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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ક્રમાંકઃઓથો./પરિપત્ર/૧૩૬૪૭/૨૦૨૬
તા.૧૯/૦૬/૨૦૨૬

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

વિષયઃ– શૈક્ષણિક વર્ષ ૨૦૨૬–૨૭ થી અમલમાં આવનાર 2 Year PG-M.Sc. Aquatic Biology Sem.-1 ના અભ્યાસક્રમ બાબત.

સુજ્ઞશ્રી,

સવિનય જણાવવાનું કે, NEP-2020 અંતર્ગત શૈક્ષણિક વર્ષ ૨૦૨૬–૨૭ થી અમલમાં આવનાર 2 Year PG - M.Sc. Aquatic Biology Sem.-1 નો PO, PSO અને CO સહિતનો અભ્યાસક્રમ એકવેટિક બાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૨૦/૦૧/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંકઃ૦૨ થી મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા.૦૪/૦૬/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંકઃ૨૧ થી મંજૂર કરવા એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૧૮/૦૬/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંકઃ૧૯ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

કુલસચિવ

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

.....જાણ સારૂ.

SYLLABUS
(2026-2027)

Postgraduate Programme
In
AQUATIC BIOLOGY

M. Sc. (Aquatic Biology)
1 Years (Two semester) Degree Programme

DEPARTMENT OF AQUATIC BIOLOGY
VEER NARMAD SOUTH GUJARAT UNIVERSITY
SURAT (GUJARAT) 395007

Structure of Program (Semester I)

PG Programm (1 Year) without Research Work (2 Semester Course Work) for 4 Year UG with Honors students

Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours / Week		Exam Duration (Hr.)		Credit		Internal Marks		External Marks		Total Marks	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
Major	AQB 1001	Aquatic Resources and their management	Aquatic Resources and their management	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1001	Aquatic Resources and their management: Practical	Aquatic Resources and their management: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1002	Fisheries Technology	Fisheries Technology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1002	Fisheries Technology: Practical	Fisheries Technology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1003	Aquatic Pollution and toxicology	Aquatic Pollution and toxicology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1003	Aquatic Pollution and toxicology: Practical	Aquatic Pollution and toxicology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1004	Bhartiya knowledge system in Aquatic Sciences	Bhartiya knowledge system in Aquatic Sciences	500-599	4	-	2	-	4	-	50	-	50	-	100	-
MDC	AQB 1005	Fundamentals of Cyber Security	Fundamentals of Cyber Security	500-599	4	-	2	-	4	-	50	-	50	-	100	-
SEC	AQB 1006	Technology for Fish Products	Technology for Fish Products	500-599	2	-	1	-	2	-	25	-	25	-	50	-
Total					**16**	**6**	**8**	**12**	**16**	**6**	**200**	**75**	**200**	**75**	**400**	**150**

MDC is Multidisciplinary Course and SEC is Skill Enhancement Course

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT PROGRAM TITLE	
Name of Program	**Master of Science in Aquatic Biology**
Program Abbreviation	**AQB**
Duration	1 Year (Two Semester)
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree with honours in Zoology, Botany, Fisheries or any allied subject in Biological and Environmental Sciences
Pre-requisite	B. Sc. Honours in biological and Environmental Science
Medium of Instruction	English
Objective of Program	The main objective of the M.Sc. (Aquatic Biology) 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)	**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 start-ups 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 (PSO)	**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						

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT SYLLABUS						
Program Name	Master of Science (Aquatic Biology)					
Semester	I					
NCrF Credit Level	6.0					
Course Type	Major					
Course Subtype	Nil					
Subject Type	Discipline Specific					
Course Code	AQB 1001					
Course Level	500-599					
Course Title	**Aquatic Resources and their Management**					
Credit	**Theory:**	2	**Practical:**	2	**Total:**	4
Effective From	Academic Year: 2026-27					
Course Outcomes	**CO1:** Explain inland ecosystems and marine ecosystems to strengthen and develop the basic concepts to handle challenging situations in aquaculture sectors. **CO2:** Student will understand the management practices of aquatic resources including inland and marine animals and plants to explore the aquaculture practices. **CO3:** Explain the types of important aquatic faunal resources available in the water bodies to develop theoretical and practical aspects. **CO4:** Student will able to perform and evaluate various water properties. **CO5:** Student will understand various commercially important fishes, weed fishes and predatory fishes. They even able to identify various important seaweeds. **CO6:** 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						
Course Content	**Unit – 1 Aquatic Resources** Introduction, origin, classification and distribution of Inland (Rivers, Ponds, Lakes and Reservoirs), Brackish water (Estuaries, Lagoons and Coastal inlets) and Marine resources of India and Gujarat. Introduction, Biology, Distribution and Importance of fin fishes: (catla, rohu, mrigal, Indian magur, singhi, hilsa, mullet, sardine, mackerel), Shell fishes (Prawn, shrimp and mollusks), Sport fishes (Golden Mahseer, Brown trout and Rainbow trout), Ornamental fishes (Barb sp. Danio sp. Puntius sp. Channa sp.) and Aquatic plants: (freshwater higher vascular plants, sea weeds, sea grasses and mangroves). **Unit – 2 Aquatic Resources Management** Management of Aquatic resources: Utilization, regulation,						

	conservation and development of aquatic system. Strategies and policy frameworks for sustainable management of aquatic resources at the Global and National levels.
Course Code	**AQBP 1001**
Course Title	**Aquatic Resources and their Management : Practical**
Course Practical Content	1. Determination of organic carbon present in a soil sample 2. Determination of Phosphorous present in a soil sample 3. Determination of Nitrogen, present in a soil sample 4. Determine the pH and Electrical conductivity of the soil sample 5. Water quality estimation (Physical): Temperature, Light and Turbidity 6. Water quality estimation (Titrimetric estimation): DO, pH, Hardness, Alkalinity 7. Water quality estimation (Colorimetric estimation): Salinity, ammonia, Nitrite, Nitrate, silicate 8. Determination of Lake morphometric parameters () by graphimetric and gravimetric method. 9. Determine the shore line length and shore line development index. 10. Determine the water quality index from given data. 11. Visit of the aquatic resources (Dam, Lake, Pond, Estuaries etc.).
Reference Books	• Korring, P. (1976). Farming of marine fishes and shrimp. Elsvier Science Publishers, NY. • Oren, O.H. (1981). Aquaculture of Grey Mullets. Cambridge University Press, London. • Pillay, T.V.R. and Kutty, M.N. (2005). Aquaculture – Principles and Practices. Black Well Sciences, U.K. • Barnes R.S.K. (1999). Introduction to Marine Ecology. Blackwell Science, Oxford UK. • Hutchinson, G.E. (1976). A Treatise on limnology. Vol. I &II John Wiley sons. • Levinton, J. S. (2000). Marine Ecology, Biodiversity and Function. Oxford, UK • Jhingaran, V.G. (1985). Fish and Fisheries of India. Hindustan publication Corp., New Delhi. • Lecren, E.D. and Lowe-Mac Connel, R.H. (1980). The functioning of freshwater ecosystem. Cambridge University Press, UK. • Perkins, E.J. (1980). The Biology of Estuaries and coastal water. Academic Press, London. • Mishra, S. R. (2002). Management of Aquatic Habitats, Daya Publishing House, Delhi • Mackie, G. (2005). Applied Aquatic Ecosystem Concepts (2^{nd} Ed.), Kendall/Hunt Publishing, Dubuque, Lowa. • Greene, Thomas F. (2004). Marine Science: Marine Biology and Oceanography. (2^{nd} Ed.), Amsco School Pub. Inc. • Biswas, K.P. (1996). A Textbook of Fish, Fisheries and Technology. (2^{nd} Ed.), Narendra Publishing House, India. • Jayaram, K.C. (1999). The Freshwater Fishes of the Indian Region. Narendra Publishing Company, New Delhi. • Khanna, S.S. and Singh, H.R. (2006). A Textbook of Fish

	Biology and Fisheries. Narendra Publishing House. India.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1002
Course Level	500-599
Course Title	**Fisheries Technology**
Credit	**Theory:** 2 **Practical:** 2 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**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 water bodies efficiently for fishery research and management. **CO4:** Students will be aware age and growth of fish which are essential for sustainable fish farming and population studies**.** **CO5:** This paper deals with post-harvest technology which helps to identify the preserved fish products and maintain quality (appearance, texture, flavor and nutritive value) to protect food safety and to reduce losses between harvest and consumption. **CO6:** 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						

Course Content	**Unit – I** **Hatcheries:** Introduction and types of hatcheries (Traditional, Circular, Vertical, Shrimp/Prawn hatchery). Hatchery management practices. **Induced breeding:** Selection and conditioning of brooders, Use of inducing agents, pituitary gland extraction dosage, injection, courtship, spawning and fertilization. Other methods of induced breeding (Stripping, Eyestalk ablation, Thermal and Chemical stimulation). **Age and growth of fishes:** Application and utility of different methods for determining the age and growth, study of maturity,

	mortality and yield. Factors affecting age and growth of fishes. **Unit – II** **Fishing Technique and:** Introduction and types of fishing crafts (mechanized and non-mechanized) and gears (traditional and modern), Maintenance and preservation of fishing gears. Advances in fishing methods. **Fish transportation:** Introduction of fish transportation methods (traditional and modern) for fish seeds, fingerlings, brooders and trout eggs. Use of chemicals in live fish transportation. Challenges in fish transportation. **Remote sensing:** Mechanism, satellites and cameras, Importance and Application of remote sensing in Aquatic biology.
Course Code	**AQBP**
Course Title	**Fisheries Technology: Practocal**
Course Practical Content	1. Identification and description of active fishing gears by models and images 2. Identification and description of passive fishing gears by models and images 3. Identification and description of traditional/non-mechanized crafts by models and images. 4. Mending and repair of fishing gears 5. Identification and description of modern/mechanized crafts by models and images 6. Determination of Age and Growth of fin fishes by hard parts (scale). 7. Biometric study of fishes. 8. Study of Remote sensing techniques with help of images 9. Identification and description of preserved and processed fish (Specimen/Images) 10. Field/farm/institute visit and report preparation.
Reference Books	• Agrawal, S. C. (1994). A Hand Book of Fish Farming. Narendra Publishing House, Delhi. • Balachandran, K. K. (1998). Advances and Priorities in Fisheries Technology. Cochin. • Biswas, S. P. (2002). Fundamentals of Ichthyology. Narendra Publishing House, Delhi. • Deekshatulu, B. L. and Rajan, Y. S. (1984). Remote Sensing. Indian Academy of Sciences, Banglore. • Felix, S. (2007). Aquaculture Management Techniques. Narendra Publishing House, New Delhi. • Gupta, S. K. and Gupta, P. C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Jhingran, V. G. (2007). Fish and Fisheries of India (3rd Ed.). Hindustan Publishing Corporation. New Delhi. • Krjstjonsson, H. (1959). Modern Fishing Gear of the World. Vol. I to III, Fishing news (books) Ltd., England. • Meenakumari, B. (2009). Handbook of Fishing Technology. Central Institute of Fisheries Technology, Cochin.

