Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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ક્રમાંક :ઓથો./પરિપત્ર/૧૨૧૭૬/૨૦૨૫
તા.૦૨/૦૬/૨૦૨૫

પ્રતિ,
વડાશ્રી,
એકવેટીક બાયોલોજી ડિપાર્ટમેન્ટ,
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી,
સુરત.

વિષયઃ– M.Sc. Aquatic Biology Sem.-1 & 2 નો અભ્યાસક્રમ અને PO, PSO, CO અંગે.

સુજ્ઞ શ્રી,

સવિનય જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૫–૨૬ થી અમલમાં આવનાર M.Sc. Aquatic Biology Sem.-1 & 2 નો અભ્યાસક્રમ અને PO, PSO, CO અંગે એકવેટિક બાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૯/૦૪/૨૦૨૫ ની સભાના ઠરાવ ક્રમાંકઃ૦૨ થી કરેલ ભલામણ સ્વીકારી વિજ્ઞાન વિદ્યાશાખાની તા.૩૦/૦૪/૨૦૨૫ ની સભાનાં ઠરાવ ક્રમાંકઃ૩૩ થી કરેલ ભલામણ સ્વીકારી એકેડેમિક કાઉન્સિલની તા.૦૫/૦૫/૨૦૨૫ ની સભાનાં ઠરાવ ક્રમાંકઃ ૯૭ થી મંજુર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

કુલસચિવ

પ્રતિ,
૧) ડીનશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૨) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

SYLLABUS

For

M.Sc. (Aquatic Biology)

Semester I to II

Effective from 2025-26

Submitted by
Department of Aquatic Biology
Veer Narmad South Gujarat University
Surat-395007

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester I					
Theory Paper /Practical	Teaching schedule Hrs. /week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103:Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis and Fish physiology	12	12	45	105	150	06
Skill based papers						
AQB 106: Aquarium management for employment Or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester I

<table>
<tr><td>Course Code</td><td>101</td></tr>
<tr><td>Course Title</td><td>Aquatic Resources and their Management</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs.</td></tr>
<tr><td>Minimum weeks/semester</td><td>16 (Classwork, Practical, Examination, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The main purpose of the course is to make students acquainted with concepts of different types of aquatic resources and the way to manage them.</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is to make the student capable of understanding the types of aquatic ecosystems and aquatic resources along with the measures for their management.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Explain inland ecosystems and marine ecosystems to strengthen and develop the basic concepts to handle challenging situations in aquaculture sectors
CO2: Explain the types of important aquatic faunal resources available in the water bodies to develop theoretical and practical aspects can be developed
CO3: Explain the status of ornamental fish farming and trading possibilities, their transportation and management
CO4: Explain the management practices of aquatic resources including inland and marine to explore the aquaculture practices.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of biology and chemistry</td></tr>
<tr><td>Course Content</td><td>Unit – I: Inland Environment:
Origin, classification and distribution of rivers, Major River system of India and Gujarat
Origin, classification and distribution of lakes, Thermal stratification and thermal exchange in lakes.
Origin, classification and distribution of ponds
Classification and distribution of reservoir, important reservoir of Gujarat, transitional phases of reservoir
Classification, morphology and distribution of Estuaries, Lagoons and Coastal inlets
Unit – II Marine Environment:
Introduction, origin and zonation of ocean, sea bottom topography: Abyssal, canyons and trenches
Main physical (density, viscosity, surface tension, temperature) and chemical (major and minor constituents) properties of sea water
Introduction, origin and types of tides, currents and waves
Unit – III Aquatic resources:</td></tr>
</table>

	Fin fishes: major carps, catfishes, hilsa, mullet, sardine, mackerel Sport fishes and Ornamental fishes: Introduction and some important species Shell fishes: Prawn, shrimp and molluscs Aquatic plants: freshwater higher vascular plants, sea weeds, sea grasses and mangroves **Unit – IV Management of Aquatic resources** Aquatic resources management practices with reference to present and future aspect Concept of Integrated Water Resources Management (IWRM) - water allocation and water scheduling problem - equitable manners of water management Role of regulatory bodies in Management of aquatic resources (Pond, Lake, River, Sea, Estuaries and Reservoirs) Management of fishery resources
Reference Books	1. Barnes R.S.K. (1999). Introduction to Marine Ecology (3rd Edition), Blackwell Science, Oxford UK 2. Edmondson, W.T. (1976). Freshwater Biology 2nd Edn. John Wiley and Sons Inc. 3. Golterman, H.L., Clyno, R.S. and Ohnstad, M.A.M. (1978). Methods for physical and chemical analysis of freshwater.2nd Ed. IBP Handbook no.8 Blackwell scientific publication. 4. Grasshoff, K. Enrhardt, M. and Kreenling, K. (1983). Methods of seawater analysis. 2nd Ed. Verlag Chemical 5. Hutchinson, G.E. (1976). A Treatise on limnology. Vol. I & II John Wiley & sons. 6. Jeffery S. Levinton (2000). Marine Ecology, Biodiversity and Function. Oxford, UK 7. Jhingaran, V.G. (1985). Fish and Fisheries of India. Hindustan publication Corp., New Delhi. 8. Lecren, E.D. and Lowe-Mac Connel, R.H. (1980). The functioning of freshwater ecosystem. Cambridge University Press, UK. 9. Nair,B. N. and Thampy D.M. (1980). A text Book of Marine Ecology, Macmillan Co. India Ltd., Delhi, 10. Nybakaken, J.W. (2001). Marine Biology an Ecological Approach. 4th Edn, Addison Wessley Publishing, Boston. 11. Perkins, E.J. (1980). The Biology of Estuaries and coastal water. Academic Press, London. 12. Mishra, S R (2002). Management of Aquatic Habitats, Daya Publishing House, Delhi 13. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Second Ed.). Springer, Netherlands. 14. Mackie, G. 2005. Applied Aquatic Ecosystem Concepts (2nd Ed.). Kendall/Hunt Publishing, Dubuque, Lowa 15. Wetzel, R.G. 2001. Limnology. Lake and Reservoir Ecosystems (3rd Ed.). Academic Press, San Diego 16. Chapman, V.J. and D.J. Chapman, 1980. Seaweed and Their Use. Chapman & Hall, London

	17. Greene, Thomas F. 2004. Marine Science: Marine Biology and Oceanography, 2nd Edition. Amsco School Pub. Inc. 18. Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited 19. Biswas, K.P. 1996. A Textbook of Fish, Fisheries and Technology. 2nd ed. Narendra Publishing House., India 20. Jayaram, K.C. 1999. The Freshwater Fishes of the Indian Region. Narendra Publishing Company., New Delhi 21. Khanna, S.S. & H.R. Singh 2006. A Textbook of Fish Biology and Fisheries. Narendra Publishing House., India 22. Meenakshi, J., N.K. Yadava & R.K. Gupta. 2010. Freshwater Ornamental Fishes. Mangalam Publications, Delhi
Teaching Methodology	Classwork, Discussion, Self-Study, models and Assignment
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

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PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester I					
Theory Paper /Practical	Teaching schedule Hrs. /week	Exam Schedule			Total marks	Credit
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AQB 103:Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis and Fish physiology	12	12	45	105	150	06
Skill based papers						
AQB 106: Aquarium management for employment Or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester I

<table>
<tr><td>Course Code</td><td>102</td></tr>
<tr><td>Course Title</td><td>Aquatic Pollution and Toxicology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum week/semester</td><td>16 (Classwork, Practical, Examination, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to develop concepts of water pollution and toxicological studies and also to learn how to manage aquatic resources.</td></tr>
<tr><td>Course Objective</td><td>To develop skills in students to identify pollution load, biomarkers in aquatic resources and how to develop bioassays.
To acquire knowledge to monitor aquatic resources and conduct toxicity tests.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: To know about the sources of water pollution, the fate of pollutants in aquatic ecosystems, affluents, and their treatment and concept of toxicology.
CO2: Acquire knowledge to monitor pollution load, control and prevention of pollution by various methods.
CO3: Develop the skill to conduct toxicity tests i.e., Bioassay, Biostimulation and Bioinhibition
CO4: Acquire skill to identify Biomarkers as water quality monitoring tool.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
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</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology and chemistry</td></tr>
<tr><td>Course Content</td><td>Unit – I General Introduction:
Water pollution: Introduction, Sources and Fate of Pollutants
Interaction of pollutants in Aquatic resources
Role of Central Pollution Control Board (CPCB) and Gujarat Pollution Control Board (GPCB) in the management of pollution.
Unit – II Types of Pollution:
Sources, Fate, Biological Effects and Management of Thermal pollution, Oil pollution, Radioactive pollution, Detergent pollution and Acid rain
Unit – III Effluents and their treatment:
Introduction and characteristics of domestic, industrial and agricultural discharges. Biological concern: Eutrophication, Bioaccumulation and Biomagnification
Important methods for wastewater treatment.
Water quality standards and water quality indices.
Unit – IV Toxicology:
Toxicology: Introduction, concepts, principles and factors affecting the toxicity</td></tr>
</table>

