VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM&SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN AQUACULTURE MANAGEMENT

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023& NEP, 2020

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN AQUACULTURE MANAGEMENT
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	2nd	III	**SEMESTER-III**							
			Major-3	**ACMHMJ03**	T: Fisheries Resources, Management, and Conservation; P: Practical	**4**	**3-0-1**	**15**	**60**	**75**
			Major-4	**ACMHMJ04**	T: Fish Nutrition and Feed Technology; P: Practical	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**ACMSEC03**	P: Field study	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC03**	Communicative English -2 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC03**	Multidisciplinary Course -3 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			Minor-3 (Disc.-I)	**ACMMIN03**	T: Aquatic Biodiversity and Conservation; P: Practical ***(To be taken by students of other Disciplines)***	**4**	**3-0-1**	**15**	**60**	**75**
					Semester-III Total	**20**				**375**
		IV	**SEMESTER-IV**							
			Major-5	**ACMHMJ05**	T: Post-Harvest Technology; P: Practical	**4**	**3-0-1**	**15**	**60**	**75**
			Major-6	**ACMHMJ06**	T: Anatomy & Physiology of Finfish & Shellfish; P: Practical	**4**	**3-0-1**	**15**	**60**	**75**
			Major-7	**ACMHMJ07**	T: Fish Disease & Immunology; P: Practical	**4**	**3-0-1**	**15**	**60**	**75**
			AEC	**AEC04**	MIL-2 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			Minor-4 (Disc.-II)	**ACMMIN04**	T: Fish health and disease prevention ***(To be taken by students of other Disciplines)***	**4**	**3-1-0**	**15**	**60**	**75**
			Summer Intern.	**INT**	Internship/ Apprenticeship - activities to be decided by the Colleges following the guidelines	**4**	**0-0-4**	**-**	**-**	**50**
					Semester-IV Total	**22**				**400**
					TOTAL of YEAR-2	**42**				**775**

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language

MAJOR (MJ)

MJ-3: Fisheries Resources, Management, and Conservation Credits 04(Full Marks: 75)

MJ-3T: Fisheries Resources, Management, and Conservation Credits 03

Course Objectives:

1. To have comprehensive knowledge on fisheries resources.
2. To learn about sustainable management practices for fisheries resources.
3. To explore conservation strategies for fisheries and aquatic biodiversity.

Course contents:

Classification of fisheries resources. Types of fisheries. Importance of fisheries in global and local economies. Fisheries as a source of food, livelihoods, and recreational activities. Trends, challenges, and future prospects of global and Indian fisheries. Fish diversity in different fisheries resources. Principles and objectives of sustainable fisheries. Ecosystem-based management approaches. Global challenges and opportunities in sustainable fisheries. Methods of estimation of fish population and maximum sustainable yield. Impacts of climate change on fish populations. Types of gears used in marine and freshwater fisheries. Community based fisheries resource management. Importance of conserving endangered and threatened fish species. Importance of seasonal restrictions. Strategies for fish habitat protection and restoration. Role of marine protected areas and freshwater sanctuaries. *In-situ* and *ex-situ* conservation strategies for fish species. Consrvation of fish migration routes and migratory species.

MJ-3P: Practical Credits 01

Practical:

Practical identification of fish/aquatic species and their ecological roles. Practical work on water quality testing, and stock assessment technique. Field visits to fish farms, marine, coastal and riverine ecosystems.

Suggested readings

1. Fish and Fisheries of India by V.G. Jhingran 3rd Edn. Hindustan Publishing Corporation. 1991.
2. Handbook of Fisheries and Aquaculture. ICAR Publication New Delhi.
3. Coldwater Fisheries of India. Edited by V. G. Jhingran and K. L. Sehgal, IFSI, Kolkata.
4. Management Systems for Riverine Fisheries. FAO Fisheries Technical Paper. FAO, 1986.
5. Reservoir Fisheries of India. by V.V. Sugunnan. FAO, 1995.
6. Principles of Fisheries Management by R. H. R. Francis.
7. Fisheries Management: A Manual for the Management of Fisheries by J. M. Kapetsky.
8. Fisheries Conservation and Management by K. J. H. Chao.

MJ-4: Fish Nutrition and Feed Technology **Credits 04(Full Marks: 75)**

MJ-4T: Fish Nutrition and Feed Technology **Credits 03**

Objectives

1. To have a basic understanding of fish nutrition and the functions of various nutrients.
2. To gain knowledge on the formulation and preparation of finfish & shell fish feed.