	• Moyle, P.B. (2002). Fishes-An Introduction to Ichthyology. Prentice Hall Inc. NJ 07458. • Nikolsky, G.V. (1999). Ecology of Fishes, Allied Scientific Publishers. • Rao, D.P. (1995). Remote Sensing for Earth Resources. Association of Exploration Geophysicists, Hyderabad. • Regenstein, J.M. and Regenstein, C.E. (1997). Introduction to Fish Technology. CBS Publishers and Distributors, New Delhi. • Sabins, F.F. (1997). Remote Sensing, Principles and Interpretation. W.H. Freeman & Co., New Delhi. • Sharma, O.P. (2009). Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur. • Sreekrishna, Y. and Shenoy, L. (2001). Fishing Gear and Craft Technology. Indian Council of Agricultural Research, New Delhi. • Welcomme, R.L. (2007). Inland Fisheries. Discovery Publishing House, New Delhi. • Yadav, B.N. (1997). Fish and Fisheries. Daya Publishing House, Delhi. • Yadav, N.K. (2009). Management Practices in Fish Farming. Manglam Publications, Delhi. • Ayappan, S. (2011). Handbook of Fisheries and Aquaculture. ICAR, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

<table>
<tr><th colspan="2">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td>Master of Science (Aquatic Biology)</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td>NCrF Credit Level</td><td>6.0</td></tr>
<tr><td>Course Type</td><td>Major</td></tr>
<tr><td>Course Subtype</td><td>Nil</td></tr>
<tr><td>Subject Type</td><td>Discipline Specific</td></tr>
<tr><td>Course Code</td><td>AQB 1003</td></tr>
<tr><td>Course Level</td><td>500-599</td></tr>
<tr><td>Course Title</td><td>Aquatic Pollution and Toxicology</td></tr>
<tr><td>Credit</td><td>Theory: 2 | Practical: 2 | Total: 4</td></tr>
<tr><td>Effective From</td><td>Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Explain water pollution concepts including sources, fate, interaction of pollutants, types of pollution and their biological effects with management strategies.
CO2: Analyze biological concerns (eutrophication, bioaccumulation, biomagnification) and evaluate effluents along with wastewater treatment methods, water quality standards and indices.
CO3: Understand the basic concepts of toxicology including principles, factors affecting toxicity and classification of toxicants such as metals, pesticides, teratogens, xenobiotics and biological toxins.
CO4: Evaluate toxicity through test procedures like bioassay, biostimulation and bioinhibition and interpret the role of biomarkers in aquatic systems.
CO5: Evaluate the micronuclei from fish blood and assess the pollution status in the water body.
CO6: 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.</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>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Course Content</td><td>Unit – I Aquatic pollution
Water pollution: Introduction, Sources and Fate of Pollutants, Interaction of pollutants in Aquatic resources.
Types of Pollution: Sources, Biological Effects and Management of Thermal pollution, Oil pollution, Radioactive pollution, Detergent pollution and Acid rain.
Biological concern: Eutrophication, Bioaccumulation and Biomagnification.
Effluents and their treatment: Introduction and characteristics of domestic, industrial and agricultural discharges. Important methods</td></tr>
</table>

	for wastewater treatment, Water quality standards and water quality indices. **Unit – II Toxicology** **Toxicology:** Introduction, principles and factors affecting the toxicity. **Classification of toxicants:** Metals, Pesticides, Teratogens, Xenobiotics, Toxins of animal and plant origin. **Toxicity test procedures:** Bioassay, Biostimulation and Bioinhibition. Biomarkers in Aquatic system.
Course Code	**AQBP 1003**
Course Title	**Aquatic Pollution and Toxicology: Practical**
Course Practical Content	1. Titrimetric method for the estimation of Biochemical Oxygen Demand (BOD) in a water sample. 2. Titrimetric method for the estimation of Chemical Oxygen Demand (COD) in a water sample. 3. Colorimetric/Photometric method for the estimation of nitrate in a water sample. 4. Colorimetric/Photometric method for the estimation of nitrite in a water sample. 5. Colorimetric/Photometric method for the estimation of inorganic phosphate in a water sample. 6. Colorimetric/Photometric method for the estimation of sulphate in a water sample. 7. Estimate the concentration of total suspended solids (TSS) in a water sample. 8. Find out the median lethal concentration (LC_{50}) of a toxicant using bioassay technique. **OR** Toxicity study in reference to LC_{50}. 9. Study of micronuclei from fish blood. 10. Visit of sewage or water treatment plant.
Reference Books	• Agarwal, S.K. (2008). Water Pollution, ABH Publishing Corporation, New Delhi. • Albert, A. (1951). Selective Toxicity, John Wiley and Sons, Chichester. (Where????) • Ghosh, G.K. (2002). Water of India, A.P.H. Publishing Corporation, New Delhi. • Goel, P.K. (2006). Water Pollution, New Age International Publishers, New Delhi. • Kukal S.S. and Dhaliwal, G.S. (2005). Essential of Environmental Science, Kalyani Publishers, Ludhiana. • Prabhakar, V.K. (2001). Marine Ecology and Pollution, Anmol Publications, New Delhi. • Rand, G.M. (1995). Fundamentals of Aquatic toxicology, Taylor and Francis, Washington, D.C. • Rao, M.K. (2007). Environnemental Pollution & Toxicology, Manglam Publishers, Delhi. • Salpekar, A.C. (2008). Marine Pollution, Jnanada Prakashan, New Delhi.

	• Schmitz, R.J. (1995). Introduction to Water Pollution Biology, Gulf Publishing Company, Texas. • Sinha, P.C. (1998). Marine Pollution, Anmol Publications, New Delhi. • Trivedi, R.K. and Goel, P.K. (1984). Chemical & Biological Methods for Water Pollution Studies, Environmental Publications, Karad. • Trivedi, R.K. (2001). Aquatic Pollution and Toxicology, ABD Publishers, Jaipur. • Gupta, P., Chanjta, A. and Mehta, Y. (2024). Environmental Toxicology, CRC Press. • Knasmueller, S. and Fenech, M. (2019). Micronucleus Assay in Toxicology, Vol. 39, Royal Society of Chemistry. • Rand, G.M. and Petrocelli, S.R. (1985). Fundamentals of Aquatic Toxicology: Methods and Applications, Hemisphere Publishing Corporation. (Where????) • Padhy, B.M. (2000). Environmental Toxicology Assessment, New Age International Publishers.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1004
Course Level	500-599
Course Title	**Bhartiya knowledge system in Aquatic Sciences**
Credit	**Theory:** 4 **Practical:** 0 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Helps to create the foundations, scope, and relevance of the Bharatiya Knowledge System (BKS) with special reference to aquatic sciences and natural ecosystems. **CO2:** Enhance to examine aquatic knowledge documented in Vedic, Puranic, and Ayurvedic texts and analyze the cultural and ecological significance of rivers, lakes, oceans, and indigenous classifications of aquatic organisms. **CO3:** Increase the indigenous water management systems and traditional aquaculture and fisheries practices for their scientific basis, sustainability, and biodiversity conservation potential. **CO4:** Integrate Bharatiya aquatic knowledge systems with modern aquatic biology to address contemporary challenges in conservation, sustainable aquaculture, climate resilience, and resource management.
Course Content	**Unit – 1 BKS and Aquatic Environment** Concept, scope and relevance of BKS in aquatic sciences. Aquatic resources in Indian tradition: Rivers, lakes, tanks, temple ponds, step wells, sacred groves and oceans. **Unit – 2 Traditional Systems in Aquatic Resource Management** Traditional systems of aquatic resource and water quality management. Ethics of water uses, conservation and stewardship in Indian traditions. Role of community practices in sustaining aquatic ecosystems. **Unit – 3 Ethno-Ichthyology and Aquaculture Practices** Ethno-ichthyology: Folk taxonomy and indigenous classification of fishes. Introduction and principles of indigenous aquaculture practices. Indigenous aquaculture systems in India (Pokkali rice–fish farming system, Loktak Lake phumdis fisheries, Bheri fisheries). **Unit – 4 Cultural Scopes of Aquatic Ecosystems** Aquatic symbolism in Indian art, folklore, and literature. Rituals, festivals associated with aquatic ecosystems. Interrelationship between culture, biodiversity, and conservation
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

	CO4
Reference Books	• Agarwal, A., & Narain, S. (1997). Dying wisdom: Rise, fall and potential of India's traditional water harvesting systems. Centre for Science and Environment (India). • Altekar, A. S. (2009). Education in ancient India (Reprint Ed.). Motilal Banarsidass Publishers, New Delhi. • Bandyopadhyay, B. K. (2023). Fundamentals of freshwater fish and fisheries of India. New India Publishing House, New Delhi. • Berkes, F. (2012). Sacred ecology (3rd Ed.). Routledge, New York • Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications, Montana (USA) • Chakraborty, C., Mukherjee, M., & Lepcha, R. F. (2011). Fish and fisheries of Himalayan and Terai region of West Bengal: With ornamental touch. Daya Publishing House / Astral International, New Delhi. • Gadgil, M., & Guha, R. (1992). This fissured land: An ecological history of India. Oxford University Press, London (UK) • Mishra, A. (1993). Aaj Bhi Khare Hain Talaab [The ponds are still relevant]. Prabhat Prakashan, New Delhi • Radhakrishnan, S. (2008). Indian philosophy: Volume I. Oxford University Press, London (UK) • Radhakrishnan, S. (2008). Indian philosophy: Volume II. Oxford University Press, London (UK) • The Matsya Mahāpuranam (2007). Sanskrit text with English translation and notes (2 vols.), Parimal Publications, Delhi • Talwar, P. K., & Jhingran, A. G. (1991). Inland fishes of India and adjacent countries (Vols. 1–2). Oxford & IBH Publishing, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (50 T + 0 P) Marks External Assessment: Total 50 (50 T + 0 P) Marks

<table>
<tr><th colspan="4">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td colspan="3">Master of Science in Aquatic Biology</td></tr>
<tr><td>Semester</td><td colspan="3">I</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="3">6.0</td></tr>
<tr><td>Course Type</td><td colspan="3">Multidisciplinary Coourse</td></tr>
<tr><td>Course Subtype</td><td colspan="3">Nil</td></tr>
<tr><td>Subject Type</td><td colspan="3">Discipline Specific</td></tr>
<tr><td>Course Code</td><td colspan="3">AQB 1005</td></tr>
<tr><td>Course Level</td><td colspan="3">500-599</td></tr>
<tr><td>Course Title</td><td colspan="3">Instrumentation</td></tr>
<tr><td>Credit</td><td>Theory: 4</td><td>Practical: 0</td><td>Total: 4</td></tr>
<tr><td>Effective From</td><td colspan="3">Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">CO1: Aware and train the students for safe work procedure and handling of the instruments in the laboratory.
CO2: Elucidate principle of instruments that help to students to understand the instrument and analysis process.
CO3: The students are proficient to use the advances technology and instruments to speed up the analysis process and error free results.
CO4: The working procedure of instruments are elaborated in details that would be able 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.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td colspan="3"><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>
</table></td></tr>
<tr><td>Course Content</td><td colspan="3">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 turbidometer, Colorimeter, Spectrophotometer (Single bean & double beam), Infrared, NMR and Mass spectrometer
Unit – III Separation techniques
(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 Electrophoresis:
Chromatography: Introduction, Principle and types of chromatography.
Electrophoresis: Introduction, Principle and types of electrophoresis
Blotting: Introduction, types and function
Unit – IV Water quality analysers</td></tr>
</table>