	Classification of toxicants: metals, pesticides, teratogens, xenobiotics, toxins of animal and plant origin Toxicity test procedures: Bioassay, Biostimulation and Bioinhibition Biomarkers in Aquatic system
Reference Books	1. Agarwal, S.K. (2008). Water pollution, ABH publishing corporation, New Delhi 2. Albert, A. (1951). Selective toxicity, John Wiley and Sons, Chichester 3. Cremlyn, R. (1978). Pesticides, John Wiley and Sons, Chichester 4. Ghosh, G.K. (2002). Water of India, A.P.H. publishing corporation, New Delhi 5. Goel, P.K. (2006). Water pollution, New age international publishers, New Delhi. 6. Kukal S.S. and Dhaliwal, G.S. (2005). Essential of environmental science, Kalyani Publishers, Ludhiana 7. Prabhakar, V.K. (2001). Marine ecology & pollution, Anmol publications New Delhi. 8. Rand, G.M. (1995). Fundamentals of Aquatic toxicology, Taylor and Francis, Washington, D.C. 9. Rao, M.K. (2007). Environnemental pollution & Toxicology, Manglam Publishers, Delhi. 10. Salpekar, A.C. (2008). Marine pollution, Jnanada Prackashan, New Delhi 11. Schmitz, R.J. (1995). Introduction to water pollution Biology, Gulf publishing company, Texas 12. Sinha, P.C. (1998). Marine pollution, Anmol Publications, New Delhi 13. Trivedi, R.K. and Goel, P.K. (1984). Chemical & Biological methods for water pollution studies, Environmental publications, Karad 14. Trivedi, R.K. (2001). Aquatic Pollution & Toxicology, ABD publishers, Jaipur.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analysing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-I					
Theory Paper /Practical	Teaching schedule Hrs. /week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103: Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	12	45	105	150	06
Skill-based papers						
AQB 106: Aquarium management for employment OR Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester I

<table>
<tr><td>Course Code</td><td>103</td></tr>
<tr><td>Course Title</td><td>Fish Physiology and Endocrinology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks/semester</td><td>16 (Classwork, Practical, Examination, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The main purpose of the course is to make students acquainted with concepts of fish physiology, endocrinology and disease management in fishes.</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is to make the student capable of understanding the general physiological functions like respiration, digestion, excretion, circulation, osmoregulation, reproduction and development and endocrinology in fishes. The course also makes students capable of managing fish diseases.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: To understand the concept of fish physiological processes (digestion, respiration, circulation, excretion, osmoregulation, reproduction and development and endocrinology).
CO2: Help the student to develop the skill for reproduction and breeding management in the fish farming sector
CO3: Trains students to establish the breeding center for fishes which help to enhance the fish seed resources
CO4: Trains students to develop careers in fish seed production and farm management.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of biology and chemistry</td></tr>
<tr><td>Course Content</td><td>Unit – I
Digestion: Digestive system of fish and associated digestive glands (liver, pancreas and gall bladder), Mechanism of digestion.
Respiration: Structure and function of gills, Mechanism of respiration, haemoglobin–oxygen uptake and dissociation, Accessory respiratory organs.
Unit - II
Circulation: Structure and function of heart, Composition of blood.
Excretion: Structure and function of the kidney, Nitrogenous end products and pattern of excretion.
Osmoregulation: Introduction, Osmoregulation in freshwater, brackish water and marine fish.
Unit - III</td></tr>
</table>

	Reproduction and Development: Introduction of the reproductive system, types of reproduction, GSI, Structure, function and development of gonads. Fecundity, Fertilization, Incubation, Hatching, Larvae and Metamorphosis, Parental care in fishes. **Unit - IV** **Endocrinology:** Hormonal control of pineal, thyroid, pituitary gland in fishes, pancreatic hormone in fishes, pheromones in fishes, ecdysis in crustacean.
Reference Books	1. Evans, Devid H. (1998): Physiology of Fishes. R.R. Bowker Company, book trade association of Philadelphia. 2. Hoar, W. S. and Randal, D. J. (1993): Fish endocrinology Vol. I to VII. Academic press, INC (London) Ltd. 3. Hoar, W. S., Randal, D. J. and Farrell, A. P. (1992): Cardiovascular system, Vol. 12, Part 2 of Fish Physiology, Academic Press. INC London Ltd. 4. Khanna S.S. (1989): An Introduction to Fishes. Central Book Depot, Allahabad. 5. Khanna S.S. and Singh, H.R. (2003): A text book of fish biology and fisheries. Narendra publishing house, New Delhi – 110 006. 6. Nikolsky, G.Y. (1989): The ecology of fishes. Academic Press, London. 7. Pandey A.K. and Sandhu G.S. (1992): Encyclopedia of fishes and fisheries of India Vol. I & IV, Amol publication, New Delhi. 8. Prosser, C. L. (1973): Comparative Animal Physiology, W. B Sounders Co., Philadelphia 9. Smith, L.S. (1982): Introduction of fish physiology. Narendra publishing house, New Delhi. 10. Yadav, B. N. (2006): Fish & Fisheries, Daya Publishing House, New Delhi. 11. Yadav, B.N. (1995): Fish endocrinology. Daya Publishing House, New Delhi. 12. Anderson, D.P. (2003): Text book of fish Immunology, Narendra publishing house, Delhi 13. Austin, B. (1999): Bacterial fish pathogen-Disease of farmed and wild fish, Paraxis publishing Ltd., U.K 14. Conroy, D.A. (1997): Textbook pf fish diseases, Narendra publishing house, Delhi 15. Cornell, J.J. (1995): Control of fish quality, Fishing new books 16. Duijn, C.V. (2000): Diseases of fishes, Narendra publishing house, Delhi 17. Inglis, V. (1993): Bacterial diseases of fish, Blackwell science Ltd., Oxford, U.K. 18. Roberts, R.J. (1982): Microbial diseases of fish, Society for general microbiology academic press, New York, USA 19. Roberts, R.J. (1978): Fish pathology, Baillere Tindall, Landon

	20. Sharma, O.P. (2009): Handbook of fisheries and aquaculture, Agrotech publishing academy, Udaipur 21. Wedemeyer, G.K. (1999): Environmental stress and fish diseases, Narendra publishing house, Delhi 22. Woo, P.T.K. and Leatheland, F. (1998): Fish diseases and disorders, CABI publishers, Wallingford
Teaching Methodology	Classwork, Discussion, Self-Study, and Assignment
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programme is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-I					
Theory Paper /Practical	Teaching schedule Hrs. /week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103: Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	12	45	105	150	06
Skill-based papers						
AQB 106: Aquarium management for employment OR Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester 1

Course Code	**104 A**
Course Title	**Instrumentation (Elective paper)**
Credit	4
Teaching per week	4 hrs.
Minimum weeks/semester	16 (Classwork, Practical, Examination, Holidays etc.)
Effective from	2025-26
Purpose of course	The purpose of the course is to develop the operation skill of the instrument that helps to analyze the different physical, chemical and biological parameters.
Course Objective	To create awareness and apprise the instrument operation among the students.
Course Outcome	**CO1** Aware and trained the students for safe work procedures and handling of the instruments in the laboratory. **CO2** Elucidate the principle of instruments that help students to understand the instrument and analysis process. **CO3** The students are proficient in using the advances technology and instruments to speed up the analysis process and error-free results. **CO4** The working procedure of instruments is elaborated in detail which would enable us to learn about the application of different instruments in the field of Aquatic Biology. **CO5** Care and maintenance of the laboratory instruments explained in the class help to longer uses of the instruments.
Mapping of COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

