



ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM

B.Sc Aquaculture

Single Major

From 2023-24 (Syllabus-Curriculum)

Course Structure

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Introduction to Classical Biology	3+2	4
	I	2	Introduction to Applied Biology	3+2	4



SEMESTER-I

COURSE 1: INTRODUCTION TO CLASSICAL BIOLOGY

Theory

Credits: 4

5 hrs/week

Learning objectives

The student will be able to learn the diversity and classification of living organisms and understand their chemical, cytological, evolutionary and genetic principles.

Learning Outcomes

1. Learn the principles of classification and preservation of biodiversity
2. Understand the plant anatomical, physiological and reproductive processes.
3. Knowledge on animal classification, physiology, embryonic development and their economic importance.
4. Outline the cell components, cell processes like cell division, heredity and molecular processes.
5. Comprehend the chemical principles in shaping and driving the macromolecules and life processes.

Unit 1: Introduction to systematics, taxonomy and ecology.

- 1.1. Systematics – Definition and concept, Taxonomy – Definition and hierarchy.
- 1.2. Nomenclature – ICBN and ICZN, Binomial and trinomial nomenclature.
- 1.3. Ecology – Concept of ecosystem, Biodiversity and conservation.
- 1.4. Pollution and climate change.

Unit 2: Essentials of Botany.

- 2.1. The classification of plant kingdom.
- 2.2. Plant physiological processes (Photosynthesis, Respiration, Transpiration, phytohormones).
- 2.3. Structure of flower – Micro and macro sporogenesis, pollination, fertilization and structure of mono and dicot embryos.
- 2.4 Mushroom cultivation, floriculture and landscaping.

Unit 3: Essentials of Zoology

- 3.1. The classification of Kingdom Animalia and Chordata.
- 3.2 Animal Physiology – Basics of Organ Systems & their functions, Hormones and Disorders
- 3.3 Developmental Biology – Basic process of development (Gametogenesis, Fertilization, Cleavage and Organogenesis)
- 34 Economic Zoology – Sericulture, Apiculture, Aquaculture



Unit 4: Cell biology, Genetics and Evolution

- 4.1. Cell theory, Ultrastructure of prokaryotic and eukaryotic cell, cell cycle.
- 4.2. Chromosomes and heredity – Structure of chromosomes, concept of gene.
- 4.3. Central Dogma of Molecular Biology.
- 4.4. Origin of life

Unit 5: Essentials of chemistry

- 5.1. Definition and scope of chemistry, applications of chemistry in daily life.
- 5.2. Branches of chemistry
- 5.3. Chemical bonds – ionic, covalent, noncovalent – Vander Waals, hydrophobic, hydrogen bonds.
- 5.4. Green chemistry

References

1. Sharma O.P., 1993. Plant taxonomy. 2nd Edition. McGraw Hill publishers.
2. Pandey B.P., 2001. The textbook of botany Angiosperms. 4th edition. S. Chand publishers, New Delhi, India.
3. Jordan E.L., Verma P.S., 2018. Chordate Zoology. S. Chand publishers, New Delhi, India.
4. Rastogi, S.C., 2019. Essentials of animal physiology. 4th Edition. New Age International Publishers.
5. Verma P.S., Agarwal V.K., 2006. Cell biology, genetics, Molecular Biology, Evolution and Ecology. S. Chand publishers, New Delhi, India.
6. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.
7. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.
8. Karen Timberlake, William Timberlake, 2019. Basic chemistry. 5th Edition. Pearson publishers.
9. Subrata Sen Gupta, 2014. Organic chemistry. 1st Edition. Oxford publishers.



