow-head virus disease, Taura syndrome and White spot syndrome.

UNIT – II Bacterial and Fungal diseases

Fish Diseases: Clinical symptoms, pathology, prevention and control measures of Bacterial Hemorrhagic Septicemia (BHS), Bacterial gill disease and Tail and fin rot.

Pathology, clinical symptoms, prevention and control measures of Saprolegniasis and Branchiomycosis.

UNIT – III

Shrimp Diseases: Clinical symptoms, pathology, prevention and control measures of Black gill disease and filamentous bacterial gill disease.

Clinical symptoms, pathology, prevention and control measures of *Lagenidium* disease (Larval Mycosis) and Brown gill disease.

UNIT – IV Protozoan, Helminthic and Crustacean diseases

Fish Diseases: Clinical symptoms, pathology and control measures of Ichthyophthiriasis, Enterococcidiasis, Whirling disease and Nodular disease.

Clinical symptoms, pathology and control measures of Enterocytozoan hepato penaei.

Clinical symptoms, pathology and control measures of Argulosis and Lernaeiasis.

Shrimp Diseases: Etiology, morphology and control measures of ectocommensal protozoa – *Zoothamnium* and *Acineta*.

Clinical symptoms, pathology and control measures of Microsporidiasis.

UNIT – V Nutritional and Ecological diseases

Fish Diseases: Diseases of vitamin deficiency and Fatty liver degeneration.

Clinical symptoms, pathology and control measures of gas bubble disease and lack of oxygen.

Shrimp Diseases: Clinical symptoms, pathology and control measures of Cramped tails, Muscle Necrosis, Gas bubble disease, Black death disease, Chronic soft shell syndrome and Blue shell syndrome. White Feces Syndrome (WFS)

Suggested Reading Material:

1. Cheng TC. 1964. *The Biology of Animal Parasites*. W.B. Saunders Company, Philadelphia, Pennsylvania, USA.
2. Conroy CA and Herman RL. 1968. *Text book of Fish Diseases*. TFH (Great Britain) Ltd, England.
3. Lightner DV. 1996. *A Handbook of Shrimp Pathology and Diagnostic Procedures for Diseases of Cultured Penaeid Shrimp*. World Aquaculture Society, Louisiana, USA.
4. Reichenbach KH. 1965. *Fish Pathology*. TFH (Gt. Britain) Ltd, England.
5. Ribelin WE and Migaki G. 1975. *The Pathology of Fishes*. The Univ. of Wisconsin Press Ltd, Great Russel Street, London, UK.
6. Shuzo Egusa. 1978. *Infectious Diseases of Fish*. Oxonian Press Pvt. Ltd. New Delhi.
7. Van Duijn, C. 1973. *Diseases of Fishes*. Cox and Wyman Ltd. London.

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

THIRD SEMESTER M.Sc. AQUACULTURE

SYLLABUS

(With effect from 2023-24 Admitted batch)

23AQCT44 AQUACULTURE BIOTECHNOLOGY

UNIT – I

Biotechnology: Origin, definition and knowledge of different branches.

Genetic Engineering: Recombinant DNA technology; Tools of genetic engineering – cloning vectors, restriction endonucleases, DNA ligases, topoisomerases, methylases, nucleases, polymerases, reverse transcriptase and their functions.

Screening analysis of recombinants: Colony hybridization technique, immunological tests.

Transgenics: Principles of Transgenic technology and its applications in fisheries.

UNIT – II

Fish breeding: Synthetic hormones for induced breeding – GnRH analogue structure and function; Selective breeding for improving fish stocks - hybridization in Indian fishes.

Androgenesis, Gynogenesis, Polyploidy and Sex reversal.

Hormonal regulation of reproduction and molting in important cultivable crustaceans.

Gene bank and Conservation: Cryopreservation of gametes and embryos.

Embryo transfer technology.

UNIT – III

Feed technology: Micro encapsulated feeds; micro coated feeds; micro particulate feeds and bio-encapsulated feeds; mycotoxins and their effects on feeds.

UNIT – IV

Algal biotechnology: Biotechnological approaches for production of important microalgae; single cell protein from *Spirulina*; vitamins, minerals and omega3 fatty acids from micro algae; enrichment of micro algae with micronutrients.