Course prerequisite	Microscopes, Centrifuge machine, Electrophoretic and water analyser unit
	Unit – I Microscopy: Microscopes: Introduction, principle and structural description Types of microscopes: Simple microscope, compound microscope (Student's microscope, Stereoscopic microscope, Phase contrast microscope, fluorescence microscope and interference microscope) and Electron microscope **Unit – II Photometry:** Introduction, principle and application of Colorimeter, Spectrophotometer, (Single bean & double beam), Infrared, NMR and Mass spectrometer **Unit – III Separation method:** **(A) Centrifuge and Centrifugation:** Centrifuge: Introduction, different parts and types of centrifuges Centrifugation: Introduction, principle and types (Differential centrifugation and Density gradient centrifugation) **(B) Chromatography and Electrophoretic:**

	Chromatography: Introduction, Principle and types of chromatography Electrophoresis: Introduction, Principle and types of electrophoresis Blotting: Introduction, types and function **Unit – IV Water quality analysers:** Introduction, structure, principle and operation of water quality analysers (Conductivity meter, pH meter, Salino meter, DO meter, turbidometer, COD reflaxor (close and open) and BOD analyser)
References	1. Brown, S.B. (1980). An introduction to spectroscopy for Biochemists, Academic press, London, New York. 2. Robertis, E.D.P. and Robertis, E.M.F. (2001). Cell and Molecular Biology, Lippincott Williams & Wilkins, London 3. Hawcroft, D.M. (1996). Electrophoresis. The Basics IRL press, Oxford. 4. Jenning, W.G. (1993). Analytical Gas chromatography. Academic Press. New York. 5. Skoogs, H.P. and Nieman, M. (2006). Principle of Instrumental analysis. Thomson Inc. Ltd.
Teaching methods	Chalk and talk, Discussion, Videos, Self-study, Seminars and Assignments
Evaluation methods	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-I					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103: Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis and Fish physiology	12	12	45	105	150	06
Skill-based elective papers						
AQB 106: Aquarium management for employment OR Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester I

<table>
<tr><td>Course Code</td><td>104-B</td></tr>
<tr><td>Course Title</td><td>Computer Application</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks/semester</td><td>16 (Classwork, examination, preparation, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The main purpose of the course is to make students acquainted with concepts of different types of computer applications and its use in research, presentation and management of aquatic resources</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is to make the student capable of understanding how the computer works and the importance of various components of computers. This course will also help students to process data and present it. After successful completion, students will be able to use different aspects of computer that are useful in research activities. Related to fisheries, pollution and aquatic resources management.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Reveal a basic understanding of computer hardware, software and operating system
CO2: Helps to gain problem-solving skills for managing aquatic environment and their resources
CO3: Capable of presenting research work effectively.
CO4: Capable of understanding basics of network principles.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of biology and chemistry</td></tr>
<tr><td>Course Content</td><td>Unit – I
Computer and GUI Based Operating System
Introduction, History of Computers, Characteristics of Computer System, Computer and Latest IT gadgets and their applications
Components of Computer System: Hardware, Software
Introduction to GUI Based Operating System
The User Interface: Task Bar, Icons, Start Menu, Running an application, Simple Setting of Operating System
Unit – II
Processing of Word, Excel and PowerPoint
Basics: Title Bar, Menu Bar, Toolbars & Sidebar, creating a New Document, Opening and Closing Documents, Save and Save As Document, Page Setup, Print Preview, Printing of Documents and Saving a Document as PDF file, Word Document Creation, Formatting the Text, Table Manipulation, Mail Merge, Shortcut Keys
Excel Elements of Spread Sheet, Manipulation of Cells and Sheet, Formulas, Functions and Charts</td></tr>
</table>

	PowerPoint Creation of Presentation, Manipulating Slides, Presentation of Slides, Providing Aesthetics to Slides & Printing **Unit-III** Internet and WWW Introduction, Basic of Computer Networks: Local Area Network (LAN), Wide Area Network (WAN), Network Topology Internet: Concept of Internet & WWW, Applications of Internet, Website Address and URL, Introduction to IP Address, ISP and Role of ISP, Internet Protocol, Modes of Connecting Internet (Hotspot, Wi- Fi, LAN Cable, Broadband, USB Tethering), Identifying and uses of IP/MAC/IMEI of various devices Popular Web Browsers, Exploring the Internet: Surfing the web, Popular Search Engines, Searching on Internet, Downloading Web Pages, Printing Web Pages **Unit-IV** E-mail, Social Networking and e- Governance Services Introduction and Structure of E-mail Using E-mails Social Networking for researcher, Introduction to Blogs, Basics of E-commerce, Netiquettes, Academic Research Databases Overview of e-Governance Services in education and fisheries sector Accessing e-Governance Services on Mobile Using "UMANG APP" Digital Locker, Application of computer, computerized information and data analysis in fisheries Introduction to various statistical packages and development of programmes and their use in biological data analysis
Reference Books	1. V.Rajaraman, 2002, Fundamentals of Computers, 3rd Edition, Prentice Hall ofIndia. 2. Marilyn W. Meyer and Roberta L. Baber, Computers in your future, 2nd Edition Prentice Hall of India. 3. Chris Ewin (Author), Carrie Ewin (Author), Cheryl Ewin (Author),2017, Computers for Seniors: Email, Internet, Photos, and More in 14 Easy Lessons 1st Edition, No Starch Press 4. Computer Fundamentals: Concepts, Systems & Applications- 8th Edition Priti Sinha, Pradeep K, Sinha 5. Michael Miller, 2007, Absolute Beginner's guide to computer Basics, Fourth Edition, Pearson Education 6. Deborah Morley, Charles S. Parker,2007, Understanding computers today and tomorrow, 11th edition, Thomson
Teaching Methodology	Classwork, Discussion, Self-Study, models and Assignment
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester I					
Theory Paper /Practical	Teaching schedule Hrs. /week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103:Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis and Fish physiology	12	12	45	105	150	06
Skill based papers						
AQB 106: Aquarium management for employment Or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester I

<table>
<tr><td>Course Code</td><td>105</td></tr>
<tr><td>Course Title</td><td>Water & Sediment analysis and Fish physiology</td></tr>
<tr><td>Credit</td><td>6</td></tr>
<tr><td>Teaching per Week</td><td>12 Hrs.</td></tr>
<tr><td>Minimum weeks/semester</td><td>16 (Classwork, Practical, Examination, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The main purpose of the course is to make students acquainted with the practical concepts. The student will gain the knowledge for analysis of water and sediment and the use of different types of instruments used for specific analysis. The purpose of the course is also to develop skill regarding fisheries technology.</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is to make the student capable of analysing different physico chemical parameters in water and sediment. Students will be capable of handling instruments used for analysis of water and sediment parameters. Students will develop skill in feeding, breeding, growth aspects of fishes and the concept of anatomical structure of different organs of fishes</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students will be capable of estimating different physicochemical parameters in both water and Sediments for the management of fisheries
CO2: Develop skills for standardization and measurement of water quality by using instruments like Turbidometer, pH meter, Colorimeter, Conductivity meter, Salinometer, Autoclave, Centrifuge, incubator, hot air oven, Spectrophotometer, Sechhi disc
CO3: Gain practical knowledge by field visits to different sewage/water treatment plants
CO4: Students will be able to develop the skill to find the feeding pattern of fish by dissecting the buccal cavity and associated structures (Gill rackers, Bucco pharynx), Gut content analysis, and GaSI.
CO5: Students will be able to develop the skill to measure fecundity, egg diameter, and Gonadosomatic index of fishes
CO6: Students will be capable of using different computer applications</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of biology and chemistry</td></tr>
<tr><td>Course Content</td><td>Unit I
Physical properties of water
Gravimetric method to estimate the Total solids, Total suspended solids and Total dissolved solids
Photometric/Colorimetric method to estimate the Turbidity and Transparency</td></tr>
</table>