Course contents:

Fundamentals of fish nutrition and growth in fish. Principal nutrients and nutritional requirements of cultivable fish and shellfish. Nutritional energetics: definition and forms of energy partitioning. Methods of feed formulation and manufacturing. Forms of feeds: wet feeds, moist feeds, dry feeds, mashes, pelleted feeds, floating and sinking pellets. Feed additives: binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants. Feed storage: use of preservatives and antioxidants. Feed evaluation: feed conversion ratio, feed efficiency ratio, protein efficiency ratio, net protein utilization and biological value. Feeding devices and methods. Non-conventional feed ingredients and antinutritional factors. Digestive enzymes, feed digestibility. Factors affecting digestibility. Nutritional deficiency diseases.

MJ-4 P: Practical **Credits: 01**

Proximate composition analysis of feed ingredients and feeds. Formulation and preparation of artificial feeds. Determination of sinking rate and stability of feeds. Equipments and machineries used in feed production. Visit to commercial feed plant.

Suggested readings

1. ADCP (Aquaculture Development and Co-ordination Program). 1980. Fish Feed Technology, ADCP/REP/80/11. FAO., Rome.
2. De Silva, S. S. and Anderson, T. A. 1995. Fish Nutrition in Aquaculture, Chapman and Hall Aquaculture Series, London.
3. FAO training manual related to feed analysis.
4. Guillame, J., Kaushik, S., Berqot, P. and Metallier, R. 2001. Nutrition and Feeding of Fish and Crustaceans, Springer Praxis Publishing, Chichester, U.K.
5. Halver J. E. 1989. Fish Nutrition, Academic Press, San Diego, California.
6. Halver, J. E. and Hardy, R. W. 2002. Fish Nutrition. Academic Press, London.
7. Halver, J. E. and Tiews, K. T. 1979. Finfish Nutrition and Fish feed Technology Vol. I and II Heenemann, Berlin.
8. Hepher, B. 1988. Nutrition of Pond Fishes. Cambridge University Press, Cambridge.
9. Lovell, R. T. 1998. Nutrition and Feeding of Fishes. Kluwer Academic Publishers.
10. New, M.B. 1987. Feed and Feeding of Fish and Shrimp. A Manual on the Preparation and Preservation of Compound Feeds for Shrimp and Fish in Aquaculture. ADCP/REP/87/26 F.A.O. Rome.
11. Paulraj, R., 1993. Aquaculture Feed. CMFRI publication, 84 pp.

MJ-5: Post-Harvest Technology **Credits 04(Full Marks: 75)**

MJ-5T: Post-Harvest Technology **Credits 03**

Objectives

1. To study the muscle composition of fish, biochemical changes after death, spoilage processes, and preservation techniques.
2. To learn modern practices in fish handling, transportation, storage, product enhancement, and ensuring food safety standards.

Course contents:

Study of fish muscle structure. Structural and biochemical changes during postmortem. Factors affecting quality of fresh fish. Spoilage mechanisms, microbial growth, spoilage indicators, and determination of shelf-life. Proper handling of fish at landing centers and during transportation of raw fish. Refrigerated transport systems. Classification of transport vehicles. Cold chain management. Principles and methods of fish preservation and processing. Traditional fish processing methods. Low-temperature and chill storage of fish. Preparation of traditional and modern value-added fish products. Fish by-products utilization. Biochemical and pharmaceutical products from aquatic organisms. Physical, chemical, microbiological, and sensory changes during chill storage. Iced storage shelf life. Cold shock. Types of ice and their advantages. Packaging and storage of processed fish. Quality standards for processed and preserved fish. HACCP implementation for ensuring food safety.

MJ-5 P: Practical **Credits: 01**

Handling and icing of fresh fish. Measurement of fish freshness (organoleptic evaluation).Determination of shelf life under chilled and iced storage. Comparison of different types of ice and their efficiency. Preparation of dried, salted, and smoked fish. Study of packaging materials and shelf-life impact. Quality and safety analysis: Chemical tests: pH, TVBN, peroxide value, TMA. Microbiological analysis: total plate count, specific spoilage organisms. Identification of spoilage signs in different preservation methods. Quality assessment of market sample of dried and fermented fish products. Good hygiene and sanitation practices in lab/processing setup.

Suggested readings

1. Aitken A, Mackie M, Merritt SH & and Windsor ML. 1982. Fish Handling and Processing.
2. AkhilMathur. 2012. Food Processing, Packaging, Labeling and Marketing. Anmol Publications
3. AOAC manual
4. Balachandran KK. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publ. House.
5. George MH. 1992. Fish Processing Technology. VCH Publ.
6. Gopakumar K. (Ed.). 2002. Text Book of Fish Processing Technology. ICAR.
7. Hall GM. (Ed). 1992. Fish Processing Technology. Blackie.
8. Nambudiri DD. 2006. Technology of Fishery Products. Fishing Chimes.
9. Sen DP. 2005. Advances in Fish Processing Technology. Allied Publ.
10. Venugopal V. 2006. Seafood Processing. Taylor and Francis.
11. Wheaton FW and Lawson TB. 1985. Processing Aquatic Food Products. John Wiley and Sons.
12. Zeathen P. 1984. Thermal Processing and Quality of Foods. Elsevier.