Application of Nanotechnology in aquaculture; A general knowledge of tissue culture.

UNIT – IV

Health management: DNA and RNA vaccines; molecular diagnosis of viral diseases; Biofilms and its impact on health management; genetically modified microorganisms as probiotics, immunostimulants, bioremediation of soil and water.

Nitrogen fixation in aquatic environment and Biofertilizers.

Post-harvest biotechnology: Delaying of spoilage; biosensors.

Suggested Reading Material:

1. Bhattacharya S.1992.*Hormones in Pisciculture*. Biology Education,Vol. 9 No.1 pp.31- 41.

2. CIFE. 1998. Summer School Manuals, Mumbai.

i). *Recent Developments in Biotechnology: Applications to Aquaculture & Fisheries*. ii). *Genetics and Biotechnological Tools in Aquaculture and Fisheries*.

3. Felix S. 2007. *Molecular Diagnostic Biotechnology in Aquaculture*. Daya Publ. House.
4. ICAR. 1992. *Biotechnology in Aquaculture*. Training Manual. C.I.F.A, Kausalyaganga, Bhubaneswar, Orissa.
5. Lakra WS, Abidi SAH, Mukherjee SC & Ayyappan S. 2004. *Fisheries Biotechnology*. Narendra Publ. House.
6. Nagabhushanam R, Diwan AD, Zahurnec BJ & Sarojini R. 2004. *Biotechnology of Aquatic Animals*. Science Publ.
7. Nair PR. 2008. *Biotechnology and Genetics in Fisheries and Aquaculture*. Dominant Publ.
8. Pandian TJ, Strüssmann CA & Marian MP. 2005. *Fish Genetics and Aquaculture Biotechnology*. Science Publ.
9. Ramesh RC. 2007. *Microbial Biotechnology in Agriculture and Aquaculture*. Vol. II. Science Publ.
10. ReddyPVGK, AyyappanS, ThampyDM & Gopalakrishna 2005. *Text Book of Fish Genetics and Biotechnol.* ICAR
11. Singh B. 2006. *Marine Biotechnology and Aquaculture Development*. Daya Publ. House

IV- SEMESTER PRACTICALS

23AQCP45 Aquaculture lab:

1. Identification of major cultivable species - fin fish and shell fish, molluscs.
2. Pituitary gland extract preparation.
3. Visit to hatcheries and grow out farms.

23AQCP46 Fish Processing Technology Lab:

1. Analysis of fish for Biochemical constituents.
2. Visit to fish processing unit.
3. Method of evaluation of freshness of fish.
4. Fishery by products.

23AQCP47 Fish Pathology Lab:

1. Identification of Fish and Shrimp disease.
2. Examination of normal and diseased fish.
3. External examination on diseased fish diagnostic features and procedure.
4. Atrophy of organ of diseased fish, Host examination – collection of parasites
Histopathology of organs of diseased fish. Slides of fish parasites.

23AQP48 Aquaculture Biotechnology Lab:

1. Molecular diagnosis of disease- PCR method.
2. Cell density of algal culture.
3. Eyestalk ablation procedure in crustaceans.
4. Use of probiotics in aquaculture farms.
5. Induced breeding

S.V.K.P. &Dr. K.S. RAJU ARTS & SCIENCE COLLEGE (A)

Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– I Semester

PAPER –I: TOOLS AND TECHNIQUES FOR BIOLOGY (23ZAQT11)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1. a) What is an assay? Explain different types of assays.
(OR)
b) Write about pH meter: Operation of pH electrodes.
2. a) Describe various types of chromatographic techniques to separate molecules
(OR)
b) Describe the principle and applications of spectrophotometer.
3. a) Write an essay on Visualization of cells and subcellular components by light microscopy.
(OR)
b) Write the principle and types of microscopy and elaborate on dark field microscopy
4. a) Write about microtomy working principle and different types of microtomes.
(OR)
b) Write about the applications of microtomy in biological studies.
5. a) Describe the process of inoculation and growth monitoring.
(OR)
b) Explain in detail about microbial assays.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Density gradient centrifugation
7. Electrophoreses
8. TLC.
9. TEM.
10. Histology.
11. Sterilization.
12. Growth Media.
13. HPLC

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M.Sc. Zoology– I Semester

PAPER –II: BIOSYSTEMATICS, BIODIVERSITY & EVOLUTION(23ZAQT12)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1. a) Define Biosystematics. Explain in detail the importance and applications of Biosystematics

(OR)

b) Write about chemotaxonomy

2. a) Discuss about the different taxonomic procedures.