	Electrometric method to estimate the Conductivity and Salinity **Unit II** **Chemical properties of water** Titrimetric method to estimate the Dissolved oxygen, Carbon dioxide, Alkalinity (PA and TA), Hardness (Total, Ca and Mg), Chloride, BOD and COD Colorimetric/Photometric method to estimate the Nitrate, Nitrite, Inorganic Phosphate, Silicate, Ammonia and Sulphate Electrometric method to estimate the pH **Unit III** **Physical properties of sediment:** Organic matter, Moisture, Water holding capacity, Bulk density, Particle density, Porosity and Texture **Unit IV** **Chemical properties of sediment:** Nitrate, Nitrite, Inorganic Phosphate, Silicate and Ammonia **Unit V** **Haematological parameters:** Preparations and observations of micronuclei in fish blood, Structure of blood cells, Counting of RBC and WBC, Haemoglobin content and Haematocrit value **Unit VI** **Biological parameters of fish:** Gut content analysis and Gastrosomatic Index (GaSI) Study of buccal cavity and associated structures (Gill rackers, Bucco pharynx) Measurement of fecundity, Egg diameter and Gonadosomatic Index (GSI)
Reference Books	1. APHA (2005). Standard method for the examination of water and wastewater, American Public Health Association, E.G. Arnold, S.C. Lenore, A.E. Eaton (Eds.), Washington. 2. Trivedy, R.K. and Goel, P.K (1986). Chemical and biological methods for water pollution studies, Environmental publication, Karad. 3. Skoogs, H, P.and Nieman, M (2006). Principle of Instrumental analysis. Thomson Inc Ltd. 4. Brown, S.B (1980). An introduction to spectroscopy for Biochemists, Academic press, London, New York
Teaching Method	Practical performance and demonstration, Discussion, Self-Study, ICT, Field visit
Evaluation Method	Internal assessment (30%) and External assessment (70%) are based on practical performance, journal preparation and viva-voce examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester I					
Theory Paper /Practical	Teaching schedule Hrs. /week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103:Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis and Fish physiology	12	12	45	105	150	06
Skill based papers						
AQB 106: Aquarium management for employment Or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester I

<table>
<tr><td>Course Code</td><td>106</td></tr>
<tr><td>Course Title</td><td>Aquarium Management for Employment</td></tr>
<tr><td>Credit</td><td>2</td></tr>
<tr><td>Teaching per Week</td><td>2 Hrs.</td></tr>
<tr><td>Minimum weeks/semester</td><td>16 (Classwork, Practical, Examination, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to make the student able of implementing the concepts and techniques of Aquarium management and develop the opportunity for employment.</td></tr>
<tr><td>Course Objective</td><td>To make students familiar about Introduction to aquaculture and ornamental fishes trading, Introduction to ornamental fishes, Construction of aquarium as well as Maintenance and management of aquarium.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students will able to understand about world trading of ornamental fish and its potential in export for aquaculture entrepreneurship.
CO2: Students will able to gain the basic knowledge about aquarium and it's accessories, aquarium plants as well as ornamental fishes in world for successful Aquarium management.
CO3: This paper gives detail idea about public fresh water and marine aquaria as well as oceanarium which cover all aspects of aquarium construction.
CO4: Explain and train students to deal with management of ornamental fish diseases and feeding which helps to enhance the fish quality for revenue generation.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Zoology and Fisheries</td></tr>
<tr><td>Course Content</td><td>UNIT-I
Introduction, history and present scenario of aquaculture. World trading of ornamental fish and export potential. Ornamental fisheries new dimensions in aquaculture entrepreneurship.
Introduction to aquarium and aquarium accessories. Profile and information of ornamental fishes and selected aquarium plants in the world and India.
UNIT- II
Design, settings up and maintenance of fresh water and marine aquaria. Introduction and construction of ornamental fish breeding unit and Ornamental fish farm.
Ornamental fish diseases management, feeding management and maintenance of aquarium.
Aquascaping: Introduction, types, setup and management</td></tr>
</table>

Reference Books	1. Hawlins, A.D. (1981). Aquarium Systems. Academic Press. 2. Hunnam, P. Ward Lock, Living Aquarium. 3. Ratjak, K. and Zukal, R. (1971). Aquarium Fishes and Plants. Spring Books, London. 4. Spotte, S. (1979). Seawater Aquariums. John Wiley and Sons, New York. 5. Straughan, R. P. L. (1970). Salt water Aquarium in the Home. (2nd Ed.), A.S. Barnes & Co., NY. 6. Mills, D. (1987). Illustrated Guide to Aquarium Fishes. Galley and Price, an imprint of W.H. Smith and Sons Limited, England. 7. Spotte, S. (1993). Marine Aquarium Keeping. (2nd Ed.), A Wiley-Interscience Publication. 8. Mills, D., Vevers, G., Campbell and Douglas G. (1982). The Practical Encyclopaedia of Tropical Aquarium Fishes. Salamander Books Limited, London. 9. Carcasson, R.H. (1977). A Field Guide to the Coral Reef Fishes of the Indian and West Pacific Oceans. Collins, London. 10. Hargreaves, V.B. (1978). The Tropical Marine Aquarium. McGraw-Hill Book Company. New York. 11. Smith, G. N. (1979). Profitable Fish Keeping. Saiga Publishing Company, Limited. 12. Melzak, M. (1984). Marine Aquarium Manual. Acro pub. 13. Tekrival, K. L. and Rao, A. A. (1999). Ornamental Aquarium Fishes of India. Kingdom Books, Havant. 14. Cato, J. C. and Brown, C. L. (2008). Marine Ornamental species (collection, culture and conservation). (1st Ed.) Wiley -Blackwell.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments, etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analysing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs./week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	04	03	30	70	100	04
AQB 202: Fish Nutrition and feed Technology	04	03	30	70	100	04
AQB 203: Fish Genetics and Biotechnology	04	03	30	70	100	04
Elective papers						
AQB: 204 A: Fisheries legislation AQB: 204 B: Biostatistical Analysis	04	03	30	70	100	04
Practical:						
AQB 205: Fisheries Technology, Biochemistry and Genetics	12	12	45	105	150	06
Skilled based paper						
AQB- 206 Fish Products and Byproducts technology OR Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester II

<table>
<tr><td>Course Code</td><td>201</td></tr>
<tr><td>Course Title</td><td>Fisheries Technology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs.</td></tr>
<tr><td>Minimum weeks/semester</td><td>16 (Classwork, Examination, Preparation, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to introduce different fisheries technologies and its applications which would help and develop the skill among students for development of fisheries sectorin scientific way.</td></tr>
<tr><td>Course Objective</td><td>To introduce different fisheries technologies which would be helpful in finding, harvesting, handling, processing and distribution of aquatic resources and their products.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Explain students about seed production technologies including hatcheries and induced breeding which gives idea about fisheries management in concern to get pure and desired spawn of certain species of fishes and habitat conservation.
CO2: Students will be aware regarding transportation as well as age and growth of fishes which are essential for sustainable fish farming and population studies.
CO3: The students will be able to acquire the knowledge about fishing techniques to catch fishes in large scale from waterbodies efficiently for fishery research and management.
CO4: This paper deals with post-harvest technology which helps to maintain quality (appearance, texture, flavour and nutritive value) to protect food safety, and to reduce losses between harvest and consumption.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Fisheries Science</td></tr>
<tr><td>Course Content</td><td>Unit – I
Hatcheries: Types of Traditional, Circular, Vertical hatcheries, Shrimp/Prawn hatcheries and hatchery Management (Japanese, Galveston, Indian).
Induced breeding: Selection of brooders, extraction of pituitary gland, preparation of dosage and injection, spawning and fertilization, stripping method, use of inducing agents in induced breeding, Eyestalk ablation technique in shrimp.
Unit – II
Transportation: Causes of mortality during transportation, methods for transportation (traditional and modern) of fish seeds, fingerlings, brooders and trout eggs, use of chemicals in live fish transportation.</td></tr>
</table>

	Age and growth of fishes: Utility and methods for determining age and growth, study of maturity, mortality and yield, factors affecting the age and growth. **Unit – III** **Techniques for Fishing:** Introduction of fishing crafts, types of fishing crafts (mechanized and non-mechanized) Introduction of fishing gears, types of fishing gears (Traditional, conventional, non-conventional and Active, Passive), Maintenance and preservation of fishing gears. **Remote sensing:** Mechanism, satellites and cameras, Importance and Application of remote sensing in Aquatic biology. **Unit – IV** **Post-harvest technology:** Principles and techniques of processing and preservation, chilling, freezing, drying, salting, smoking, canning, pickling, pasting, preservation with chemicals, preservation by exposure of gamma rays, modern techniques of preservation, packaging of fish and fish products, Effect of processing and preservation on nutritive aspects of fish, fishery products and by-products.
Reference Books	1. Agrawal, S. C. (1994). A Hand Book of Fish Farming. Narendra Publishing House, Delhi. 2. Balachandran, K. K. (1998). Advances and Priorities in Fisheries Technology. Cochin. 3. Biswas, S. P. (2002). Fundamentals of Ichthyology. Narendra Publishing House, Delhi. 4. Deekshatulu, B. L. and Rajan, Y. S. (1984). Remote Sensing. Indian Academy of Sciences, Banglore. 5. Felix, S. (2007). Aquaculture Management Techniques. Narendra Publishing House, New Delhi. 6. Gupta, S. K. and Gupta, P. C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. 7. Harrison, P.J. and Parsons, T.R. (2000). Fisheries Oceanography. Blackwell Science. 8. Jhingran, V. G. (2007). Fish and Fisheries of India (3rd Ed.). Hindustan Publishing Corporation. New Delhi. 9. Joseph, J. (2009). Post-Harvest Technology of Freshwater Fish. Central Institute of Fisheries Technology, Cochin. 10. Khanna, S. S. and Singh, H. R. (2003). A Text Book of Fish Biology and Fisheries. Narendra Publishing House, Delhi. 11. Krjstjonsson, H. (1959). Modern Fishing Gear of the World. Vol. I to III, Fishing news (books) Ltd., England. 12. Meenakumari, B. (2009). Handbook of Fishing Technology. Central Institute of Fisheries Technology, Cochin. 13. Moyle, P.B. (2002). Fishes-An Introduction to Ichthyology. Prentice Hall Inc. NJ 07458. 14. Nikolsky, G.V. (1999). Ecology of Fishes, Allied Scientific Publishers.