	Introduction, structure, principle and operation of water quality analysers (Conductivity meter, pH meter, Salino meter, DO meter, COD reflaxor (close and open) and BOD analyser)
Reference Books	• Brown, S.B. (1980). An introduction to spectroscopy for Biochemists. Academic press, London, New York. • Robertis, E.D.P. and Robertis, E.M.F. (2001). Cell and Molecular Biology. Lippincott Williams & Wilkins, London. • Hawcroft, D.M. (1996). Electrophoresis. The Basics IRL press, Oxford. • Jenning, W.G. (1993). Analytical Gas chromatography. Academic Press. New York. • Skoogs, H.P. and Nieman, M. (2006). Principle of Instrumental analysis. Thomson Inc. Ltd.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 50 + P 00) Marks External Assessment: Total 50 (T 50 + P 00) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	SEC
Course Subtype	Skill Enhancement Course
Subject Type	Discipline Specific
Course Code	AQB 1006
Course Level	500-599
Course Title	**Technology for Fish Products**
Credit	**Theory:** 2 **Practical:** 0 **Total:** 2
Effective Form	Academic Year: 2026-27
Course Outcomes	**CO1**: Students will be able to explain preparation methods and uses of fish products, by-products and value-added products**.** **CO2**: Students will be able to differentiate between fish products, by-products and value-added products based on raw materials, processing techniques and applications. **CO3**: Students will be able to describe and evaluate various packaging technologies used for fish products, by-products and value-added products. **CO4**: Students will be able to analyze the role of appropriate packaging in ensuring quality, safety, shelf life and marketability of fish products and their derivatives.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	**Unit – I Fish products, By-Products and Value-Added Products** Introduction, methods of preparation and use of various fish products (fish oil, fish roe), by-products (fish liver oil, fish meal, fish manure, fish silage, fish glue, fish gelatin, isinglass, chitosan, pearl essence) and value added products (fish oil capsule, fish flour, fish protein powder, fish hydrolysate, caviar, fish fin soup, fish sausage, fish ham, fish pickles, surimi, fish sauce, battered and braided products). **Unit – II Packaging** Packaging of fish products (polythene wrapping, vacuum packaging, Modified Atmosphere Packaging, frozen packaging, active packaging), fish by-products (bulk packaging, airtight packaging, light-resistant packaging) and value-added products (vacuum-sealed packaging, retort packaging, aseptic packaging, tray packaging, canning and bottling)
Reference Books	• Gupta, S.K. and Gupta, P.C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Joseph, J. (2009). Postharvest Technology of Freshwater Fish. Central Institute of Fisheries Technology, Cochin. • Ninawe, A. and Rathnakumar, K. (2008). Fish Processing Technology and Product Development. Narendra Publishing House.

	• Sachindra, N. M. and Mahendrakar, N. S. (2014). Fish Processing Byproducts: Quality Assessment and Application. Studium Press, LLC, US. • Martin, R. E., Carter, E. P., Flick, G. J. and Davis, L. M. (2000). Marine and Freshwater Products Handbook, CRC Press. • Balasundari, S., Raghu, G. and Felix, S. (2020). Fish Products and Value Addition. Daya Publishing House. • Shitole, P. B., and Sarang, N. S. (2017). Fish processing technology. Narendra Publishing House. • Balachandran, K. K**.** (2001). Post-harvest technology of fish and fish products. Daya Publishing House. • Sen, D. P. (2005). Advances in fish processing technology. Allied Publishers. • Venugopal, V. (2009). Marine products for healthcare: Functional and bioactive nutraceutical compounds from the ocean. CRC Press. • Rustad, T. (2010). Utilization of marine by-products. Electronic Journal of Environmental, Agricultural and Food Chemistry. • Park, J. W. (2013). Surimi and surimi seafood. (3rd Ed.), CRC Press.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment : Total 25 (T 25 + P 0) Marks External Assessment : Total 25 (T 25 + P 0) Marks

SYLLABUS
(2026-27)

Postgraduate Programme
In
AQUATIC BIOLOGY

M. Sc. (Aquatic Biology)
1 Years (Two semester) Degree Programme

DEPARTMENT OF AQUATIC BIOLOGY
VEER NARMAD SOUTH GUJARAT UNIVERSITY
SURAT (GUJARAT) 395007

Structure of Program (Semester I)

PG Programm (1 Year) with Research Work (1Semester Research Work and 1 Semester Course Work) for 4 Year UG with Honors students

Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours / Week		Exam Duration (Hr.)		Credit		Internal Marks		External Marks		Total Marks	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
Major	AQB 1001	Aquatic Resources and their management	Aquatic Resources and their management	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1001	Aquatic Resources and their management: Practical	Aquatic Resources and their management: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1002	Fisheries Technology	Fisheries Technology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1002	Fisheries Technology: Practical	Fisheries Technology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1003	Aquatic Pollution and toxicology	Aquatic Pollution and toxicology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1003	Aquatic Pollution and toxicology: Practical	Aquatic Pollution and toxicology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1004	Bhartiya knowledge system in Aquatic Sciences	Bhartiya knowledge system in Aquatic Sciences	500-599	4	-	2	-	4	-	50	-	50	-	100	-
MDC	AQB 1005	Fundamentals of Cyber Security	Fundamentals of Cyber Security	500-599	4	-	2	-	4	-	50	-	50	-	100	-
SEC	AQB 1006	Technology for Fish Products	Technology for Fish Products	500-599	2	-	1	-	2	-	25	-	25	-	50	-
Total					**16**	**6**	**8**	**12**	**16**	**6**	**200**	**75**	**200**	**75**	**400**	**150**

MDC is Multidisciplinary Course and SEC is Skill Enhancement Course

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT PROGRAM TITLE	
Name of Program	**Master of Science in Aquatic Biology**
Program Abbreviation	**AQB**
Duration	1 Year (Two Semester)
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree with honours in Zoology, Botany, Fisheries or any allied subject in Biological and Environmental Sciences
Pre-requisite	B. Sc. Honours in biological and Environmental Science
Medium of Instruction	English
Objective of Program	The main objective of the M.Sc. (Aquatic Biology) 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)	**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 start-ups 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 (PSO)	**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						

<table>
<tr><th colspan="2">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td>Master of Science (Aquatic Biology)</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td>NCrF Credit Level</td><td>6.0</td></tr>
<tr><td>Course Type</td><td>Major</td></tr>
<tr><td>Course Subtype</td><td>Nil</td></tr>
<tr><td>Subject Type</td><td>Discipline Specific</td></tr>
<tr><td>Course Code</td><td>AQB 1003</td></tr>
<tr><td>Course Level</td><td>500-599</td></tr>
<tr><td>Course Title</td><td>Aquatic Pollution and Toxicology</td></tr>
<tr><td>Credit</td><td>Theory: 2 | Practical: 2 | Total: 4</td></tr>
<tr><td>Effective From</td><td>Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Explain water pollution concepts including sources, fate, interaction of pollutants, types of pollution and their biological effects with management strategies.
CO2: Analyze biological concerns (eutrophication, bioaccumulation, biomagnification) and evaluate effluents along with wastewater treatment methods, water quality standards and indices.
CO3: Understand the basic concepts of toxicology including principles, factors affecting toxicity and classification of toxicants such as metals, pesticides, teratogens, xenobiotics and biological toxins.
CO4: Evaluate toxicity through test procedures like bioassay, biostimulation and bioinhibition and interpret the role of biomarkers in aquatic systems.
CO5: Evaluate the micronuclei from fish blood and assess the pollution status in the water body.
CO6: 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.</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>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Content</td><td>Unit – I Aquatic pollution
Water pollution: Introduction, Sources and Fate of Pollutants, Interaction of pollutants in Aquatic resources.
Types of Pollution: Sources, Biological Effects and Management of Thermal pollution, Oil pollution, Radioactive pollution, Detergent pollution and Acid rain.
Biological concern: Eutrophication, Bioaccumulation and Biomagnification.
Effluents and their treatment: Introduction and characteristics of domestic, industrial and agricultural discharges. Important methods</td></tr>
</table>

	for wastewater treatment, Water quality standards and water quality indices. **Unit – II Toxicology** **Toxicology:** Introduction, principles and factors affecting the toxicity. **Classification of toxicants:** Metals, Pesticides, Teratogens, Xenobiotics, Toxins of animal and plant origin. **Toxicity test procedures:** Bioassay, Biostimulation and Bioinhibition. Biomarkers in Aquatic system.
Course Code	**AQBP 1003**
Course Title	**Aquatic Pollution and Toxicology: Practical**
Course Practical Content	1. Titrimetric method for the estimation of Biochemical Oxygen Demand (BOD) in a water sample. 2. Titrimetric method for the estimation of Chemical Oxygen Demand (COD) in a water sample. 3. Colorimetric/Photometric method for the estimation of nitrate in a water sample. 4. Colorimetric/Photometric method for the estimation of nitrite in a water sample. 5. Colorimetric/Photometric method for the estimation of inorganic phosphate in a water sample. 6. Colorimetric/Photometric method for the estimation of sulphate in a water sample. 7. Estimate the concentration of total suspended solids (TSS) in a water sample. 8. Find out the median lethal concentration (LC_{50}) of a toxicant using bioassay technique. **OR** Toxicity study in reference to LC_{50}. 9. Study of micronuclei from fish blood. 10. Visit of sewage or water treatment plant.
Reference Books	• Agarwal, S.K. (2008). Water Pollution, ABH Publishing Corporation, New Delhi. • Albert, A. (1951). Selective Toxicity, John Wiley and Sons, Chichester. (Where????) • Ghosh, G.K. (2002). Water of India, A.P.H. Publishing Corporation, New Delhi. • Goel, P.K. (2006). Water Pollution, New Age International Publishers, New Delhi. • Kukal S.S. and Dhaliwal, G.S. (2005). Essential of Environmental Science, Kalyani Publishers, Ludhiana. • Prabhakar, V.K. (2001). Marine Ecology and Pollution, Anmol Publications, New Delhi. • Rand, G.M. (1995). Fundamentals of Aquatic toxicology, Taylor and Francis, Washington, D.C. • Rao, M.K. (2007). Environnemental Pollution & Toxicology, Manglam Publishers, Delhi. • Salpekar, A.C. (2008). Marine Pollution, Jnanada Prakashan, New Delhi.