(OR)

b) Write about ICZN in detail.

3. a) Discuss the types of Biodiversity and ecosystem.

(OR)

b) Write about Equitable sharing & conservation of Biodiversity.

4. a) Write about different species concepts.

(OR)

b) What is Speciation. Explain the mechanism involved in speciation.

5. a) Discuss in detail about the theories of Organic Evolution.

(OR)

b) What is Hardy Weinberg Law Discuss.

Answer any FIVE questions

SECTION-B

(5x4 = 20 Marks)

6. Cytotaxonomy.
7. Essentialism.
8. Taxonomic keys.
9. Gene Banks.
10. Eras.
11. Experiment of Miller.
12. Mutations.
13. Punctuated equilibrium.

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M.Sc. Zoology– I Semester

PAPER –III: BIOMOLECULES (23ZAQT13)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1. a) Write about Biomolecules chemical composition.
(OR)
b) Discuss the principles and laws of thermodynamics.
2. a) Describe the structure, classification and properties of aminoacids.
(OR)
b) Explain about structural characterization of proteins.
3. a) Write about the classification, structure, properties and functions of monosaccharides.
(OR)
b) Explain about polysaccharides and their occurrence in nature.
4. a) Discuss about the classification, structures, properties and biological functions of fatty acids.
(OR)
b) Explain about phospholipids, sphingolipids, prostaglandins, and steroids with their biological role.
5. a) Explain about the structure, types and physicochemical properties of DNA.
(OR)
b) Write in detail about RNA and its functions.

Answer any Five questions

SECTION-B

(5x4 = 20 Marks)

6. Entropy and enthalpy
7. Ramachandranplot.
8. Peptidebond.
9. Glycoproteins.
10. fattyacids.
11. Chitin
12. Denaturation of DNA.
13. mRNA

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M.Sc. Zoology– I Semester

PAPER –IV: MOLECULAR CELL BIOLOGY(23ZAQT14)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Describe in detail about the transport across the cell membrane.
(OR)
b) Explain the transport of macromolecules across the epithelial layer.
2. a) Explain the role of cytoskeletal elements in defining the structure of a cell.
(OR)
b) Enumerate the role of cytoskeletal elements in mitosis.
3. a) Elaborate on the second messenger system in cell signaling
(OR)
b) Write about MAP kinase pathways
4. a) Write in detail about cell adhesion and communication mechanisms.
(OR)
b) Write an essay on cell cycle.
5. a) Write an essay on mobile DNA
(OR)
b) Describe various post-translational mechanisms in protein synthesis.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Membrane potential.
7. Surface receptor
8. Kinesin
9. Apoptosis
10. Integrins and collagen.
11. Chromosomal organization of genes.
12. Non coding DNA.
13. Symports and antiports.

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M.Sc. Zoology– II Semester

PAPER –I: BIOSTATISTICS & BIOINFORMATICS (23ZAQT21)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1. a) What an essay on Sampling.

(OR)

b) Write about graphical presentation of data.

2. a) Discuss in detail about the Measures of Central tendency.

(OR)

b) Write about Measures of dispersion.

3. a) Explain in detail about the bivariate analysis..

(OR)

b) What is test of significance. Discuss in detail.

4. a) Describe about the Basic components of the Computer..

(OR)

b) Explain the use of MS excel in for data presentation..

5. a) What are biological databases? Explain.

(OR)

b) Discuss in detail about sequence alignments.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Primary data and secondary data

7. Ogive.

8. Mode

9. Poisson distribution

10. Chi square test.

11. MS word.

12. Power point.

13. Phylogenetic analysis

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M.Sc. Zoology– II Semester

PAPER –II: ANIMAL PHYSIOLOGY (23ZAQT22)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

2. a) Write briefly molecular structure and properties of muscle, Add note on sliding filament theory.