	15. Rao, D.P. (1995). Remote Sensing for Earth Resources. Association of Exploration Geophysicists, Hyderabad. 16. Regenstein, J.M. and Regenstein, C.E. (1997). Introduction to Fish Technology. CBS Publishers and Distributors, New Delhi. 17. Sabins, F.F. (1997). Remote Sensing, Principles and Interpretation. W.H. Freeman & Co., New Delhi. 18. Sharma, O.P. (2009). Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur. 19. Sreekrishna, Y. and Shenoy, L. (2001). Fishing Gear and Craft Technology. Indian Council of Agricultural Research, New Delhi. 20. Welcomme, R.L. (2007). Inland Fisheries. Discovery Publishing House, New Delhi. 21. Yadav, B.N. (1997). Fish and Fisheries. Daya Publishing House, Delhi. 22. Yadav, N.K. (2009). Management Practices in Fish Farming. Manglam Publications, Delhi. 23. Ayappan, S (2011). Handbook of Fisheries and Aquaculture. ICAR, New Delhi.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT and Field visit
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programme is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	04	03	30	70	100	04
AQB 202: Fish Nutrition and feed Technology	04	03	30	70	100	04
AQB 203: Fish Genetics and Biotechnology	04	03	30	70	100	04
Elective papers						
AQB: 204 A: Fisheries legislation AQB: 204 B: Biostatistical Analysis	04	03	30	70	100	04
Practical:						
AQB 205: Fisheries Technology, Biochemistry and Genetics	12	12	45	105	150	06
Skilled based paper						
AQB- 206 Fish Products and Byproducts technology OR Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester II

<table>
<tr><td>Course Code</td><td>202</td></tr>
<tr><td>Course Title</td><td>Fish Nutrition and Feed Technology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs.</td></tr>
<tr><td>Minimum weeks/semester</td><td>16 (Classwork, Examination, Preparation, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The main purpose of the course is to make students acquainted with concepts of Fish Nutrition, fish Biochemistry and Feed Technology</td></tr>
<tr><td>Course Objective</td><td>The objectives of the course is to make the student capable of understanding the general fish nutrition, biochemistry, Chemical and Biological analysis and different methods used in fish feed Technology.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: The course explains the fish nutrition requirements to manage the fishery resources
CO2: Enhance the knowledge regarding proximate and biological analysis of feed and fish.
CO3: Explain the skills required in feed technology.
CO4: Explain the skill to measure Gastro-somatic Index (GaSI), Feed Conversion Ratio (FCR), Food Conversion Efficiency (FCE), Protein Efficiency Ratio (PER), Productive Protein Value (PPV), Net Protein Utilization (NPU) to manage fish resources in natural resources and farms
CO5: Explain the process of feed formulation, feed processing and feed manufacture</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of biology and chemistry</td></tr>
<tr><td>Course Content</td><td>Unit – I
Fish nutrition: Introduction and Principles of nutrition. Nutritional requirements of fin fish and shellfish, Factors affecting nutritional requirements
Feeding evaluation: Feed dispensing devices, ration size/feeding rate, feeding frequency, check trays, restricted feeding, mixed feeding.
Unit - II
Biochemistry: Introduction, classification and function of nutritional compounds (Protein, Lipid, Carbohydrates, Vitamins and Minerals)
Nutritive value of live food: Algae, Artemia, Cladocerans, Ostracods, Rotifers and Copepods as fish food
Proximate composition of fish and feed
Unit – III
Biological evaluation:</td></tr>
</table>

	Growth evaluation: Feed Conversion Ratio (FCR), Food Conversion Efficiency (FCE), absolute growth, relative growth. Specific Growth Rate (SGR), weight gain (%), Digestible growth coefficient (DGC), Gastro-somatic Index (GaSI) **Protein evaluation:** Protein Efficiency Ratio (PER), Productive Protein Value (PPV), Net Protein Utilization (NPU). **Unit - IV** **Feed Technology:** Feed ingredients: Introduction, sources and anti-nutritional factors, Feed formulation, feed formulation methods (traditional and advances) Feed attractants, binders, growth promoters (antibiotics, probiotics), colouring and flavouring agents, **Types of feed:** pellets, flakes, powdered, micro-encapsulated, micro-bound and micro-coated diets, Compact pellet feed, floating and sinking pellet feeds **Feed processing:** Machineries, Effects of processing on the nutritional value of feeds, Feed Packing and storage.
Reference Books	1. ADCP (Aquaculture Development and Co-ordination Programme) (1980). Fish Feed Technology, ADCP/REP/80/11.FAO, Rome. 2. D' Abramo, LR., Conklin, D.E and Aklyama. D.M, (1977). Crustacean Nutrition: Advances in Aquaculture Vol. 6. World Aquaculture Society, Baton Roughe, L.A. 3. Evans, D.H. and Claiborne, J.B. (2006). The Physiology of fishes. CRC press. 4. Guillame, J., Kaushik, S., Berqot P., and Metallier, R., (2001). Nutrition and feeding of fish and crustaceans, Springer Praxis Publishing, Chichester, UK. 5. Halver J.E. (1989). Fish Nutrition, Academic Press, San Diego, CA. 6. Halver, J and Hardy, R.W. (2002). Fish nutrition. Academic press, London. 7. Halver, J.E, and Tlews, K.T. (1979). Finfish nutrition and fish feed technology Vol. I and II Heenemann, Berlin. 8. Hepper, B. (1988). Nutrition of pond fishes. Cambridge Univ. Press, Cambridge, UK. 9. Houlihan, D., Boujard, T and Jobling, M. (2001). Food intake in fish. Blackwell science, Ltd, London. 10. Joachim W. Hertrampf and Felicitas Piedad-Pascual. (2000). Handbook on ingredients for aquaculture feeds. Kluwer Academic Publishers, London 11. Jobling, M. (1994). Fish Bioenergetics. Chapman & Hall. London 12. Keith Wilson and John Walker. (1995). Principles and Techniques of Practical Biochemistry. Cambridge University Press. 13. Lovell, R.T. (1998). Nutrition and Feeding of Fishes, Chapman & Hall, New York. 14. 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. F.A.O. Rome –

	15. Rechcigl, M. (1977). CRC Handbook series in nutrition and food. CRC press. 16. Rechcigl, M. (1981). Handbook of nutritional supplements in a functional context. CRC press. 17. Sena S. De Silva, Trevor A. Anderson. (1995). Fish Nutrition in Aquaculture, Chapman & Hall Aquaculture Series, London 18. Guillame, J., Kaushik, S., Berqot, P. and Metallier, R. 2001. Nutrition and Feeding of Fish and Crustaceans. Springer Praxis Publishing, Chichester, U. K.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT and Field visit
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programe is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	04	03	30	70	100	04
AQB 202: Fish Nutrition and feed Technology	04	03	30	70	100	04
AQB 203: Fish Genetics and Biotechnology	04	03	30	70	100	04
Elective papers						
AQB: 204 A: Fisheries legislation AQB: 204 B: Biostatistical Analysis	04	03	30	70	100	04
Practical:						
AQB 205: Fisheries Technology, Biochemistry and Genetics	12	12	45	105	150	06
Skilled based paper						
AQB- 206 Fish Products and Byproducts technology OR Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester II