ACTIVITIES:

1. Make a display chart of life cycle of nonflowering plants.
2. Make a display chart of life cycle of flowering plants.
3. Study of stomata
4. Activity to prove that chlorophyll is essential for photosynthesis
5. Study of pollen grains.
6. Observation of pollen germination.
7. Ikebana.
8. Differentiate between edible and poisonous mushrooms.
9. Visit a nearby mushroom cultivation unit and know the economics of mushroom cultivation.
10. Draw the Ultrastructure of Prokaryotic and Eukaryotic Cell
11. Visit to Zoology Lab and observe different types of preservation of specimens
12. Hands-on experience of various equipment – Microscopes, Centrifuge, pH Meter, Electronic Weighing Balance, Laminar Air Flow
13. Visit to Zoo / Sericulture / Apiculture / Aquaculture unit
14. List out different hormonal, genetic and physiological disorders from the society



SEMESTER-I

COURSE 2: INTRODUCTION TO APPLIED BIOLOGY

Theory

Credits: 4

5 hrs/week

Learning objectives

The student will be able to learn the foundations and principles of microbiology, immunology, biochemistry, biotechnology, analytical tools, quantitative methods, and bioinformatics.

Learning Outcomes

1. Learn the history, ultrastructure, diversity and importance of microorganisms.
2. Understand the structure and functions of macromolecules.
3. Knowledge on biotechnology principles and its applications in food and medicine.
4. Outline the techniques, tools and their uses in diagnosis and therapy.
5. Demonstrate the bioinformatics and statistical tools in comprehending the complex biological data.

Unit 1: Essentials of Microbiology and Immunology

- 1.1. History and Major Milestones of Microbiology; Contributions of Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister.
- 1.2. Groups of Microorganisms – Structure and characteristics of Bacteria, Fungi, Archaea and Virus.
- 1.3. Applications of microorganisms in – Food, Agriculture, Environment, and Industry.
- 1.4. Immune system – Immunity, types of immunity, cells and organs of immune system.

Unit 2: Essentials of Biochemistry

- 2.1. Biomolecules I – Carbohydrates, Lipids.
- 2.2. Biomolecules II – Amino acids & Proteins.
- 2.3. Biomolecules III – Nucleic acids -DNA and RNA.
- 2.4. Basics of Metabolism – Anabolism and catabolism.

Unit 3: Essentials of Biotechnology

- 3.1. History, scope, and significance of biotechnology. Applications of biotechnology in Plant, Animal, Industrial and Pharmaceutical sciences.
- 3.2. Environmental Biotechnology – Bioremediation and Biofuels, Bio fertilizers and Bio pesticides.
- 3.3. Genetic engineering – Gene manipulation using restriction enzymes and cloning vectors; Physical, chemical, and biological methods of gene transfer.
- 3.4. Transgenic plants – Stress tolerant plants (biotic stress – BT cotton, abiotic stress – salt tolerance). Transgenic animals – Animal and disease models.



Unit 4: Analytical Tools and techniques in biology – Applications

- 4.1. Applications in forensics – PCR and DNA fingerprinting
- 4.2. Immunological techniques – Immunoblotting and ELISA.
- 4.3. Monoclonal antibodies – Applications in diagnosis and therapy.
- 4.4. Eugenics and Gene therapy

Unit 5: Biostatistics and Bioinformatics

- 5.1. Data collection and sampling. Measures of central tendency – Mean, Median, Mode.
- 5.2. Measures of dispersion – range, standard deviation and variance. Probability and tests of significance.
- 5.3. Introduction, Genomics, Proteomics, types of Biological data, biological databases- NCBI, EBI, Gen Bank; Protein 3D structures, Sequence alignment
- 5.4. Accessing Nucleic Acid and Protein databases, NCBI Genome Workbench

REFERENCES

1. Gerard J., Tortora, Berdell R. Funke, Christine L. Case., 2016. Microbiology: An Introduction. 11th Edition. Pearson publications, London, England.
2. Micale, J. Pelczar Jr., E.C.S. Chan., Noel R. Kraig., 2002. Pelczar Microbiology. 5th Edition. McGraw Education, New York, USA.
3. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.
4. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.
5. R.C. Dubey, 2014. Advanced Biotechnology. S. Chand Publishers, New Delhi, India.
6. Colin Ratledge, Bjorn, Kristiansen, 2008. Basic Biotechnology. 3rd Edition. Cambridge Publishers.
7. U. Sathyanarayana, 2005. Biotechnology. 1st Edition. Books and Allied Publishers pvt. ltd., Kolkata.
8. Upadhyay, Upadhyay and Nath. 2016. Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.
9. Arthur M. Lesk. Introduction to Bioinformatics. 5th Edition. Oxford publishers.
10. AP Kulkarni, 2020. Basics of Biostatistics. 2nd Edition. CBS publishers.