(OR)

- b) Write about haemopoiesis, Haemoglobin, and haemostasis. Add note on factors affecting blood coagulation.

2. a) Write about the anatomy of brain.

(OR)

- b) Write about photoreceptors, Auditory, Mechanoreceptors..

3. a) Write about osmoregulation in aquatic Environments.

(OR)

- b) Write about response to biotic and abiotic factors.

4. a) Write about the comparative physiology of excretion, Urine formation, Urine concentration, and waste elimination.

(OR)

- b) Write about comparative anatomy of heart structure, myogenic heart. Add a note on blood pressure.

5. a) Explain fresh water and terrestrial environment..

(OR)

- b) Write about Yoga and Meditation

Answer any FIVE questions

SECTION-B

(5x4 = 20 Marks)

6. Cardiac muscle
7. Blood groups.
8. Synaptic transmission.
9. Chemoreceptor.
10. Acclimatization
11. BMR
12. Micturition
13. Estuaries.

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M.Sc. Zoology– I Semester

PAPER –III: IMMUNOLOGY (23ZAQT23)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1.a) What is innate immunity? Describe various innate immune mechanisms.

(OR)

b) Describe the structure and functions of various types of immunoglobulins

2.a) Write an essay on antigen-antibody interactions.

(OR)

b) What are the cells involved in immune response? Describe their role.

3.a) Write about processing and presentation of intracellular and extracellular antigens

(OR)

b) Elucidate the mechanisms of antibody response to antigens.

4. a) Write about cell mediated immunity

b) Write about Classical and alternative activation of complement..

5. a) What is immune tolerance? Elucidate the mechanisms of tolerance in T and B cells.

(OR)

b) Write an essay on immunological tests used in molecular and diagnostic laboratories.

Answer any Five questions

SECTION-B

(5x4 = 20 Marks)

6. Acquired immunity.

7. Haptens

8. Primary lymphoid organs.

9. Antigen presenting cells

10. Macrophage

11. Antigen receptors.

12. ELISA.

13. Thymic hormones.

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M.Sc. Zoology– II Semester

PAPER –IV: MOLECULAR BIOLOGY(23ZAQT24)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Explain the prokaryotic and eukaryotic DNA replication.

(OR)

b) Explain the mechanics of DNA replication.

2. a) Explain the post transcription in prokaryote and eukaryotic transcription.

(OR)

b) Explain the post transcriptional modifications in RNA.

3. a) Explain the mechanisms of prokaryotic and eukaryotic translation.

(OR)

b) Explain the molecular mechanism of the antisense molecules and add a note on inhibition of splicing.

4. a) Write about DNA damage- DNA damage agents.

(OR)

b) Write about gene targeting and DNA repair.

5. a) Explain the types of mapping and molecular mapping of genome.

(OR)

b) Explain the Southern fluorescence in situ hybridization for genome analysis.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Structure of DNA
7. RNA polymerases.
8. mRNA
9. Genetic code.
10. Ribozyme
11. Mutagens
12. Holiday junction
13. FISH

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M.Sc. Aquaculture – III Semester

PAPER –I: CONCEPTS OF AQUATIC ECOLOGY (23AQCT31)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) What is Ecology? Explain the features of organism and environment and their relationships.

(OR)

b) Discuss about the Marine Ecosystem.

2. a). Explain light as factor of the environment.

(OR)

b) Discuss about the gases dissolved in water.

3. a) Write in detail about the Nitrogen cycle and its importance.

(OR)

b) Discuss about the aquatic fauna.

4. a) What is productivity? Explain.

(OR)

b) Discuss about ecological pyramids.

5. a) What is productivity? Explain.

(OR)

b) Discuss about ecological pyramids.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Habitat.
7. Lentic ecosystem.
8. Turbidity.
9. Photoperiod.
10. Alkalinity.
10. Dissolved oxygen.
11. Eutrophication.
12. Niche.