<table>
<tr><td>Course Code</td><td>203</td></tr>
<tr><td>Course Title</td><td>Fish Genetics and Biotechnology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks/semester</td><td>16 (Classwork, Examination, Preparation, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to develop the skill about executing the different scientific methods of Fish genetics and biotechnology in field of Aquatic Biology with reference to improving aquaculture production and quality.</td></tr>
<tr><td>Course Objective</td><td>To make the students acquaint regarding fundamentals of molecular biology, principle of fish genetics, fish biotechnology, bioinformatics, nanotechnology and its applications.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Inculcate students about fundamentals of Molecular biology like structure of DNA and RNA, DNA replication, mutation, transcription and translation to understand formations, actions, and regulations of various parts of cells which can be used to efficiently target new drugs, diagnose disease and understand the physiology of the cell.
CO2: Explain students about structure of chromosome with help of banding techniques, fish as a cytogenetic model, application of molecular biology techniques like sex-reversion, chromosomal manipulation and transgenic fish for increasing aquaculture production by genetically modifying aquatic organisms and fish population management.
CO3: This paper describes scope and application of fish biotechnology with the help of different techniques like PCR, cryopreservation and vaccination which helps in mmolecular and genetic diagnostics as well as genetic upgradation of cultivable species with minimum risk of infection.
CO4: Train students to deal with bioinformatics and nanotechnology in the field of Aquatic Biology. It provides the skillful digital database information which certainly required for aquatic resource management.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
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<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Genetics and Biotechnology</td></tr>
<tr><td>Course Content</td><td>Unit - I
Fundamentals of Molecular Biology
DNA as a genetic material, DNA replication and Mutations, Structure and Types of RNA, Transcription, Protein synthesis. Recombinant DNA technology, DNA barcoding.
Unit - II
Principle of Fish Genetics</td></tr>
</table>

	Chromosome study: Fish chromosome preparation method, Banding techniques, Fish as a cytogenetic model. **Genetic manipulation:** Sex-reversion and sex control, Chromosomal manipulation. **Transgenic fish** **Unit - III** **Fish Biotechnology:** Scope and application. PCR technique, Cryopreservation, Vaccination, Hybridization. **Unit - IV** **Bioinformatics:** Use of computers in Bioinformatics, Search engines and databases, Application of Bioinformatics in Aquatic Biology. **Nanotechnology:** Introduction, History, Applications in Aquatic Biology.
Reference Books	1. Lesk, A. M. (2003). Introduction to Bioinformatics Oxford Uni. Press. 2. Falcon, D. S. (2000). An Introduction to Quantitative Genetics. ELBS Publisher, England. 3. Lakra, W. S. (2000). Fish Genetics and Biotechnology. CIFE, Mumbai. 4. Benjamin, L. (2008). GENES- IX London, Jones & Bartler Publ. 5. Claverie, M. and Notredame, C. (2003). Bioinformatics A Beginners Guide. Wiley India Private Limited. 6. Claverie, J. M. and Notredame, C. (2003). Bioinformatics for Dummies. Wiley India Private Limited. 7. Murthy, C.V.S. (2004). Bioinformatics. Himalaya Publishing House. 8. Rashidi, H. H. and Buehler, L. K. (2003). Bioinformatics Basics: Applications in Biological Sciences and Medicine. 9. Sinnit, E. W., Dunn, L. C. and Dobzhansky, T. (1998). Principle of Genetics. Macgrodo Hill Publishing Company Ltd. 10. Krebs, J. E., Lewin, B., Goldstein, E. S. and Kilpatrick, S. T. (2013). Lewin's Essential Genes. Jones & Barlett Learning. 11. Lakra, W. S., Abidi, S. A. H., Mukherjee, S. C. and Ayyappan, S. (2004). Fisheries Biotechnology. Narendra Publishing House. 12. Lewin, B. (2008). Genes lX. Jones & Bartlett Publishers, Massachusetts. 13. Lodish, H., Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M., Scott, M. P. and Lutz, C. G. (2003). Practical Genetics for Aquaculture. Wiley-Blackwell. 14. Lehninger, A. L. (2004). Principles of Biochemistry (4th Ed.). W. H Freeman and Company. 15. Muralidharan, V. S. and Subramania, A. (2009). Nanosciences & Technology. Ane Books Pvt. Ltd., New Delhi. 16. Kar, D. K. and Halder, S. (2009). Cell Biology Genetics Molecular Biology. New Central Book Agency, Kolkata.

	17. Roy, S. C. and De, K. K. (2008). Cell Biology. New Central Book Agency, Kolkata. 18. Nair, A. J. (2008). Introduction to Biotechnology and Genetic Engineering. Infinity Science Press LLC, New Delhi, India. 19. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. (2008). Molecular Biology of the cell (5^{th} Ed.). Garland science, Taylor & Francis Group, LLC, New York, USA. 20. Nagabhushanam, R., Diwan, A. D. and Gyananath, G. (2009). Biotechnology Fundamentals and Applications. Narendra Publishing House, Delhi, India. 21. Malvee, S. (2008). Fish Genetics, SBS Publishers, New Delhi. 22. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. (2002). Molecular Biology of the Cell (4^{th} Ed.). Science Publ. 23. Barnes, D. and Mathur, P. J. (1998). Methods in Cell Biology. Vol. 57. Animal Cell Culture Methods. Academic Press. 24. Basega, R. (1989). Cell Growth and Division: A Practical Approach. IRL Press. 25. Gupta, M. L. and Jangir, M. L. (2012). Cell Biology Fundamentals & Applications. Agrobios. 26. Kirpichnikov, V. S. (1981). Genetic Basis of Fish Selection. Springer-Verlag. 27. Wolfe, S. L. (1995). Introduction to Cell and Molecular Biology. Wordsworth Publ. Co., Belmont. 28. Zipursky, L. and Darnell, J. (2004). Molecular Cell Biology (5^{th} Ed.). W.H. Freeman.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT and Field visit
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments, etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analysing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs./week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	04	03	30	70	100	04
AQB 202: Fish Nutrition and feed Technology	04	03	30	70	100	04
AQB 203: Fish Genetics and Biotechnology	04	03	30	70	100	04
Elective papers						
AQB: 204 A: Fisheries legislation AQB: 204 B: Biostatistical Analysis	04	03	30	70	100	04
Practical:						
AQB 205: Fisheries Technology, Biochemistry and Genetics	12	12	45	105	150	06
Skilled based paper						
AQB- 206 Fish Products and Byproducts technology OR Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester II

<table>
<tr><td>Course Code</td><td>204 A</td></tr>
<tr><td>Course Title</td><td>Fisheries Legislation</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs.</td></tr>
<tr><td>Minimum weeks/semester</td><td>16 (Classwork, Examination, Preparation, Holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2025-26</td></tr>
<tr><td>Purpose of Course</td><td>The main purpose of the course is to make students acquainted with concepts of different types of laws and regulations of the fisheries resources which would be helpful for the formation of the database and resources management.</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is to make the student capable of understanding about the fisheries resource's regulations.</td></tr>
<tr><td>Course Outcomes</td><td>CO1. The course acquaints students' knowledge about role of different regulatory bodies in aquatic resource management.
CO2. The inland fisheries policies implemented by the state and central government are elaborated to students to improve their technical knowledge.
CO3. The explanation regarding the marine fisheries regulation and international law of the sea develop the knowledge and awareness for managing marine resources.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of biology and chemistry</td></tr>
<tr><td>Course Content</td><td>Unit – I
Fisheries legislation:
Introduction, History and Importance in aquatic resources management.
Unit – II
Inland Fisheries Regulation and Development:
Inland Fisheries Act, Leasing policies for water bodies. Issues of property rights in Inland water bodies.
Unit – III
Marine fisheries legislations in India and Gujarat:
Coastal Aquaculture legislations (Environmental Protection Act, Biodiversity Act and Aquaculture Authority Act).
Maritimes Zones of India Act 1981, Coastal Regulation Zone (CRZ) and Integrated Coastal Zone Management.
Unit – IV
International Law of the Sea:
Historical perspectives. Exclusive Economic Zone, Regulatory and developmental issues concerning deep sea fishing – Guidelines for operation Indian deep sea fishing vessels in Indian EEZ.</td></tr>
<tr><td>Reference Books</td><td>1. Branson, E.J. (2008). Fish welfare. Pub. Blackwell Publication, Oxford.</td></tr>
</table>