	• Schmitz, R.J. (1995). Introduction to Water Pollution Biology, Gulf Publishing Company, Texas. • Sinha, P.C. (1998). Marine Pollution, Anmol Publications, New Delhi. • Trivedi, R.K. and Goel, P.K. (1984). Chemical & Biological Methods for Water Pollution Studies, Environmental Publications, Karad. • Trivedi, R.K. (2001). Aquatic Pollution and Toxicology, ABD Publishers, Jaipur. • Gupta, P., Chanjta, A. and Mehta, Y. (2024). Environmental Toxicology, CRC Press. • Knasmueller, S. and Fenech, M. (2019). Micronucleus Assay in Toxicology, Vol. 39, Royal Society of Chemistry. • Rand, G.M. and Petrocelli, S.R. (1985). Fundamentals of Aquatic Toxicology: Methods and Applications, Hemisphere Publishing Corporation. (Where????) • Padhy, B.M. (2000). Environmental Toxicology Assessment, New Age International Publishers.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT SYLLABUS						
Program Name	Master of Science (Aquatic Biology)					
Semester	I					
NCrF Credit Level	6.0					
Course Type	Major					
Course Subtype	Nil					
Subject Type	Discipline Specific					
Course Code	AQB 1001					
Course Level	500-599					
Course Title	**Aquatic Resources and their Management**					
Credit	**Theory:**	2	**Practical:**	2	**Total:**	4
Effective From	Academic Year: 2026-27					
Course Outcomes	**CO1:** Explain inland ecosystems and marine ecosystems to strengthen and develop the basic concepts to handle challenging situations in aquaculture sectors. **CO2:** Student will understand the management practices of aquatic resources including inland and marine animals and plants to explore the aquaculture practices. **CO3:** Explain the types of important aquatic faunal resources available in the water bodies to develop theoretical and practical aspects. **CO4:** Student will able to perform and evaluate various water properties. **CO5:** Student will understand various commercially important fishes, weed fishes and predatory fishes. They even able to identify various important seaweeds. **CO6:** 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						
Course Content	**Unit – 1 Aquatic Resources** Introduction, origin, classification and distribution of Inland (Rivers, Ponds, Lakes and Reservoirs), Brackish water (Estuaries, Lagoons and Coastal inlets) and Marine resources of India and Gujarat. Introduction, Biology, Distribution and Importance of fin fishes: (catla, rohu, mrigal, Indian magur, singhi, hilsa, mullet, sardine, mackerel), Shell fishes (Prawn, shrimp and mollusks), Sport fishes (Golden Mahseer, Brown trout and Rainbow trout), Ornamental fishes (Barb sp. Danio sp. Puntius sp. Channa sp.) and Aquatic plants: (freshwater higher vascular plants, sea weeds, sea grasses and mangroves). **Unit – 2 Aquatic Resources Management** Management of Aquatic resources: Utilization, regulation,						

	conservation and development of aquatic system. Strategies and policy frameworks for sustainable management of aquatic resources at the Global and National levels.
Course Code	**AQBP 1001**
Course Title	**Aquatic Resources and their Management : Practical**
Course Practical Content	1. Determination of organic carbon present in a soil sample 2. Determination of Phosphorous present in a soil sample 3. Determination of Nitrogen, present in a soil sample 4. Determine the pH and Electrical conductivity of the soil sample 5. Water quality estimation (Physical): Temperature, Light and Turbidity 6. Water quality estimation (Titrimetric estimation): DO, pH, Hardness, Alkalinity 7. Water quality estimation (Colorimetric estimation): Salinity, ammonia, Nitrite, Nitrate, silicate 8. Determination of Lake morphometric parameters () by graphimetric and gravimetric method. 9. Determine the shore line length and shore line development index. 10. Determine the water quality index from given data. 11. Visit of the aquatic resources (Dam, Lake, Pond, Estuaries etc.).
Reference Books	• Korring, P. (1976). Farming of marine fishes and shrimp. Elsvier Science Publishers, NY. • Oren, O.H. (1981). Aquaculture of Grey Mullets. Cambridge University Press, London. • Pillay, T.V.R. and Kutty, M.N. (2005). Aquaculture – Principles and Practices. Black Well Sciences, U.K. • Barnes R.S.K. (1999). Introduction to Marine Ecology. Blackwell Science, Oxford UK. • Hutchinson, G.E. (1976). A Treatise on limnology. Vol. I &II John Wiley sons. • Levinton, J. S. (2000). Marine Ecology, Biodiversity and Function. Oxford, UK • Jhingaran, V.G. (1985). Fish and Fisheries of India. Hindustan publication Corp., New Delhi. • Lecren, E.D. and Lowe-Mac Connel, R.H. (1980). The functioning of freshwater ecosystem. Cambridge University Press, UK. • Perkins, E.J. (1980). The Biology of Estuaries and coastal water. Academic Press, London. • Mishra, S. R. (2002). Management of Aquatic Habitats, Daya Publishing House, Delhi • Mackie, G. (2005). Applied Aquatic Ecosystem Concepts (2^{nd} Ed.), Kendall/Hunt Publishing, Dubuque, Lowa. • Greene, Thomas F. (2004). Marine Science: Marine Biology and Oceanography. (2^{nd} Ed.), Amsco School Pub. Inc. • Biswas, K.P. (1996). A Textbook of Fish, Fisheries and Technology. (2^{nd} Ed.), Narendra Publishing House, India. • Jayaram, K.C. (1999). The Freshwater Fishes of the Indian Region. Narendra Publishing Company, New Delhi. • Khanna, S.S. and Singh, H.R. (2006). A Textbook of Fish

	Biology and Fisheries. Narendra Publishing House. India.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1002
Course Level	500-599
Course Title	**Fisheries Technology**
Credit	**Theory:** 2 **Practical:** 2 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**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 water bodies efficiently for fishery research and management. **CO4:** Students will be aware age and growth of fish which are essential for sustainable fish farming and population studies**.** **CO5:** This paper deals with post-harvest technology which helps to identify the preserved fish products and maintain quality (appearance, texture, flavor and nutritive value) to protect food safety and to reduce losses between harvest and consumption. **CO6:** 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						

Course Content	**Unit – I** **Hatcheries:** Introduction and types of hatcheries (Traditional, Circular, Vertical, Shrimp/Prawn hatchery). Hatchery management practices. **Induced breeding:** Selection and conditioning of brooders, Use of inducing agents, pituitary gland extraction dosage, injection, courtship, spawning and fertilization. Other methods of induced breeding (Stripping, Eyestalk ablation, Thermal and Chemical stimulation). **Age and growth of fishes:** Application and utility of different methods for determining the age and growth, study of maturity,

	mortality and yield. Factors affecting age and growth of fishes. **Unit – II** **Fishing Technique and:** Introduction and types of fishing crafts (mechanized and non-mechanized) and gears (traditional and modern), Maintenance and preservation of fishing gears. Advances in fishing methods. **Fish transportation:** Introduction of fish transportation methods (traditional and modern) for fish seeds, fingerlings, brooders and trout eggs. Use of chemicals in live fish transportation. Challenges in fish transportation. **Remote sensing:** Mechanism, satellites and cameras, Importance and Application of remote sensing in Aquatic biology.
Course Code	**AQBP**
Course Title	**Fisheries Technology: Practocal**
Course Practical Content	1. Identification and description of active fishing gears by models and images 2. Identification and description of passive fishing gears by models and images 3. Identification and description of traditional/non-mechanized crafts by models and images. 4. Mending and repair of fishing gears 5. Identification and description of modern/mechanized crafts by models and images 6. Determination of Age and Growth of fin fishes by hard parts (scale). 7. Biometric study of fishes. 8. Study of Remote sensing techniques with help of images 9. Identification and description of preserved and processed fish (Specimen/Images) 10. Field/farm/institute visit and report preparation.
Reference Books	• Agrawal, S. C. (1994). A Hand Book of Fish Farming. Narendra Publishing House, Delhi. • Balachandran, K. K. (1998). Advances and Priorities in Fisheries Technology. Cochin. • Biswas, S. P. (2002). Fundamentals of Ichthyology. Narendra Publishing House, Delhi. • Deekshatulu, B. L. and Rajan, Y. S. (1984). Remote Sensing. Indian Academy of Sciences, Banglore. • Felix, S. (2007). Aquaculture Management Techniques. Narendra Publishing House, New Delhi. • Gupta, S. K. and Gupta, P. C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Jhingran, V. G. (2007). Fish and Fisheries of India (3rd Ed.). Hindustan Publishing Corporation. New Delhi. • Krjstjonsson, H. (1959). Modern Fishing Gear of the World. Vol. I to III, Fishing news (books) Ltd., England. • Meenakumari, B. (2009). Handbook of Fishing Technology. Central Institute of Fisheries Technology, Cochin.

	• Moyle, P.B. (2002). Fishes-An Introduction to Ichthyology. Prentice Hall Inc. NJ 07458. • Nikolsky, G.V. (1999). Ecology of Fishes, Allied Scientific Publishers. • Rao, D.P. (1995). Remote Sensing for Earth Resources. Association of Exploration Geophysicists, Hyderabad. • Regenstein, J.M. and Regenstein, C.E. (1997). Introduction to Fish Technology. CBS Publishers and Distributors, New Delhi. • Sabins, F.F. (1997). Remote Sensing, Principles and Interpretation. W.H. Freeman & Co., New Delhi. • Sharma, O.P. (2009). Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur. • Sreekrishna, Y. and Shenoy, L. (2001). Fishing Gear and Craft Technology. Indian Council of Agricultural Research, New Delhi. • Welcomme, R.L. (2007). Inland Fisheries. Discovery Publishing House, New Delhi. • Yadav, B.N. (1997). Fish and Fisheries. Daya Publishing House, Delhi. • Yadav, N.K. (2009). Management Practices in Fish Farming. Manglam Publications, Delhi. • Ayappan, S. (2011). Handbook of Fisheries and Aquaculture. ICAR, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1004
Course Level	500-599
Course Title	**Bhartiya knowledge system in Aquatic Sciences**
Credit	**Theory:** 4 **Practical:** 0 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Helps to create the foundations, scope, and relevance of the Bharatiya Knowledge System (BKS) with special reference to aquatic sciences and natural ecosystems. **CO2:** Enhance to examine aquatic knowledge documented in Vedic, Puranic, and Ayurvedic texts and analyze the cultural and ecological significance of rivers, lakes, oceans, and indigenous classifications of aquatic organisms. **CO3:** Increase the indigenous water management systems and traditional aquaculture and fisheries practices for their scientific basis, sustainability, and biodiversity conservation potential. **CO4:** Integrate Bharatiya aquatic knowledge systems with modern aquatic biology to address contemporary challenges in conservation, sustainable aquaculture, climate resilience, and resource management.
Course Content	**Unit – 1 BKS and Aquatic Environment** Concept, scope and relevance of BKS in aquatic sciences. Aquatic resources in Indian tradition: Rivers, lakes, tanks, temple ponds, step wells, sacred groves and oceans. **Unit – 2 Traditional Systems in Aquatic Resource Management** Traditional systems of aquatic resource and water quality management. Ethics of water uses, conservation and stewardship in Indian traditions. Role of community practices in sustaining aquatic ecosystems. **Unit – 3 Ethno-Ichthyology and Aquaculture Practices** Ethno-ichthyology: Folk taxonomy and indigenous classification of fishes. Introduction and principles of indigenous aquaculture practices. Indigenous aquaculture systems in India (Pokkali rice–fish farming system, Loktak Lake phumdis fisheries, Bheri fisheries). **Unit – 4 Cultural Scopes of Aquatic Ecosystems** Aquatic symbolism in Indian art, folklore, and literature. Rituals, festivals associated with aquatic ecosystems. Interrelationship between culture, biodiversity, and conservation
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