ACTIVITIES

1. Identification of given organism as harmful or beneficial.
2. Observation of microorganisms from house dust under microscope.
3. Finding microorganism from pond water.

4. Visit to a microbiology industry or biotech company.
5. Visit to a waste water treatment plant.
6. Retrieving a DNA or protein sequence of a gene'
7. Performing a BLAST analysis for DNA and protein.
8. Problems on biostatistics.
9. Field trip and awareness programs on environmental pollution by different types of wastes and hazardous materials.
10. Demonstration on basic biotechnology lab equipment.
11. Preparation of 3D models of genetic engineering techniques.
12. Preparation of 3D models of transgenic plants and animals.

[**NOTE:** In the colleges where there is availability of faculty for microbiology and biotechnology, those chapters need to be handled by microbiology and biotechnology faculty. In other colleges, the above topics shall be dealt by Botany and Zoology faculty]

Course – I & II Model Paper (70 Marks)

SECTION A (Multiple Choice Questions)

30 x 1 = 30 M

30 Multiple Choice Questions (Each Unit 6 Questions)

SECTION B (Fill in the blanks)

10 x 1 = 10 M

10 Fill in the Blanks (Each Unit 2 Questions)

SECTION C (Very short answer questions)

10 x 1 = 10 M

10 Very short answer questions (Each Unit 2 Questions)

SECTION D (Matching) (From 5 Units)

2 x 5 = 10 M

1 A

B

C

D

E

2 A

B

C

D

E

SECTION E (True or False)

10 x 1 = 10 M

10 True or False (Each Unit 2 Questions)



ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Aquaculture (w.e.f:2023-24A.B)

B.Sc. Honours in Aquaculture: MAJOR
SEMESTER – II

COURSE STRUCTURE

SEMESTER	Code	Title of the paper	Hr /week	Credits
II	3	Taxonomy and Functional Anatomy of Fin Fish and Shellfish- (T)	3	3
		Taxonomy and Functional Anatomy of Fin Fish and Shellfish- (P)	2	1
	4	Biology of fin fish & shell fish - (T)	3	3
		Biology of fin fish & shell fish- (P)	2	1



ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Aquaculture (w.e.f:2023-24A.B)

II SEMESTER

Course No.: 3 Taxonomy and Functional Anatomy of Fin Fish and Shellfish

Theory

Credits: 3

3 hrs/week

Course Outcomes

1. Acquire knowledge on the Classification of major groups of Finfish and Shell fish
2. Students will be familiar with the general characters of Finfish and Shell fish
3. Gain knowledge on the structure and functions of Digestive system
4. Understand the difference between the brain of fish and prawn
5. Acquire knowledge on the functional anatomy of fish and prawn

Unit I: General characters & Classification of Cultivable fin fish and shell fish

- 1.1 General Characters of Crustacea
- 1.2 Classification of Crustacean: Major groups up to orders and their important characters.
- 1.3 General Characters of fishes
- 1.4 Classification of Fishes: Major groups up to subclass and their important characters.

Unit 2: Digestive and Respiratory systems of Fish and shell fish

- 2.1: Digestive system of fish
- 2.2 Respiratory system of fish
- 2.3 Digestive system of Prawn
- 2.4 Respiratory system of prawn

Unit 3: Circulatory systems of Fish and shell fish

- 3.1 Cardiovascular system: Structure of heart in fishes
- 3.2 Blood vascular system in prawn

Unit 4: Nervous system of Fish and shell fish

- 4.1 Nervous system in fish: Structure and functions of Brain
- 4.2 Central Nervous system in prawn.