	2. Malhotra, S.P. and Sinha, V.R.P. (2007). Indian Fisheries and Aquaculture in a Globalizing Economy, 2 Vols. Narendra publishing house New Delhi. 3. Coupes, A., and Edgar, H. (1987). The marine environment and sustainable development; law, policy and science law of the sea institute, Honolulu. 4. G.W. (2009). Towards Sustainable Fisheries Law: A Comparative Analysis. IUCN Environmental Policy and Law Paper No. 74. IUCN publication Service, Switzerland 5. Neler, A.P., Rangnar Ameson and Nina Mollett. (1997). Right Based Fishing. Klupner Academic Publisher. 6. O'Connell, D.P. (1982). The international law of the sea. Clarendon press. 7. William E, Devid F, and Elly G. (2001). Legislating for Sustainable Fisheries: A Guide to Implementing the 1993 FAO Compliance Agreement and 1995 UN Fish Stocks Agreement Published by World Bank.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT and Field visit
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs./week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	04	03	30	70	100	04
AQB 202: Fish Nutrition and feed Technology	04	03	30	70	100	04
AQB 203: Fish Genetics and Biotechnology	04	03	30	70	100	04
Elective papers						
AQB: 204 A: Fisheries legislation AQB: 204 B: Biostatistical Analysis	04	03	30	70	100	04
Practical:						
AQB 205: Fisheries Technology, Biochemistry and Genetics	12	12	45	105	150	06
Skilled based paper						
AQB- 206 Fish Products and Byproducts technology OR Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester II

Course Code	**204- B**
Course Title	**Biostatistical analysis**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks/semester	16 (Classwork, Examination, Preparation, Holidays etc.)
Effective From	2025-26
Purpose of Course	The purpose of the course is to develop the analysis methodology, dissemination methods of the innovations and regulations of the fisheries resources which would be helpful for the formation of the database and resources management.
Course Objective	To acquaint the students about the biostatical methods, innovation dissemination and fisheries resources regulations.
Course Outcomes	CO1: The application of computer, different software and bio-statistical analysis in the field of aquatic biology help for resource management. CO2: To help students acquire knowledge on different methods of data collection for research studies. CO3: The course would help students to apply statistical analysis in fisheries management and to predict the outcomes of the research for future aspects.
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	**UNIT – I** **Fundamental of Biostatistics:** Introduction and Scope of biostatistics, Concepts of population and sample, Sampling and its types, Primary and Secondary data, Classification and tabulation of data, Frequency distribution, Graphic representation of data- bar diagram, histograms, pie diagram, frequency polygon and Ogive. Measures of central tendency: mean, median, mode. Measures of Dispersion: variance, standard deviation, coefficient of variation, Skewness, kurtosis and moments Methods of Data Collection – Quantitative and qualitative Quantitative Methods: Questionnaire (mail method, interviews through telephone, internet and computers), interview schedule Questionnaire/interview schedule design and construction: Principles of constructing a questionnaire/interview schedule, Types of questions, framing of questions, sequencing of sections and questions and Interview techniques Qualitative Method: Walk through and observation (participatory and non-participatory), Social mapping, key informant interview, In-depth interviews, Focus group discussion, content analysis, free listing, pile sorting, mechanical devices (camera, tape recorder) Applications of statistics in fisheries **UNIT – II**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

	Probability and hypothesis: Probability and probability distributions-definition of probability - binomial, Poisson and normal distributions Hypothesis testing and its applications in biological data-Null and Alternate Hypotheses, Errors in Hypothesis Testing-Critical Region and error probabilities Level of Significance-One Tailed and Two Tailed tests **Unit - III** **Statistical test:** Bivariate Data: Scatter diagram. Correlation coefficient and its properties, Correlation ratio. Rank– Spearman's and Kendall's measures of correlation. Principle of least squares, linear regression, fitting of curves reducible to polynomials by transformation. Multiple regression, Multiple and partial correlation coefficients. Tests of significance: Z test, t test, F test, Chi-square test, ANOVA (one way and two way) Non parametric test: Wilcoxon test, Mann-Whitney U-test, Kruskal and Wallis test and Friedman's test **Unit - IV** **Use of computer software for data analysis:** Computer applications: Analyses of data using Microsoft Excel and SPSS
Reference Books	1. Clarke G.M. and Cooke D. (1994): A Basic Course in Statistics Arnold London. 2. Goon A.M. Gupta M.K. and Dasgupta B. (1985): Fundamental of Statistics Vol. I. The World Press Private Ltd. Calcutta. 3. Gupta S.C. and Kapoor V.K. (1986): Fundamental of Mathematical Statistics Sultan Chand and Sons Publishers 4. Whitlock, C. & Schluter, D. (2014). The analysis of biological data, 2nd Edition. Roberts and Company Publishers. ISBN 978-1936221486. 5. Dutta, N. K. (2004). Fundamentals of Biostatistics, Kanishka Publishers. 6. Gurumani N. (2005). An Introduction to Biostatistics, MJP Publishers. 7. Daniel, W. W. (2007). Biostatistics- A Foundation for Analysis in the Health Sciences,Wiley 8. Bhatt B R, Srivenkatramana T and Rao Madhva K S (1996): Statistics: A l Beginner's Text, Vol1, and New Age International (P) Ltd.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT and Field visit
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programme is to prepare the students for productive career in Aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries department etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the students capable for handling instruments and use of latest technology to find remedial measures with respect to fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situation in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	04	03	30	70	100	04
AQB 202: Fish Nutrition and feed Technology	04	03	30	70	100	04
AQB 203: Fish Genetics and Biotechnology	04	03	30	70	100	04
Elective papers						
AQB: 204 A: Fisheries legislation AQB: 204 B: Biostatistical Analysis	04	03	30	70	100	04
Practical:						
AQB 205: Fisheries Technology, Biochemistry and Genetics	12	12	45	105	150	06
Skilled based paper						
AQB- 206 Fish Products and Byproducts technology OR Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester II

Course Code	**205**
Course Title	**Fisheries Technology and Biostatistics**
Credit	6
Teaching per Week	12 Hrs
Minimum weeks/semester	16 (Classwork, Examination, Preparation, Holidays etc.)
Effective From	2025-26
Purpose of Course	The purpose of the course is to develop the skill about executing the different scientific methods of Biochemistry and Genetics in field of Aquatic Biology with reference to improving aquaculture production and quality. The purpose of the course is to introduce different fisheries technologies and its applications which would help and develop the skill among students for development of fisheries sector in scientific way. The purpose of the course is to make students acquainted with analysis methodology which would be helpful for the formation of the database and resources management.
Course Objective	To acquaint the students about the biochemical quantification of fish and feed, Quantitative estimation of DNA, staining of DNA and RNA, banding techniques, Determination of Age and Growth of fin fishes, Biometric study of fish, Study of different gears and crafts, Remote sensing techniques, fish products and by-products as well as biostatistical methods.
Course Outcomes	CO1: Biochemical quantification of fish and feed is essential for consumption purpose to make legitimate comparisons of best suitable feeds and fish on the basis of nutritional requirements of human being. CO2: Quantitative estimation of DNA, staining of DNA and RNA as well as study of banding techniques helps in aquatic resource management. CO3: Students will be aware age and growth of fish which are essential for sustainable fish farming and population studies. CO4: The students will be able to acquire knowledge about fishing techniques to catch fish in large scale from waterbodies efficiently for fishery research and management. CO5: This paper deals with post-harvest technology which helps to maintain quality (appearance, texture, flavour and nutritive value) to protect food safety and to reduce losses between harvest and consumption. CO6: The application of bio-statistical analysis in the field of aquatic biology which helps for resource management to develop. Understanding and application of expertise in the preparation and presentation of data for scientific studies. CO7: Explore students through field and institute visits which make them to understand the interaction between their chosen fields of study to the rest of the world. It also provides an exposure to students about practical working environment.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
	CO1						
	CO2						
	CO3						
	CO4						
	CO5						
	CO6						
	CO7						
Pre-requisite	Basics of Zoology and Fisheries						
Course Content	**Unit I** Determination of Age and Growth of fin fishes (by hard parts) Biometric study of fish **Unit II** Identification and demonstration of different gears (Bag net, Trawls Otter trawl, Beam trawl Cast net, Drage net Drag net without pocket, drag net with pockets, Gill net) and crafts (Dugout canoes, Plank built canoes, Outrigger canoes, Rampani, Raft, Raft catamaran, Masula boats, Non-rigid Masula) by models and images **Unit III** Description of Remote sensing techniques (by images) Identification and description of fish products and by-products (by specimens and images) **Unit IV** Preparation of reagents, standard graph and biochemical estimation of Protein, Lipid, Reducing Sugar and carbohydrate in fish and fish feed **Unit V** Estimation of Ash and Moisture content in fish and fish feed Feed formulation by Pearson square method **Unit VI** Preparation of Schiff's reagent, Toludene blue and Pyronin-Y DNA staining (by Schiff's reagent) and RNA staining (by Toludene blue and Pyronin-Y) in aquatic plants Study of banding techniques (by images) Isolation of DNA from aquatic organism (demonstration)						
Reference Books	1. Ravindranath, M. H. (1981). Manual of Research Methods for Crustacean Biochemistry and Physiology. CMFRI, Cochin-682018. 2. Nielsen, S. S. (2017). Food Analysis. Purdue University, Springer International Publishing. 3. Bioseparation Technology Laboratory. Department of Biotechnology, SRM University. 4. Lodish, H., Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M., Scott, M. P. and Lutz, C. G. (2003). Practical Genetics for Aquaculture. Wiley-Blackwell. 5. Cummings, S. A. and Thorgaard, G. H. (1994). Extraction of DNA from fish blood and sperm. Biotechniques, 17(3): 426-430.						