MJ-6: Anatomy & Physiology of Finfish & Shellfish **Credits 04(Full Marks: 75)**

MJ-6T: Anatomy & Physiology of Finfish & Shellfish **Credits 03**

Objectives

1. To understand the anatomical and physiological systems of finfish and shellfish species.
2. To study the structure and function of finfish and shellfish systems.

Course contents:

Study of external and internal body structures of major finfish and shellfish species. Study of the digestive system and associated glands. Food and feeding habits of commercially important fishes; Methods of gut content analysis. Energy and nutrient status of food; Nitrogen balance; Standard and active metabolism; Energy utilization; Effect of environmental factors on the physiology of fish and shellfish. Stress-related physiological changes. Length-weight relationships. Age and growth determination. Study of circulatory, respiratory, nervous, excretory (urino-genital), osmoregulation, endocrine, skeletal, and sensory systems. Reproductive biology of finfish and shellfishes. Study of fish migration types, their biological significance, and tagging/marking techniques.

MJ-6: Practical **Credits: 01**

Study of internal organs of finfish and shellfish – digestive, respiratory, circulatory, urino-genital system, nervous, skeletal systems and endocrine system. Study of food and feeding habits - analysis of gut contents, length - weight relationship. Reproductive biology: maturity stages, spawning periodicity, fecundity, embryonic and larval stages. Estimation of oxygen consumption, Haematology of finfish and shellfishes.

Suggested readings

1. Barrington EJW. 1981. Invertebrate Structure and Function. 2nd edn. The English Language Book Society and Nelson.
2. Jobling M. 1995. Environmental Biology of Fishes. Chapman and Hall.
3. Tembhre, M. 1996. Anatomy and Physiology of Fishes. Vikas Publishing House.
4. William O. Reece and Rowe, Eric W. 2017. Functional Anatomy and Physiology.
5. Diwan. 2007. Physiology of Marine White Shrimp: *Fenneropenaeusindicus*. Delhi NPH.
6. Evans, 2014. Physiology of Fishes. Boca Raton CRC Press 2014, 4th Edition.
7. Hoar WS and Randall DJ.1988. Fish Physiology. Academic Press.
8. Johnston, 2014. Fish Physiology (Series 1-35 volumes) New Delhi Reed Elsevier India Pvt. Ltd.
9. Ray Samanta. 2015. Physiology of Finfish and Shellfish. New Delhi, New India Pub. Agency.
10. Rocha 2008. Fish reproduction. Enfield Science Publishers, Inc.

MJ-7: Fish Disease & Immunology **Credits 04(Full Marks: 75)**

MJ-7T: Fish Disease & Immunology **Credits 03**

Objectives

1. To understand fish and shellfish diseases, their diagnosis and management in aquaculture.
2. To study fish immune mechanisms, antigen detection, and recent developments in fish vaccination.

Course contents:

Fish Disease: Significance of fin Fish and Shellfish diseases in aquaculture. Principles of disease diagnosis in fin-fishes and shellfish. Disease surveillance and reporting Host, Pathogen and Environment Interaction. Stress in aquaculture and its role in disease development. Classification of fish disease. General characteristics, life cycle, diagnosis, prevention and treatment of common viral, bacterial, fungal, parasitic diseases (protozoan and metazoan) of finfish and shellfish. Immunology: Types of immunity: Innate and adaptive immunity, cell mediated and humoral immunity, cells and organs of the immune system in fishes. Antigen and antigens interaction. Epitopes, paratope, haptenes. Immunoglobulin in fishes with structure, classes and functions. MHC complex Specific and non-specific defense system in fish. Introduction to fish vaccine. Immunostimulant components.

MJ-7: Practical **Credits: 01**

Comparison of fresh and diseased fish and shellfish. Methods of sampling fish and shellfish for disease diagnosis. General procedure for disease diagnosis. Identification of common fish and shellfish diseases. Taxonomy, lifecycle and identification of fish and shellfish parasites. Techniques in disease diagnosis: Microbiological, Histopathological, immunological, molecular techniques and Biochemical tests. Collection, separation and identification of fish leucocytes. Separation of blood plasma and serum. Differential counting - RBC and WBC by Haemocytometer. Study of different types of leukocytes and macrophages.