	CO4
Reference Books	• Agarwal, A., & Narain, S. (1997). Dying wisdom: Rise, fall and potential of India's traditional water harvesting systems. Centre for Science and Environment (India). • Altekar, A. S. (2009). Education in ancient India (Reprint Ed.). Motilal Banarsidass Publishers, New Delhi. • Bandyopadhyay, B. K. (2023). Fundamentals of freshwater fish and fisheries of India. New India Publishing House, New Delhi. • Berkes, F. (2012). Sacred ecology (3rd Ed.). Routledge, New York • Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications, Montana (USA) • Chakraborty, C., Mukherjee, M., & Lepcha, R. F. (2011). Fish and fisheries of Himalayan and Terai region of West Bengal: With ornamental touch. Daya Publishing House / Astral International, New Delhi. • Gadgil, M., & Guha, R. (1992). This fissured land: An ecological history of India. Oxford University Press, London (UK) • Mishra, A. (1993). Aaj Bhi Khare Hain Talaab [The ponds are still relevant]. Prabhat Prakashan, New Delhi • Radhakrishnan, S. (2008). Indian philosophy: Volume I. Oxford University Press, London (UK) • Radhakrishnan, S. (2008). Indian philosophy: Volume II. Oxford University Press, London (UK) • The Matsya Mahāpuranam (2007). Sanskrit text with English translation and notes (2 vols.), Parimal Publications, Delhi • Talwar, P. K., & Jhingran, A. G. (1991). Inland fishes of India and adjacent countries (Vols. 1–2). Oxford & IBH Publishing, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (50 T + 0 P) Marks External Assessment: Total 50 (50 T + 0 P) Marks

<table>
<tr><th colspan="4">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td colspan="3">Master of Science in Aquatic Biology</td></tr>
<tr><td>Semester</td><td colspan="3">I</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="3">6.0</td></tr>
<tr><td>Course Type</td><td colspan="3">Multidisciplinary Coourse</td></tr>
<tr><td>Course Subtype</td><td colspan="3">Nil</td></tr>
<tr><td>Subject Type</td><td colspan="3">Discipline Specific</td></tr>
<tr><td>Course Code</td><td colspan="3">AQB 1005</td></tr>
<tr><td>Course Level</td><td colspan="3">500-599</td></tr>
<tr><td>Course Title</td><td colspan="3">Instrumentation</td></tr>
<tr><td>Credit</td><td>Theory: 4</td><td>Practical: 0</td><td>Total: 4</td></tr>
<tr><td>Effective From</td><td colspan="3">Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">CO1: Aware and train the students for safe work procedure and handling of the instruments in the laboratory.
CO2: Elucidate principle of instruments that help to students to understand the instrument and analysis process.
CO3: The students are proficient to use the advances technology and instruments to speed up the analysis process and error free results.
CO4: The working procedure of instruments are elaborated in details that would be able 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.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td colspan="3"><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>
</table></td></tr>
<tr><td>Course Content</td><td colspan="3">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 turbidometer, Colorimeter, Spectrophotometer (Single bean & double beam), Infrared, NMR and Mass spectrometer
Unit – III Separation techniques
(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 Electrophoresis:
Chromatography: Introduction, Principle and types of chromatography.
Electrophoresis: Introduction, Principle and types of electrophoresis
Blotting: Introduction, types and function
Unit – IV Water quality analysers</td></tr>
</table>

	Introduction, structure, principle and operation of water quality analysers (Conductivity meter, pH meter, Salino meter, DO meter, COD reflaxor (close and open) and BOD analyser)
Reference Books	• Brown, S.B. (1980). An introduction to spectroscopy for Biochemists. Academic press, London, New York. • Robertis, E.D.P. and Robertis, E.M.F. (2001). Cell and Molecular Biology. Lippincott Williams & Wilkins, London. • Hawcroft, D.M. (1996). Electrophoresis. The Basics IRL press, Oxford. • Jenning, W.G. (1993). Analytical Gas chromatography. Academic Press. New York. • Skoogs, H.P. and Nieman, M. (2006). Principle of Instrumental analysis. Thomson Inc. Ltd.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 50 + P 00) Marks External Assessment: Total 50 (T 50 + P 00) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	SEC
Course Subtype	Skill Enhancement Course
Subject Type	Discipline Specific
Course Code	AQB 1006
Course Level	500-599
Course Title	**Technology for Fish Products**
Credit	**Theory:** 2 **Practical:** 0 **Total:** 2
Effective Form	Academic Year: 2026-27
Course Outcomes	**CO1**: Students will be able to explain preparation methods and uses of fish products, by-products and value-added products**.** **CO2**: Students will be able to differentiate between fish products, by-products and value-added products based on raw materials, processing techniques and applications. **CO3**: Students will be able to describe and evaluate various packaging technologies used for fish products, by-products and value-added products. **CO4**: Students will be able to analyze the role of appropriate packaging in ensuring quality, safety, shelf life and marketability of fish products and their derivatives.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	**Unit – I Fish products, By-Products and Value-Added Products** Introduction, methods of preparation and use of various fish products (fish oil, fish roe), by-products (fish liver oil, fish meal, fish manure, fish silage, fish glue, fish gelatin, isinglass, chitosan, pearl essence) and value added products (fish oil capsule, fish flour, fish protein powder, fish hydrolysate, caviar, fish fin soup, fish sausage, fish ham, fish pickles, surimi, fish sauce, battered and braided products). **Unit – II Packaging** Packaging of fish products (polythene wrapping, vacuum packaging, Modified Atmosphere Packaging, frozen packaging, active packaging), fish by-products (bulk packaging, airtight packaging, light-resistant packaging) and value-added products (vacuum-sealed packaging, retort packaging, aseptic packaging, tray packaging, canning and bottling)
Reference Books	• Gupta, S.K. and Gupta, P.C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Joseph, J. (2009). Postharvest Technology of Freshwater Fish. Central Institute of Fisheries Technology, Cochin. • Ninawe, A. and Rathnakumar, K. (2008). Fish Processing Technology and Product Development. Narendra Publishing House.

	• Sachindra, N. M. and Mahendrakar, N. S. (2014). Fish Processing Byproducts: Quality Assessment and Application. Studium Press, LLC, US. • Martin, R. E., Carter, E. P., Flick, G. J. and Davis, L. M. (2000). Marine and Freshwater Products Handbook, CRC Press. • Balasundari, S., Raghu, G. and Felix, S. (2020). Fish Products and Value Addition. Daya Publishing House. • Shitole, P. B., and Sarang, N. S. (2017). Fish processing technology. Narendra Publishing House. • Balachandran, K. K**.** (2001). Post-harvest technology of fish and fish products. Daya Publishing House. • Sen, D. P. (2005). Advances in fish processing technology. Allied Publishers. • Venugopal, V. (2009). Marine products for healthcare: Functional and bioactive nutraceutical compounds from the ocean. CRC Press. • Rustad, T. (2010). Utilization of marine by-products. Electronic Journal of Environmental, Agricultural and Food Chemistry. • Park, J. W. (2013). Surimi and surimi seafood. (3rd Ed.), CRC Press.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment : Total 25 (T 25 + P 0) Marks External Assessment : Total 25 (T 25 + P 0) Marks

SYLLABUS
(2026-27)

Postgraduate Programme
In
AQUATIC BIOLOGY

M. Sc. (Aquatic Biology)
1 Years (Two semester) Degree Programme

DEPARTMENT OF AQUATIC BIOLOGY
VEER NARMAD SOUTH GUJARAT UNIVERSITY
SURAT (GUJARAT) 395007

Structure of Program (Semester I)

PG Programm (1 Year) with Research Work (2 Semester Research Work) for 4 Year UG with Honors students

Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours / Week		Exam Duration (Hr.)		Credit		Internal Marks		External Marks		Total Marks	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
Major	AQB 1001	Aquatic Resources and their management	Aquatic Resources and their management	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1001	Aquatic Resources and their management: Practical	Aquatic Resources and their management: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1002	Fisheries Technology	Fisheries Technology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1002	Fisheries Technology: Practical	Fisheries Technology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1003	Aquatic Pollution and toxicology	Aquatic Pollution and toxicology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1003	Aquatic Pollution and toxicology: Practical	Aquatic Pollution and toxicology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1004	Bhartiya knowledge system in Aquatic Sciences	Bhartiya knowledge system in Aquatic Sciences	500-599	4	-	2	-	4	-	50	-	50	-	100	-
MDC	AQB 1005	Fundamentals of Cyber Security	Fundamentals of Cyber Security	500-599	4	-	2	-	4	-	50	-	50	-	100	-
SEC	AQB 1006	Technology for Fish Products	Technology for Fish Products	500-599	2	-	1	-	2	-	25	-	25	-	50	-
Total					**16**	**6**	**8**	**12**	**16**	**6**	**200**	**75**	**200**	**75**	**400**	**150**

MDC is Multidisciplinary Course and SEC is Skill Enhancement Course

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT PROGRAM TITLE	
Name of Program	**Master of Science in Aquatic Biology**
Program Abbreviation	**AQB**
Duration	1 Year (Two Semester)
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree with honours in Zoology, Botany, Fisheries or any allied subject in Biological and Environmental Sciences
Pre-requisite	B. Sc. Honours in biological and Environmental Science
Medium of Instruction	English
Objective of Program	The main objective of the M.Sc. (Aquatic Biology) 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)	**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 start-ups 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 (PSO)	**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						

<table>
<tr><th colspan="6">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td colspan="5">Master of Science (Aquatic Biology)</td></tr>
<tr><td>Semester</td><td colspan="5">I</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="5">6.0</td></tr>
<tr><td>Course Type</td><td colspan="5">Major</td></tr>
<tr><td>Course Subtype</td><td colspan="5">Nil</td></tr>
<tr><td>Subject Type</td><td colspan="5">Discipline Specific</td></tr>
<tr><td>Course Code</td><td colspan="5">AQB 1001</td></tr>
<tr><td>Course Level</td><td colspan="5">500-599</td></tr>
<tr><td>Course Title</td><td colspan="5">Dissertation</td></tr>
<tr><td>Credit</td><td>Theory and Practical:</td><td>22</td><td>Total:</td><td colspan="2">22</td></tr>
<tr><td>Effective From</td><td colspan="5">Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">CO1: Enables researchers to understand the nature, scope, and importance of research in Aquatic Biology by identifying research gaps and formulating relevant research problems.
CO2: Helps to develop a research proposal by developing clear objectives, hypotheses and appropriate research methodologies relevant to aquatic resources and aquaculture systems.
CO3: The course enables the researcher to use laboratory and field techniques, including the use of instruments and modern technologies, for experimental work and field data.
CO4: Enable researchers to analyze and interpret experimental data using appropriate statistical tools and software.
CO5: Prepare the researcher to prepare a well-structured dissertation document following scientific writing standards and effectively communicate research findings through oral presentation and defense.
CO6: Develop self-learning, problem-solving, and research-oriented skills required for continuous learning, innovation, and professional growth in academic and industrial sectors.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td colspan="5"><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>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Course Content</td><td colspan="5">Research orientation and problem identification
Nature, scope, and Identification of research gaps, Selection of research topic, Formulation of research objectives and hypotheses
Pre-proposal presentation
Research proposal preparation and presentation
Preparation of detailed research proposal and planning of methodology
Literature exploration
Literature search and collection from journals, books, reports, theses, databases; Critical evaluation and organization of literature
Preparation of structured review and reference management
Execution of research work
Design, experimental planning and methodological approaches for Research</td></tr>
</table>