	6. Sumner, A. T. (1990). Chromosome Banding. Unwin Hyman, London; Boston. 7. Sharma, L. L., Sharma, S. K., Saini, V. P. and Sharma B. K. (2008). Management of Freshwater Ecosystems. Agrotech Publishing Academy, Udaipur, India. 8. Sreekrishna, Y. and Shenoy, L. (2001). Fishing Gear and Craft Technology, Indian Council of Agricultural Research, New Delhi. 9. Gupta, S.K. and Gupta, P.C. (2002): General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. 10. Sabins, F.F. (1997): Remote sensing, Principles and Interpretation. W.H. Freeman and Co., New Delhi 11. Sachindra, N. M. and Mahendrakar, N. S. (2014). Fish Processing By-products: Quality Assessment and Application. Studium Press, LLC, US. 12. Balachandran, K. K. (2016). Post-Harvest Technology of Fish and Fish Products. Daya Publishing House. 13. Raghavarao, D. (1983): Statistical Techniques in Agricultural and Biological Research. Oxford and IBH Publishing Co., Mumbai.
Teaching Method	Classwork, Discussion, Self-Study, Assignment, ICT and Field visit
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.

Master of Science in Aquatic Biology

Name of Program	**Master of Science in Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments, etc.
Program Outcome	**PO-01: Advanced Knowledge & Conceptual Understanding** To establish a strong foundation in aquaculture and fisheries sciences the program focus on developing essential skills across various disciplines. Emphasising proficiency in laboratory techniques, effective aqua farm management, disease control practices, feed technology, biochemistry, microbiology, fish genetics, biotechnology, and bioinformatics will improve students' knowledge. Additionally, gaining knowledge in ornamental fishes, marine and freshwater fisheries, along with planktonology, will further enrich students' potential in this field. **PO-02: Research & Analytical Skills** The program aims to cultivate advanced problem-solving and research-oriented skills by hands-on experimental analysis and immersive field-based studies. Implementation of scientific methodologies helps to evaluate aquatic ecosystems, develop effective disease management strategies, and promote sustainable fisheries practices. Through this comprehensive approach, students can gain a deeper understanding of the interactions within marine environments and contribute to the conservation and responsible management of valuable aquatic resources. **PO-03: Technological Proficiency & Instrumentation** The program can help to develop proficiency in advanced laboratory techniques, computational modelling, and instrumentation used in aquaculture, fisheries, and aquatic pollution management. Students will be capable of employing modern tools for sustainable aquatic resource management. **PO-04: Environmental & Societal Impact** The program offers the capability to recognize the importance of aquaculture and fisheries in undertaking environmental challenges, conserving biodiversity, and helping sustainable resource use. Students can utilize scientific knowledge to advance eco-friendly aquaculture practices and implement pollution control measures. **PO-05: Innovation & Entrepreneurship** The students can apply innovative solutions to enhance aquaculture production,

	improve fisheries management, and advance aquatic biotechnology. Furthermore, in the programme, there is an emphasis on fostering entrepreneurial skills to support the establishment of startups focused on sustainable fisheries, aquaculture feed technology, and biotechnology. This approach will develop sustainability as well as encourage economic growth within the sector. **PO-06: Communication & Collaborative Research** The program can enhance students' communication skills through technical writing, research presentations, and interdisciplinary collaborations. Participation in group discussions, industry visits and comprehensive research initiatives can help to tackle key challenges in the aquaculture sector. **PO-07: Ethical & Value-Based Scientific Practices** The program helps to maintain ethical standards in research, ensure professional honesty, and prioritize sustainability in aquaculture and fisheries sciences. The program enhances the knowledge to handle ethical issues, taking into account societal, legal, and environmental consequences. Students can apply advanced scientific knowledge to foster environmental responsibility. **PO-08: Lifelong Learning & Career Readiness** The program can nurture a mentality for continuous learning, flexibility, and professional development. Students can be equipped for diverse and rewarding careers in research, academia, and governmental roles, as well as in the flourishing aquaculture industries. Furthermore, students can excel in competitive examinations related to aquatic biology, enhancing their skills and knowledge for a dynamic future in these fields.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analysing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs./week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	04	03	30	70	100	04
AQB 202: Fish Nutrition and feed Technology	04	03	30	70	100	04
AQB 203: Fish Genetics and Biotechnology	04	03	30	70	100	04
Elective papers						
AQB: 204 A: Fisheries legislation AQB: 204 B: Biostatistical Analysis	04	03	30	70	100	04
Practical:						
AQB 205: Fisheries Technology, Biochemistry and Genetics	12	12	45	105	150	06
Skilled based paper						
AQB- 206 Fish Products and Byproducts technology OR Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	02	02	15	35	50	02
Total	**30**	**26**	**180**	**420**	**600**	**24**

Semester II

Course Code	**206**
Course Title	**Fish Products and By-products technology**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks/semester	16 (Classwork, Examination, Preparation, Holidays etc.)
Effective From	2025-26
Purpose of Course	The purpose of the course is to make the student able of implementing the principle and techniques of fish preservation and processing which develops the opportunity for self-employment.
Course Objective	To make students familiar about fish preservation and processing by different methods, Methods of preparation, packaging and storage of various fish products and by-products as well as quality dimensions of seafood.
Course Outcomes	CO1: Students will able to understand about fish preservation and processing which helps to keep fishes in best quality. CO2: Students will able to develop the skill about packaging and storage of various fish products which enhance the shelf-life of products for good revenue generation. CO3: This paper gives detail idea about packaging and storage of various fish by-products for nutritional enhancement. CO4: Explain and train students to deal with importance of fish quality and application of HACCP concept in surveillance and quality assurance program for packaged and freeze-dried products to reduce contamination in fish as well as improving safety of fish products and by-products for better earning.
Mapping between COs with PSOs	
Pre-requisite	Basics of Zoology and Fisheries
Course Content	**UNIT - I** Introduction and principle of fish preservation and processing. Principles, quality dimensions, methods of preparation, packaging and storage of various fish products - Fish and prawn pickles, fish sauce and fish paste, fish sausage, fish ham, surimi, fish cake, kamaboko battered and braided products fish finger, fish cutlet, fish wafer, fish soup powder etc. **UNIT - II** Principles, quality dimensions, methods of preparation, packaging and storage of various fish byproducts - Fish oil, chitosan, fish protein concentrate, fish hydrolysate, fish silage, fish maws, shark leather, fish glue, fish gelatin, isinglass, pearl essence, shark fin rays, beach-de-mer etc. Application of HACCP concept in surveillance and quality assurance program for packaged and freeze-dried products.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Reference Books	1. Gupta, S.K. and Gupta, P.C. (2002): General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. 2. Joseph, J. (2009): Post Harvest Technology of Freshwater Fish. Central Institute of Fisheries Technology, Cochin. 3. Ninawe, A. and Rathnakumar, K. (2008). Fish Processing Technology and Product Development. Narendra Publishing House. 4. Sachindra, N. M. and Mahendrakar, N. S. (2014). Fish Processing Byproducts: Quality Assessment and Application. Studium Press, LLC, US. 5. Balachandran, K. K. (2016). Post-Harvest Technology of Fish and Fish Products. Daya Publishing House. 6. Martin, R. E., Carter, E. P., Flick, G. J. and Davis, L. M. (2000). Marine and Freshwater Products Handbook, CRC Press. 7. Balasundari, S., Raghu, G. and Felix, S. (2020). Fish Products and Value Addition. Daya Publishing House.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT and Field visit
Evaluation Method	Internal assessment (30%): Exam (12) Class test & assignments (12) and Attendance (6) External assessment (70%): It will be based on university examination.