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M.Sc. Aquaculture – III Semester

PAPER –II: PRINCIPLES OF AQUACULTURE (23ZAQT32)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) What is scope and basis of Aquaculture.
(OR)
b) Describe how do you select a site for construction of a fish farm.
2. a) Explain the details in designing and construction of a hatchery.
(OR)
b) Discuss about water intake system into the farms and hatcheries. Add a note on water consumption and water budgets involved.
3. a) What are the criteria for selection of Aquaculture species.
(OR)
b) Discuss about the pa management practices.
4. a) Explain about the factors involved in post stocking management of ponds.
(OR)
b) What is growth? Discuss about different methods of age determination in fishes.
5. a) Explain about the factors involved in post stocking management of ponds.
(OR)
b) What is growth? Discuss about different methods of age determination in fishes.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Poly culture.
7. Integrated fish farming.
8. Acid sulphate soils.
9. Types of ponds.
10. Aeration.
11. Seed resources.
12. Stocking density.
13. FCR.

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M.Sc. Aquaculture – III Semester

PAPER –III: NUTRITION AND FEED TECHNOLOGY (23ZAQT33)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Write in detail the principles of fish nutrition. Add a note on nutritional requirements of fin fish & shell fish?
(OR)
b) Classify the nutrients. Write the quality & evaluation of proteins & lipids.
2. a) Explain the energy requirements of fishes with reference of protein to energy ratio?
(OR)
b) Write in detail the metabolic rate of fish. Adding a note on energy budgets & efficiency of fish production.
3. a) Write in detail the importance of natural food in aquaculture. Add a note on fish food organisms & their role in larval nutrition.
(OR)
b) Explain the types of supplementary feeds and also the mode of feeding.
4. a) Write the different methods in feed formulation and processing.
(OR)
b) Write in detail the feeding strategies, feed conversion efficiencies & feed storage methods.
5. a) Write the different methods in feed formulation and processing.
(OR)
b) Write in detail the feeding strategies, feed conversion efficiencies & feed storage methods.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Nutrient quality of carbohydrates.
7. Nitrogen balance index.
8. Isocaloric diets.
9. Microencapsulated diets.
10. Bridgers & Antioxidants.
11. Pigments & growth promoters.
12. Use of preservation.
13. Fin fish & Shell fish.

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M.Sc. Aquaculture – III Semester

PAPER –IV: WATER QUALITY MANAGEMENT (23ZAQT34)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Write in detail the management of water quality in fresh water fish & brackish water shrimp culture.
(OR)
b) Discuss about the different kinds of fertilizes and measures used in aquaculture. Add a note on use of bioactive compounds by microorganisms.
2. a) Write the reasons for changes in dissolved oxygen concentration. Add a note on identification of oxygen problems.
(OR)
b) What are the principles of aeration, emergency aeration & add a note on desertification and practical considerations.
3. a) Write in detail about the seed rearing technology. Add a note on packing and transportation of seed.
(OR)
b) Write the problems control methods for Aquatic weed management.
4. a) What are the different methods for applying and treatment of chemicals.
(OR)
b) Write in detail about pollution caused in relation to Aquaculture practices.
5. a) What are the different methods for applying and treatment of chemicals.
(OR)
b) Write in detail about pollution caused in relation to Aquaculture practices.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Effect of liming on pond ecosystem.
7. Bio fertilizers In aquaculture.
8. Oxygen budget of culture ponds.
9. Desertification.
10. Effluent treatment in hatcheries.
11. Algal bloom.
12. Turbidity & salinity.
13. Control of hardness and chlorides.

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M.Sc. Aquaculture – IV Semester

PAPER –I: AQUACULTURE (23ZAQT41)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Discuss in detail about Carp culture in India.
(OR)
b) Explain breeding of fish and shell fish in Aquaculture.
2. a) Explain integrated fish farming.
(OR)
b) Discuss the culture of *Litopenaeus vannamei*.
3. a) Write detailed notes on the crab culture.
(OR)
b) Discuss about culture of pearl oysters.
4. a) What are ornamental fishes? Explain their culture.
(OR)
b) Explain sea weed culture.
5. a) What are ornamental fishes? Explain their culture.
(OR)
b) Explain sea weed culture.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Inland water bodies.
7. Hypophysation.
8. *Macrobrachium rosenbergii*.
9. Airbreathing fishes.
10. Rearing pond.
11. Harvest of *Chanos speices*.
12. Thallus.
13. Live bearers.