	Collection of experimental and field data
Teaching Methodology	Interactive lectures, Case study discussions, Practical Guidance, Field work, Presentation, Evaluation
Evaluation Method	Internal Assessment : Total 275 (T + P) Marks External Assessment: Total 275 (T + P) Marks

SYLLABUS
(2026-27)

Postgraduate Programme
In
AQUATIC BIOLOGY

M. Sc. (Aquatic Biology)
2 Years (Four Semester) Degree Programme

DEPARTMENT OF AQUATIC BIOLOGY
VEER NARMAD SOUTH GUJARAT UNIVERSITY
SURAT (GUJARAT) 395007

Structure of Program (Semester I)

PG Programm (2 Year) without Research Work (4 Semester course work) for 3 Year UG students

Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours / Week		Exam Duration (Hr.)		Credit		Internal Marks		External Marks		Total Marks	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
Major	AQB 1001	Aquatic Resources and their management	Aquatic Resources and their management	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1001	Aquatic Resources and their management: Practical	Aquatic Resources and their management: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1002	Fisheries Technology	Fisheries Technology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1002	Fisheries Technology: Practical	Fisheries Technology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1003	Aquatic Pollution and toxicology	Aquatic Pollution and toxicology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1003	Aquatic Pollution and toxicology: Practical	Aquatic Pollution and toxicology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1004	Bhartiya knowledge system in Aquatic Sciences	Bhartiya knowledge system in Aquatic Sciences	500-599	4	-	2	-	4	-	50	-	50	-	100	-
MDC	AQB 1005	Fundamentals of Cyber Security	Fundamentals of Cyber Security	500-599	4	-	2	-	4	-	50	-	50	-	100	-
SEC	AQB 1006	Technology for Fish Products	Technology for Fish Products	500-599	2	-	1	-	2	-	25	-	25	-	50	-
Total					**16**	**6**	**8**	**12**	**16**	**6**	**200**	**75**	**200**	**75**	**400**	**150**

MDC is Multidisciplinary Course and SEC is Skill Enhancement Course

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT PROGRAM TITLE	
Name of Program	**Master of Science in Aquatic Biology**
Program Abbreviation	**AQB**
Duration	2 Year (Four Semester)
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree with honours in Zoology, Botany, Fisheries or any allied subject in Biological and Environmental Sciences
Pre-requisite	B. Sc. in biological and Environmental Science
Medium of Instruction	English
Objective of Program	The main objective of the M.Sc. (Aquatic Biology) 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)	**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 start-ups 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 (PSO)	**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						

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT SYLLABUS						
Program Name	Master of Science (Aquatic Biology)					
Semester	I					
NCrF Credit Level	6.0					
Course Type	Major					
Course Subtype	Nil					
Subject Type	Discipline Specific					
Course Code	AQB 1001					
Course Level	500-599					
Course Title	**Aquatic Resources and their Management**					
Credit	**Theory:**	2	**Practical:**	2	**Total:**	4
Effective From	Academic Year: 2026-27					
Course Outcomes	**CO1:** Explain inland ecosystems and marine ecosystems to strengthen and develop the basic concepts to handle challenging situations in aquaculture sectors. **CO2:** Student will understand the management practices of aquatic resources including inland and marine animals and plants to explore the aquaculture practices. **CO3:** Explain the types of important aquatic faunal resources available in the water bodies to develop theoretical and practical aspects. **CO4:** Student will able to perform and evaluate various water properties. **CO5:** Student will understand various commercially important fishes, weed fishes and predatory fishes. They even able to identify various important seaweeds. **CO6:** 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						
Course Content	**Unit – 1 Aquatic Resources** Introduction, origin, classification and distribution of Inland (Rivers, Ponds, Lakes and Reservoirs), Brackish water (Estuaries, Lagoons and Coastal inlets) and Marine resources of India and Gujarat. Introduction, Biology, Distribution and Importance of fin fishes: (catla, rohu, mrigal, Indian magur, singhi, hilsa, mullet, sardine, mackerel), Shell fishes (Prawn, shrimp and mollusks), Sport fishes (Golden Mahseer, Brown trout and Rainbow trout), Ornamental fishes (Barb sp. Danio sp. Puntius sp. Channa sp.) and Aquatic plants: (freshwater higher vascular plants, sea weeds, sea grasses and mangroves). **Unit – 2 Aquatic Resources Management** Management of Aquatic resources: Utilization, regulation,						

	conservation and development of aquatic system. Strategies and policy frameworks for sustainable management of aquatic resources at the Global and National levels.
Course Code	**AQBP 1001**
Course Title	**Aquatic Resources and their Management : Practical**
Course Practical Content	1. Determination of organic carbon present in a soil sample 2. Determination of Phosphorous present in a soil sample 3. Determination of Nitrogen, present in a soil sample 4. Determine the pH and Electrical conductivity of the soil sample 5. Water quality estimation (Physical): Temperature, Light and Turbidity 6. Water quality estimation (Titrimetric estimation): DO, pH, Hardness, Alkalinity 7. Water quality estimation (Colorimetric estimation): Salinity, ammonia, Nitrite, Nitrate, silicate 8. Determination of Lake morphometric parameters () by graphimetric and gravimetric method. 9. Determine the shore line length and shore line development index. 10. Determine the water quality index from given data. 11. Visit of the aquatic resources (Dam, Lake, Pond, Estuaries etc.).
Reference Books	• Korring, P. (1976). Farming of marine fishes and shrimp. Elsvier Science Publishers, NY. • Oren, O.H. (1981). Aquaculture of Grey Mullets. Cambridge University Press, London. • Pillay, T.V.R. and Kutty, M.N. (2005). Aquaculture – Principles and Practices. Black Well Sciences, U.K. • Barnes R.S.K. (1999). Introduction to Marine Ecology. Blackwell Science, Oxford UK. • Hutchinson, G.E. (1976). A Treatise on limnology. Vol. I &II John Wiley sons. • Levinton, J. S. (2000). Marine Ecology, Biodiversity and Function. Oxford, UK • Jhingaran, V.G. (1985). Fish and Fisheries of India. Hindustan publication Corp., New Delhi. • Lecren, E.D. and Lowe-Mac Connel, R.H. (1980). The functioning of freshwater ecosystem. Cambridge University Press, UK. • Perkins, E.J. (1980). The Biology of Estuaries and coastal water. Academic Press, London. • Mishra, S. R. (2002). Management of Aquatic Habitats, Daya Publishing House, Delhi • Mackie, G. (2005). Applied Aquatic Ecosystem Concepts (2^{nd} Ed.), Kendall/Hunt Publishing, Dubuque, Lowa. • Greene, Thomas F. (2004). Marine Science: Marine Biology and Oceanography. (2^{nd} Ed.), Amsco School Pub. Inc. • Biswas, K.P. (1996). A Textbook of Fish, Fisheries and Technology. (2^{nd} Ed.), Narendra Publishing House, India. • Jayaram, K.C. (1999). The Freshwater Fishes of the Indian Region. Narendra Publishing Company, New Delhi. • Khanna, S.S. and Singh, H.R. (2006). A Textbook of Fish

	Biology and Fisheries. Narendra Publishing House. India.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1002
Course Level	500-599
Course Title	**Fisheries Technology**
Credit	**Theory:** 2 **Practical:** 2 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**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 water bodies efficiently for fishery research and management. **CO4:** Students will be aware age and growth of fish which are essential for sustainable fish farming and population studies**.** **CO5:** This paper deals with post-harvest technology which helps to identify the preserved fish products and maintain quality (appearance, texture, flavor and nutritive value) to protect food safety and to reduce losses between harvest and consumption. **CO6:** 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						

Course Content	**Unit – I** **Hatcheries:** Introduction and types of hatcheries (Traditional, Circular, Vertical, Shrimp/Prawn hatchery). Hatchery management practices. **Induced breeding:** Selection and conditioning of brooders, Use of inducing agents, pituitary gland extraction dosage, injection, courtship, spawning and fertilization. Other methods of induced breeding (Stripping, Eyestalk ablation, Thermal and Chemical stimulation). **Age and growth of fishes:** Application and utility of different methods for determining the age and growth, study of maturity,

	mortality and yield. Factors affecting age and growth of fishes. **Unit – II** **Fishing Technique and:** Introduction and types of fishing crafts (mechanized and non-mechanized) and gears (traditional and modern), Maintenance and preservation of fishing gears. Advances in fishing methods. **Fish transportation:** Introduction of fish transportation methods (traditional and modern) for fish seeds, fingerlings, brooders and trout eggs. Use of chemicals in live fish transportation. Challenges in fish transportation. **Remote sensing:** Mechanism, satellites and cameras, Importance and Application of remote sensing in Aquatic biology.
Course Code	**AQBP**
Course Title	**Fisheries Technology: Practocal**
Course Practical Content	1. Identification and description of active fishing gears by models and images 2. Identification and description of passive fishing gears by models and images 3. Identification and description of traditional/non-mechanized crafts by models and images. 4. Mending and repair of fishing gears 5. Identification and description of modern/mechanized crafts by models and images 6. Determination of Age and Growth of fin fishes by hard parts (scale). 7. Biometric study of fishes. 8. Study of Remote sensing techniques with help of images 9. Identification and description of preserved and processed fish (Specimen/Images) 10. Field/farm/institute visit and report preparation.
Reference Books	• Agrawal, S. C. (1994). A Hand Book of Fish Farming. Narendra Publishing House, Delhi. • Balachandran, K. K. (1998). Advances and Priorities in Fisheries Technology. Cochin. • Biswas, S. P. (2002). Fundamentals of Ichthyology. Narendra Publishing House, Delhi. • Deekshatulu, B. L. and Rajan, Y. S. (1984). Remote Sensing. Indian Academy of Sciences, Banglore. • Felix, S. (2007). Aquaculture Management Techniques. Narendra Publishing House, New Delhi. • Gupta, S. K. and Gupta, P. C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Jhingran, V. G. (2007). Fish and Fisheries of India (3rd Ed.). Hindustan Publishing Corporation. New Delhi. • Krjstjonsson, H. (1959). Modern Fishing Gear of the World. Vol. I to III, Fishing news (books) Ltd., England. • Meenakumari, B. (2009). Handbook of Fishing Technology. Central Institute of Fisheries Technology, Cochin.