Unit 5 Reproductive system of Fish and shell fish

- 5.1 Urino-genital system in fishes
- 5.2 Reproductive system in prawn



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Taxonomy and Functional Anatomy of Fin Fish and Shellfish

Practical

Credits:2

2 hrs/week

1. Study of mouth parts in herbivorous and carnivorous fishes
2. Comparative study of digestive system of herbivorous and carnivorous fishes
3. Demonstration of brain of fish
4. Demonstration of cranial nerves of fish
5. Demonstration of Nervous system of prawn
6. Exposure of gills of prawn
7. Exposure of gills of fish

REFERENCE BOOKS

1. Bond E. Carl. 1979. *Biology of Fishes*, Saunders.
2. Halver JE. 1972. *Fish Nutrition*. Academic Press.
3. Hoar WS and Randall DJ. 1970. *Fish Physiology*, Vol. I-IX, Academic Press, New York.
4. Lagler KF, Bardach, JE, Miller, RR, Passino DRM. 1977. *Ichthyology*, 2nd Ed. John Wiley & Sons, New York.
5. Lovell J. 1989. *Nutrition and Feeding of Fish*. Van Nostrand Reinhold, New York.
6. Moyle PB and Joseph J. Cech Jr. 2004. *Fishes: An Introduction to Ichthyology*. 5th Ed. Prentice Hall.
7. Nikolsky GV. 1963. *Ecology of Fishes*, Academic Press.
8. Norman JR and Greenwood PH. 1975. *A History of Fishes*, Halsted Press.
9. Potts GW and Wootten RJ. 1984. *Fish Reproduction: Strategies and Tactics*, Academic Press.



II SEMESTER

Course No.: 4 -Biology of Fin Fish & Shellfish

Theory

Credits: 3

3 hrs/week

Course outcomes:

1. Gain Knowledge of feeding habits, gut content analysis and growth factors in fishes.
2. Understand the commercial importance of crustaceans and Fish
3. Understand and learn breeding in fishes, breeding habits, method of induced breeding in fishes.
4. To create awareness on parental care of Fishes and embryonic and larval development and environmental factors affecting development of major aquaculture organisms.
5. Acquire knowledge about Endocrine system in fishes.

UNIT- I: Specialised organs in fish

- 1.1 Sense organs of fishes and crustaceans.
- 1.2 Specialized organs in fishes – electric organ, venom and toxins
- 1.3 Buoyancy in fishes- swim bladder and mechanism of gas secretion
- 1.4 Fish and Crustaceans of commercial importance

UNIT- II: Food, Feeding and Growth

- 2.1 Natural fish food, feeding habits, feeding intensity, stimuli for feeding, utilization of food, gut content analysis, forage ratio
- 2.2 Principles of Age and growth determination; growth regulation, Growth rate measurement – scale method, otolith method, skeletal parts as age indicators
- 2.3 Length-frequency method, age composition, age-length keys, absolute and specific growth, back calculation of length and growth, annual survival rate,
- 2.4 Length-weight relationship.

UNIT- III: Reproductive Biology

- 3.1 Breeding in fishes, breeding places, breeding habits & places, breeding in natural environment and in artificial ponds, courtship and reproductive cycles
- 3.2. Induced breeding in fishes
- 3-3 Breeding in shrimp, oysters, mussels, clams, pearl oyster, pila, and cephalopods.

UNIT- IV: Development

- 4.1. Parental care in fishes, ovo-viviparity, oviparity, viviparity, nest building and brooding
- 4.2 Embryonic and larval development of fishes
- 4.3 Embryonic and larval development of shrimp, crabs and molluscs of commercial importance
- 4.4 Environmental factors affecting reproduction and development of cultivable aquatic fin & shell fish

UNIT- V: Hormones & Growth.