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Aquaculture – IV Semester

PAPER –II: FISH PROCESSING TECHNOLOGY (23ZAQT42)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Explain the biochemical constituents of fish. Add a note on their distribution and function.
(OR)
b) Discuss about the post mortem biochemical changes in fish and their significance.
2. a) Discuss about spoilage of fish. What are the factors that affect spoilage.
(OR)
b) Discuss the role of microorganism in fish preservation.
3. a) Explain the different methods of fish preservation.
(OR)
b) Write notes on fishery by products.
4. a) Discuss HACCP and good Manufacturing Practices in Fish processing technology.
(OR)
b) Explain the international standards in food safety and standards.
5. a) Discuss HACCP and good Manufacturing Practices in Fish processing technology.
(OR)
b) Explain the international standards in food safety and standards.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Toxins in fish.
7. Indicator organism.
8. Bio chemical constituents.
9. Microbial spoilage
10. Sanitary requirements for maintenance of quality.
11. Validation.
12. Assurance system.
13. AFD.

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M.Sc. Aquaculture – IV Semester

PAPER –III: FISH PATHOLOGY (23ZAQT43)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Write in detail the symptoms of pathology and control of viral hemorrhagic septiceamia (vhs) & (hn).
(OR)
 - b) Write in detail the symptoms, treatment and preservation of baculovirus disease
 2. a) What are the symptoms of pathology, prevention and control causes of bacterial diseases in fish.
(OR)
 - b) What are the symptoms, pathology preservation & control measures of shrimp diseases.
 3. a) Write the symptoms pathology and control measures of protozoan and helminthic diseases in fish.
(OR)
 - b) Write the symptoms pathology and control measures of shrimp diseases caused due to protozoa and helminthes parasites.
 4. a) Write the clinical symptoms pathology control measures of vitamin deficiency diseases and bubble disease in fishes.
(OR)
 - b) Write in detail the clinical symptoms, pathology and control measures of muscle narcosis, gas bubble diseases black death diseases in shrimp.
 5. a) Write the clinical symptoms pathology control measures of vitamin deficiency diseases and bubble disease in fishes.
(OR)
- Write in detail the clinical symptoms, pathology and control measures of muscle narcosis, gas bubble diseases black death diseases in shrimp.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Taura syndrome.
7. White spot syndrome.
8. Control measure of saprolegniasis disease.
9. Lagenidium disease.
10. Gyrodactylosis and Dactylogyrosis.
11. Ecto commensal protozoan diseases in shrimps.
12. Fish diseases due to lack of oxygen.
13. Blue shell syndrome.

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M.Sc. Aquaculture – IV Semester

PAPER –IV: AQUACULTURE BIOTECHNOLOGY (23ZAQT44)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Write in detail about the recombinant DNA Technology.
(OR)
b) Write the principles of genetic technology and its application in fisheries.
2. a) Write in brief about the synthesis hormones used in induced breeding. Add a note on hormone in reproduction and molting in cultivation of crustaceans.
(OR)
b) Write about the cryo preservation of gametes. Add a note on embryo transfer technology.
3. a) Write about different types of feed used in aquaculture.
(OR)
b) Discuss about the applications of nanotechnology in aquaculture.
4. a) Write in detail about DNA & RNA Vaccines. Add a note on Molecular *diagnosis* of viral diseases in aquaculture.
(OR)
b) Write in brief the process in delaying of spoilage & use of biosensors in aquaculture.
5. a) Write in detail about DNA & RNA Vaccines. Add a note on Molecular *diagnosis* of viral diseases in aquaculture.
(OR)
b) Write in brief the process in delaying of spoilage & use of biosensors in aquaculture.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Immunological tests.
7. Reverse transcription.
8. Androgenesis & Gynogenesis.
9. Hybridization in India fishes.
10. Bio- encapsulated feeds.
11. Omega & fatty acids from micro algae.
12. Probiotics.
13. Bioremediation.