	• Moyle, P.B. (2002). Fishes-An Introduction to Ichthyology. Prentice Hall Inc. NJ 07458. • Nikolsky, G.V. (1999). Ecology of Fishes, Allied Scientific Publishers. • Rao, D.P. (1995). Remote Sensing for Earth Resources. Association of Exploration Geophysicists, Hyderabad. • Regenstein, J.M. and Regenstein, C.E. (1997). Introduction to Fish Technology. CBS Publishers and Distributors, New Delhi. • Sabins, F.F. (1997). Remote Sensing, Principles and Interpretation. W.H. Freeman & Co., New Delhi. • Sharma, O.P. (2009). Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur. • Sreekrishna, Y. and Shenoy, L. (2001). Fishing Gear and Craft Technology. Indian Council of Agricultural Research, New Delhi. • Welcomme, R.L. (2007). Inland Fisheries. Discovery Publishing House, New Delhi. • Yadav, B.N. (1997). Fish and Fisheries. Daya Publishing House, Delhi. • Yadav, N.K. (2009). Management Practices in Fish Farming. Manglam Publications, Delhi. • Ayappan, S. (2011). Handbook of Fisheries and Aquaculture. ICAR, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

<table>
<tr><th colspan="2">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td>Master of Science (Aquatic Biology)</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td>NCrF Credit Level</td><td>6.0</td></tr>
<tr><td>Course Type</td><td>Major</td></tr>
<tr><td>Course Subtype</td><td>Nil</td></tr>
<tr><td>Subject Type</td><td>Discipline Specific</td></tr>
<tr><td>Course Code</td><td>AQB 1003</td></tr>
<tr><td>Course Level</td><td>500-599</td></tr>
<tr><td>Course Title</td><td>Aquatic Pollution and Toxicology</td></tr>
<tr><td>Credit</td><td>Theory: 2 | Practical: 2 | Total: 4</td></tr>
<tr><td>Effective From</td><td>Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Explain water pollution concepts including sources, fate, interaction of pollutants, types of pollution and their biological effects with management strategies.
CO2: Analyze biological concerns (eutrophication, bioaccumulation, biomagnification) and evaluate effluents along with wastewater treatment methods, water quality standards and indices.
CO3: Understand the basic concepts of toxicology including principles, factors affecting toxicity and classification of toxicants such as metals, pesticides, teratogens, xenobiotics and biological toxins.
CO4: Evaluate toxicity through test procedures like bioassay, biostimulation and bioinhibition and interpret the role of biomarkers in aquatic systems.
CO5: Evaluate the micronuclei from fish blood and assess the pollution status in the water body.
CO6: 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.</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>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Content</td><td>Unit – I Aquatic pollution
Water pollution: Introduction, Sources and Fate of Pollutants, Interaction of pollutants in Aquatic resources.
Types of Pollution: Sources, Biological Effects and Management of Thermal pollution, Oil pollution, Radioactive pollution, Detergent pollution and Acid rain.
Biological concern: Eutrophication, Bioaccumulation and Biomagnification.
Effluents and their treatment: Introduction and characteristics of domestic, industrial and agricultural discharges. Important methods</td></tr>
</table>

	for wastewater treatment, Water quality standards and water quality indices. **Unit – II Toxicology** **Toxicology:** Introduction, principles and factors affecting the toxicity. **Classification of toxicants:** Metals, Pesticides, Teratogens, Xenobiotics, Toxins of animal and plant origin. **Toxicity test procedures:** Bioassay, Biostimulation and Bioinhibition. Biomarkers in Aquatic system.
Course Code	**AQBP 1003**
Course Title	**Aquatic Pollution and Toxicology: Practical**
Course Practical Content	1. Titrimetric method for the estimation of Biochemical Oxygen Demand (BOD) in a water sample. 2. Titrimetric method for the estimation of Chemical Oxygen Demand (COD) in a water sample. 3. Colorimetric/Photometric method for the estimation of nitrate in a water sample. 4. Colorimetric/Photometric method for the estimation of nitrite in a water sample. 5. Colorimetric/Photometric method for the estimation of inorganic phosphate in a water sample. 6. Colorimetric/Photometric method for the estimation of sulphate in a water sample. 7. Estimate the concentration of total suspended solids (TSS) in a water sample. 8. Find out the median lethal concentration (LC_{50}) of a toxicant using bioassay technique. **OR** Toxicity study in reference to LC_{50}. 9. Study of micronuclei from fish blood. 10. Visit of sewage or water treatment plant.
Reference Books	• Agarwal, S.K. (2008). Water Pollution, ABH Publishing Corporation, New Delhi. • Albert, A. (1951). Selective Toxicity, John Wiley and Sons, Chichester. (Where????) • Ghosh, G.K. (2002). Water of India, A.P.H. Publishing Corporation, New Delhi. • Goel, P.K. (2006). Water Pollution, New Age International Publishers, New Delhi. • Kukal S.S. and Dhaliwal, G.S. (2005). Essential of Environmental Science, Kalyani Publishers, Ludhiana. • Prabhakar, V.K. (2001). Marine Ecology and Pollution, Anmol Publications, New Delhi. • Rand, G.M. (1995). Fundamentals of Aquatic toxicology, Taylor and Francis, Washington, D.C. • Rao, M.K. (2007). Environnemental Pollution & Toxicology, Manglam Publishers, Delhi. • Salpekar, A.C. (2008). Marine Pollution, Jnanada Prakashan, New Delhi.

	• Schmitz, R.J. (1995). Introduction to Water Pollution Biology, Gulf Publishing Company, Texas. • Sinha, P.C. (1998). Marine Pollution, Anmol Publications, New Delhi. • Trivedi, R.K. and Goel, P.K. (1984). Chemical & Biological Methods for Water Pollution Studies, Environmental Publications, Karad. • Trivedi, R.K. (2001). Aquatic Pollution and Toxicology, ABD Publishers, Jaipur. • Gupta, P., Chanjta, A. and Mehta, Y. (2024). Environmental Toxicology, CRC Press. • Knasmueller, S. and Fenech, M. (2019). Micronucleus Assay in Toxicology, Vol. 39, Royal Society of Chemistry. • Rand, G.M. and Petrocelli, S.R. (1985). Fundamentals of Aquatic Toxicology: Methods and Applications, Hemisphere Publishing Corporation. (Where????) • Padhy, B.M. (2000). Environmental Toxicology Assessment, New Age International Publishers.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1004
Course Level	500-599
Course Title	**Bhartiya knowledge system in Aquatic Sciences**
Credit	**Theory:** 4 **Practical:** 0 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Helps to create the foundations, scope, and relevance of the Bharatiya Knowledge System (BKS) with special reference to aquatic sciences and natural ecosystems. **CO2:** Enhance to examine aquatic knowledge documented in Vedic, Puranic, and Ayurvedic texts and analyze the cultural and ecological significance of rivers, lakes, oceans, and indigenous classifications of aquatic organisms. **CO3:** Increase the indigenous water management systems and traditional aquaculture and fisheries practices for their scientific basis, sustainability, and biodiversity conservation potential. **CO4:** Integrate Bharatiya aquatic knowledge systems with modern aquatic biology to address contemporary challenges in conservation, sustainable aquaculture, climate resilience, and resource management.
Course Content	**Unit – 1 BKS and Aquatic Environment** Concept, scope and relevance of BKS in aquatic sciences. Aquatic resources in Indian tradition: Rivers, lakes, tanks, temple ponds, step wells, sacred groves and oceans. **Unit – 2 Traditional Systems in Aquatic Resource Management** Traditional systems of aquatic resource and water quality management. Ethics of water uses, conservation and stewardship in Indian traditions. Role of community practices in sustaining aquatic ecosystems. **Unit – 3 Ethno-Ichthyology and Aquaculture Practices** Ethno-ichthyology: Folk taxonomy and indigenous classification of fishes. Introduction and principles of indigenous aquaculture practices. Indigenous aquaculture systems in India (Pokkali rice–fish farming system, Loktak Lake phumdis fisheries, Bheri fisheries). **Unit – 4 Cultural Scopes of Aquatic Ecosystems** Aquatic symbolism in Indian art, folklore, and literature. Rituals, festivals associated with aquatic ecosystems. Interrelationship between culture, biodiversity, and conservation
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

	CO4
Reference Books	• Agarwal, A., & Narain, S. (1997). Dying wisdom: Rise, fall and potential of India's traditional water harvesting systems. Centre for Science and Environment (India). • Altekar, A. S. (2009). Education in ancient India (Reprint Ed.). Motilal Banarsidass Publishers, New Delhi. • Bandyopadhyay, B. K. (2023). Fundamentals of freshwater fish and fisheries of India. New India Publishing House, New Delhi. • Berkes, F. (2012). Sacred ecology (3rd Ed.). Routledge, New York • Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications, Montana (USA) • Chakraborty, C., Mukherjee, M., & Lepcha, R. F. (2011). Fish and fisheries of Himalayan and Terai region of West Bengal: With ornamental touch. Daya Publishing House / Astral International, New Delhi. • Gadgil, M., & Guha, R. (1992). This fissured land: An ecological history of India. Oxford University Press, London (UK) • Mishra, A. (1993). Aaj Bhi Khare Hain Talaab [The ponds are still relevant]. Prabhat Prakashan, New Delhi • Radhakrishnan, S. (2008). Indian philosophy: Volume I. Oxford University Press, London (UK) • Radhakrishnan, S. (2008). Indian philosophy: Volume II. Oxford University Press, London (UK) • The Matsya Mahāpuranam (2007). Sanskrit text with English translation and notes (2 vols.), Parimal Publications, Delhi • Talwar, P. K., & Jhingran, A. G. (1991). Inland fishes of India and adjacent countries (Vols. 1–2). Oxford & IBH Publishing, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (50 T + 0 P) Marks External Assessment: Total 50 (50 T + 0 P) Marks

<table>
<tr><th colspan="4">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td colspan="3">Master of Science in Aquatic Biology</td></tr>
<tr><td>Semester</td><td colspan="3">I</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="3">6.0</td></tr>
<tr><td>Course Type</td><td colspan="3">Multidisciplinary Coourse</td></tr>
<tr><td>Course Subtype</td><td colspan="3">Nil</td></tr>
<tr><td>Subject Type</td><td colspan="3">Discipline Specific</td></tr>
<tr><td>Course Code</td><td colspan="3">AQB 1005</td></tr>
<tr><td>Course Level</td><td colspan="3">500-599</td></tr>
<tr><td>Course Title</td><td colspan="3">Instrumentation</td></tr>
<tr><td>Credit</td><td>Theory: 4</td><td>Practical: 0</td><td>Total: 4</td></tr>
<tr><td>Effective From</td><td colspan="3">Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">CO1: Aware and train the students for safe work procedure and handling of the instruments in the laboratory.
CO2: Elucidate principle of instruments that help to students to understand the instrument and analysis process.
CO3: The students are proficient to use the advances technology and instruments to speed up the analysis process and error free results.
CO4: The working procedure of instruments are elaborated in details that would be able 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.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td colspan="3"><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>
</table></td></tr>
<tr><td>Course Content</td><td colspan="3">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 turbidometer, Colorimeter, Spectrophotometer (Single bean & double beam), Infrared, NMR and Mass spectrometer
Unit – III Separation techniques
(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 Electrophoresis:
Chromatography: Introduction, Principle and types of chromatography.
Electrophoresis: Introduction, Principle and types of electrophoresis
Blotting: Introduction, types and function
Unit – IV Water quality analysers</td></tr>
</table>