- 1.1 Endocrine system in fishes.
- 1.2 Neuro-secretory cells, androgenic gland, ovary, chromatophores,
- 1.3 Molting, molting stages, metamorphosis in crustacean shell fish



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II SEMESTER

Course No.: 4 -Biology of Fin Fish & Shell Fish

Practical

Credits: 1

2 hrs/week

1. Length-weight relationship of fishes
2. Gut content analysis in fishes and shrimp
3. Mouth parts and appendages of cultivable prawns, shrimps and other crustaceans
4. Study of eggs of fishes, shrimps, prawns and other crustaceans
5. Study of oyster eggs
6. Embryonic and larval development of fish
7. Study of gonadial maturity and fecundity in fishes and shellfish
8. Observation of crustacean larvae
9. Study of nest building and brooding of fishes

PRESCRIBED BOOK(S)

1. Bone Q et al., 1995. Biology of fishes, Blackie academic & professional, LONDON.
2. Saxena AB 1996. Life of Crustaceans. Anmol Publications Pvt.Ltd., New Delh

REFERENCES:

1. Tandon KK & Johal MS 1996. Age and Growth in Indian Fresh Water Fishes. Narendra Publishing House, New Delhi.
2. Raymond T et al., 1990. Crustacean Sexual Biology, Columbia University Press, New York
3. Guiland J.A (ed) 1984. Penaeid shrimps- Their Biology and Management. 1.18Barrington FJW 1971. Invertebrates: Structure and Function.ELBS
4. 1.19Parker F & Haswell 1992. The text book of Zoology, Voll. Invertebrates (eds. Marshal AJ & Williams). ELBS & Mc Millan & Co.



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Single Major B.Sc Aquaculture (w.e.f:2023-24A.B)

Single Major
Model Question Paper
SEMESTER-II
B.Sc Aquaculture

Paper: Taxonomy and Functional Anatomy of Fin Fish and Shellfish

Time:3hrs

MAX MARKS: 70 M

SECTION-A

ANSWER ANY FIVE OF THE QUESTIONS

5×4=20M

1. Crustacea
2. Gill rakers
3. Hemocyanin
4. Fish Brain
5. Ovary of Fish
6. Hepatopancreas of Prawn
7. Decapoda
8. Placodermi

SECTION-B

5×10=50M

ANSWER ANY FIVE OF THE QUESTIONS

9. a) Write in detail about classification of Crustacea ?
OR
b) Write about the general characters of fishes?
10. a) Explain the Digestive system of Fish?
OR
b) Write an essay on respiratory system of Prawn?
11. a) Describe the structure and function of Fish heart?
OR
b) Write an essay on blood vascular system of Prawn?
12. a) Describe the Nervous system of fish?
OR
b) Describe the Nervous system of prawn?
13. a) Explain about the male reproductive system in fishes ?
OR
b) Describe the reproductive system in shrimp.



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Single Major
Model Question Paper
SEMESTER-II
B.Sc Aquaculture
Paper: Biology of fin fish & shell fish

Time:3hrs

MAX MARKS: 70

SECTION-A

ANSWER ANY FIVE OF THE QUESTIONS

5×4=20M

1. Electric organ in Fishes
2. Forage ratio
3. Courtship in Fishes
4. Viviparity
5. Androgenic gland
6. Shellfish
7. Swim bladder
8. Zooplankton

SECTION-B

5×10=50M

ANSWER ANY FIVE OF THE QUESTIONS

9. a) Write an essay on sense organs of fishes?
OR
b) Write about the commercial importance of Crustaceans?
10. a) Explain the fish age determination methods ?
OR
b) Write an essay on Length-weight relationship?
- 11.a) Write about the Induced breeding in fishes?
OR
b) Write about the breeding in Pila?
12. a) Describe the Embryonic development of fishes?
OR
b) Describe the larval development of shrimp?
13. a) Explain about the endocrine system in fishes?
OR
b) Describe the molting in crustaceans?