Suggested readings

1. Pelczar, Michael J. 1993. Microbiology. Tata McGraw-Hill publishing Company Ltd., New Delhi.
2. Volk, A.W. and Wheeler, M.F. 1980. Basic Microbiology. J.B. Lippincott Company,London.
3. Ellis, A.E. 1990. Fish Immunology. John Wiley & Sons, New York.
4. Buchanan, R.E. and Gibbons, N.E. (Co-Eds.). 1975. Bergey's Manual of Determinative bacteriology. The Williams & Wilkins Company, Baltimore.
5. Swain, P., Sahoo, P.K. and Ayyapan, S. 2006. Fish and Shellfish Immunology – An Introduction. Narendra Publishing House, New Delhi
6. Biswas, K.P., Prevention and control of fish and prawn diseases.

MINOR (MI)

MI-3: Aquatic Biodiversity and Conservation **Credits 04 (Full Marks: 75)**

MI-3 T: Aquatic Biodiversity and Conservation (Theory) **Credits: 03**

Objectives

1. To provide understanding of aquatic biodiversity, including species, ecosystems, and their functions.
2. To learn the threats to aquatic biodiversity, and explore strategies for conservation and management.

Course contents:

Types of aquatic ecosystems, Aquatic ecosystems their function and services. Aquatic species: Fish, amphibians, invertebrates, algae, and aquatic plants. Threat to aquatic system and biodiversity. Invasive aquatic species and impact and management. Conservation strategies of biodiversity and habitat. International Conventions and Agreements. National and Regional Policies and Laws

MI-3 P: Practical **Credits: 01**

Practical Outline:

Identification of aquatic organism (vertebrates/invertebrate/microbes) and plants. Study on exotic/ invasive aquatic species and their impacts. Calculation of biodiversity index.

Suggested readings:

1. Aquatic ecosystems: trends and global prospects. Cambridge University Press. Aquatic Biodiversity: Science and Technology by Polunin, N.V. ed., 2008.
2. Aquatic biodiversity conservation and ecosystem services. Springer Singapore Nakano, S.I., Yahara, T. and Nakashizuka, T. eds., 2016. .
3. Freshwater fisheries ecology John Wiley & Sons. Craig, J.F. ed., 2015.
4. Marine Conservation Biology: The Science of Maintaining the Sea's Biodiversity. Gerrodette, T., 2007.
5. FAO Technical Papers on Aquatic Biodiversity and Conservation.

MI-4: Fish health and disease prevention **Credits 04 (Full Marks: 75)**

MI-4T: Fish health and disease prevention (Theory) **Credits: 04**

Objectives

1. To understand the principles of fish disease diagnosis, immune defense mechanisms, and vaccination strategies.
2. To identify and manage bacterial, viral, parasitic, and stress-related diseases in aquaculture.

Course contents:

Principles of disease diagnosis and fish health management. Specific and non-specific defense systems in fish. Fish immunization and vaccination. Bacterial diseases in fish, Protozoan and metazoan parasitic disease. Diseases due to environmental stress - thermal stress, stress due to oxygen deficiency, gas bubble disease, acidosis and alkalosis. Diseases due to nutritional imbalances. Important diseases of cultured fish and shell fishes - Bacterial, viral and fungal. Prevention and control of diseases, Prophylaxis and therapy of fish diseases

SKILL ENHANCEMENT COURSE (SEC)

SEC-3: **Field study on Aquaculture/ Post-harvest technology and quality control / Feed formulation & management (Practical)**

Credits: 03

To be carried out in Aquaculture farms/Processing plants/ Commercial Feed production unit or related organization/Institution

Duration: 3 weeks.

Assessment: Report-30 marks, Viva-voce- 10 marks,

INTERNSHIP / APPRENTICESHIP (INT)

Credit-04 Marks: 50 **(120 hours, 8 weeks)**

Guideline for internship/apprenticeship:

The internship program will commence at the beginning of the third semester and will be evaluated upon its completion at the end of the fourth semester.

Internship / Apprenticeship is mandatory course under the programme and every student to pursue an internship/ apprenticeship in any fisheries fish farm/fish processing industries/fish feed manufacturing industries/ ancillary industry or similar organization/ research institute of concerned field as per the guidance of the Course Coordinator/ College Authority.

General instructions:

a) The final report to be prepared as per the Internship / Apprenticeship guidelines issued by the University.
b) Each intern must maintain a daily logbook of activities. At the end of the internship, a completion certificate must be obtained from the mentor, supervisor, or concerned authority.
c) Interns are expected to strictly adhere to the assigned tasks and deadlines.