	Introduction, structure, principle and operation of water quality analysers (Conductivity meter, pH meter, Salino meter, DO meter, COD reflaxor (close and open) and BOD analyser)
Reference Books	• Brown, S.B. (1980). An introduction to spectroscopy for Biochemists. Academic press, London, New York. • Robertis, E.D.P. and Robertis, E.M.F. (2001). Cell and Molecular Biology. Lippincott Williams & Wilkins, London. • Hawcroft, D.M. (1996). Electrophoresis. The Basics IRL press, Oxford. • Jenning, W.G. (1993). Analytical Gas chromatography. Academic Press. New York. • Skoogs, H.P. and Nieman, M. (2006). Principle of Instrumental analysis. Thomson Inc. Ltd.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 50 + P 00) Marks External Assessment: Total 50 (T 50 + P 00) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	SEC
Course Subtype	Skill Enhancement Course
Subject Type	Discipline Specific
Course Code	AQB 1006
Course Level	500-599
Course Title	**Technology for Fish Products**
Credit	**Theory:** 2 **Practical:** 0 **Total:** 2
Effective Form	Academic Year: 2026-27
Course Outcomes	**CO1**: Students will be able to explain preparation methods and uses of fish products, by-products and value-added products**.** **CO2**: Students will be able to differentiate between fish products, by-products and value-added products based on raw materials, processing techniques and applications. **CO3**: Students will be able to describe and evaluate various packaging technologies used for fish products, by-products and value-added products. **CO4**: Students will be able to analyze the role of appropriate packaging in ensuring quality, safety, shelf life and marketability of fish products and their derivatives.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	**Unit – I Fish products, By-Products and Value-Added Products** Introduction, methods of preparation and use of various fish products (fish oil, fish roe), by-products (fish liver oil, fish meal, fish manure, fish silage, fish glue, fish gelatin, isinglass, chitosan, pearl essence) and value added products (fish oil capsule, fish flour, fish protein powder, fish hydrolysate, caviar, fish fin soup, fish sausage, fish ham, fish pickles, surimi, fish sauce, battered and braided products). **Unit – II Packaging** Packaging of fish products (polythene wrapping, vacuum packaging, Modified Atmosphere Packaging, frozen packaging, active packaging), fish by-products (bulk packaging, airtight packaging, light-resistant packaging) and value-added products (vacuum-sealed packaging, retort packaging, aseptic packaging, tray packaging, canning and bottling)
Reference Books	• Gupta, S.K. and Gupta, P.C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Joseph, J. (2009). Postharvest Technology of Freshwater Fish. Central Institute of Fisheries Technology, Cochin. • Ninawe, A. and Rathnakumar, K. (2008). Fish Processing Technology and Product Development. Narendra Publishing House.

	• Sachindra, N. M. and Mahendrakar, N. S. (2014). Fish Processing Byproducts: Quality Assessment and Application. Studium Press, LLC, US. • Martin, R. E., Carter, E. P., Flick, G. J. and Davis, L. M. (2000). Marine and Freshwater Products Handbook, CRC Press. • Balasundari, S., Raghu, G. and Felix, S. (2020). Fish Products and Value Addition. Daya Publishing House. • Shitole, P. B., and Sarang, N. S. (2017). Fish processing technology. Narendra Publishing House. • Balachandran, K. K**.** (2001). Post-harvest technology of fish and fish products. Daya Publishing House. • Sen, D. P. (2005). Advances in fish processing technology. Allied Publishers. • Venugopal, V. (2009). Marine products for healthcare: Functional and bioactive nutraceutical compounds from the ocean. CRC Press. • Rustad, T. (2010). Utilization of marine by-products. Electronic Journal of Environmental, Agricultural and Food Chemistry. • Park, J. W. (2013). Surimi and surimi seafood. (3rd Ed.), CRC Press.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment : Total 25 (T 25 + P 0) Marks External Assessment : Total 25 (T 25 + P 0) Marks

SYLLABUS
(2026-27)

Postgraduate Programme
In
AQUATIC BIOLOGY

M. Sc. (Aquatic Biology)
2 Years (Four Semester) Degree Programme

DEPARTMENT OF AQUATIC BIOLOGY
VEER NARMAD SOUTH GUJARAT UNIVERSITY
SURAT (GUJARAT) 395007

Structure of Program (Semester I)

PG Programm (2 Year) with Research Work (3 Semester course work and 1 Semester Research Work) for 3 Year UG students

Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours / Week		Exam Duration (Hr.)		Credit		Internal Marks		External Marks		Total Marks	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
Major	AQB 1001	Aquatic Resources and their management	Aquatic Resources and their management	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1001	Aquatic Resources and their management: Practical	Aquatic Resources and their management: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1002	Fisheries Technology	Fisheries Technology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1002	Fisheries Technology: Practical	Fisheries Technology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1003	Aquatic Pollution and toxicology	Aquatic Pollution and toxicology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1003	Aquatic Pollution and toxicology: Practical	Aquatic Pollution and toxicology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1004	Bhartiya knowledge system in Aquatic Sciences	Bhartiya knowledge system in Aquatic Sciences	500-599	4	-	2	-	4	-	50	-	50	-	100	-
MDC	AQB 1005	Fundamentals of Cyber Security	Fundamentals of Cyber Security	500-599	4	-	2	-	4	-	50	-	50	-	100	-
SEC	AQB 1006	Technology for Fish Products	Technology for Fish Products	500-599	2	-	1	-	2	-	25	-	25	-	50	-
Total					**16**	**6**	**8**	**12**	**16**	**6**	**200**	**75**	**200**	**75**	**400**	**150**

MDC is Multidisciplinary Course and SEC is Skill Enhancement Course

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT PROGRAM TITLE	
Name of Program	**Master of Science in Aquatic Biology**
Program Abbreviation	**AQB**
Duration	2 Year (Four Semester)
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree with honours in Zoology, Botany, Fisheries or any allied subject in Biological and Environmental Sciences
Pre-requisite	B. Sc. in biological and Environmental Science
Medium of Instruction	English
Objective of Program	The main objective of the M.Sc. (Aquatic Biology) 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)	**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 start-ups 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 (PSO)	**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						

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT SYLLABUS						
Program Name	Master of Science (Aquatic Biology)					
Semester	I					
NCrF Credit Level	6.0					
Course Type	Major					
Course Subtype	Nil					
Subject Type	Discipline Specific					
Course Code	AQB 1001					
Course Level	500-599					
Course Title	**Aquatic Resources and their Management**					
Credit	**Theory:**	2	**Practical:**	2	**Total:**	4
Effective From	Academic Year: 2026-27					
Course Outcomes	**CO1:** Explain inland ecosystems and marine ecosystems to strengthen and develop the basic concepts to handle challenging situations in aquaculture sectors. **CO2:** Student will understand the management practices of aquatic resources including inland and marine animals and plants to explore the aquaculture practices. **CO3:** Explain the types of important aquatic faunal resources available in the water bodies to develop theoretical and practical aspects. **CO4:** Student will able to perform and evaluate various water properties. **CO5:** Student will understand various commercially important fishes, weed fishes and predatory fishes. They even able to identify various important seaweeds. **CO6:** 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						
Course Content	**Unit – 1 Aquatic Resources** Introduction, origin, classification and distribution of Inland (Rivers, Ponds, Lakes and Reservoirs), Brackish water (Estuaries, Lagoons and Coastal inlets) and Marine resources of India and Gujarat. Introduction, Biology, Distribution and Importance of fin fishes: (catla, rohu, mrigal, Indian magur, singhi, hilsa, mullet, sardine, mackerel), Shell fishes (Prawn, shrimp and mollusks), Sport fishes (Golden Mahseer, Brown trout and Rainbow trout), Ornamental fishes (Barb sp. Danio sp. Puntius sp. Channa sp.) and Aquatic plants: (freshwater higher vascular plants, sea weeds, sea grasses and mangroves). **Unit – 2 Aquatic Resources Management** Management of Aquatic resources: Utilization, regulation,						

	conservation and development of aquatic system. Strategies and policy frameworks for sustainable management of aquatic resources at the Global and National levels.
Course Code	**AQBP 1001**
Course Title	**Aquatic Resources and their Management : Practical**
Course Practical Content	1. Determination of organic carbon present in a soil sample 2. Determination of Phosphorous present in a soil sample 3. Determination of Nitrogen, present in a soil sample 4. Determine the pH and Electrical conductivity of the soil sample 5. Water quality estimation (Physical): Temperature, Light and Turbidity 6. Water quality estimation (Titrimetric estimation): DO, pH, Hardness, Alkalinity 7. Water quality estimation (Colorimetric estimation): Salinity, ammonia, Nitrite, Nitrate, silicate 8. Determination of Lake morphometric parameters () by graphimetric and gravimetric method. 9. Determine the shore line length and shore line development index. 10. Determine the water quality index from given data. 11. Visit of the aquatic resources (Dam, Lake, Pond, Estuaries etc.).
Reference Books	• Korring, P. (1976). Farming of marine fishes and shrimp. Elsvier Science Publishers, NY. • Oren, O.H. (1981). Aquaculture of Grey Mullets. Cambridge University Press, London. • Pillay, T.V.R. and Kutty, M.N. (2005). Aquaculture – Principles and Practices. Black Well Sciences, U.K. • Barnes R.S.K. (1999). Introduction to Marine Ecology. Blackwell Science, Oxford UK. • Hutchinson, G.E. (1976). A Treatise on limnology. Vol. I &II John Wiley sons. • Levinton, J. S. (2000). Marine Ecology, Biodiversity and Function. Oxford, UK • Jhingaran, V.G. (1985). Fish and Fisheries of India. Hindustan publication Corp., New Delhi. • Lecren, E.D. and Lowe-Mac Connel, R.H. (1980). The functioning of freshwater ecosystem. Cambridge University Press, UK. • Perkins, E.J. (1980). The Biology of Estuaries and coastal water. Academic Press, London. • Mishra, S. R. (2002). Management of Aquatic Habitats, Daya Publishing House, Delhi • Mackie, G. (2005). Applied Aquatic Ecosystem Concepts (2^{nd} Ed.), Kendall/Hunt Publishing, Dubuque, Lowa. • Greene, Thomas F. (2004). Marine Science: Marine Biology and Oceanography. (2^{nd} Ed.), Amsco School Pub. Inc. • Biswas, K.P. (1996). A Textbook of Fish, Fisheries and Technology. (2^{nd} Ed.), Narendra Publishing House, India. • Jayaram, K.C. (1999). The Freshwater Fishes of the Indian Region. Narendra Publishing Company, New Delhi. • Khanna, S.S. and Singh, H.R. (2006). A Textbook of Fish

	Biology and Fisheries. Narendra Publishing House. India.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1002
Course Level	500-599
Course Title	**Fisheries Technology**
Credit	**Theory:** 2 **Practical:** 2 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**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 water bodies efficiently for fishery research and management. **CO4:** Students will be aware age and growth of fish which are essential for sustainable fish farming and population studies**.** **CO5:** This paper deals with post-harvest technology which helps to identify the preserved fish products and maintain quality (appearance, texture, flavor and nutritive value) to protect food safety and to reduce losses between harvest and consumption. **CO6:** 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						

Course Content	**Unit – I** **Hatcheries:** Introduction and types of hatcheries (Traditional, Circular, Vertical, Shrimp/Prawn hatchery). Hatchery management practices. **Induced breeding:** Selection and conditioning of brooders, Use of inducing agents, pituitary gland extraction dosage, injection, courtship, spawning and fertilization. Other methods of induced breeding (Stripping, Eyestalk ablation, Thermal and Chemical stimulation). **Age and growth of fishes:** Application and utility of different methods for determining the age and growth, study of maturity,

	mortality and yield. Factors affecting age and growth of fishes. **Unit – II** **Fishing Technique and:** Introduction and types of fishing crafts (mechanized and non-mechanized) and gears (traditional and modern), Maintenance and preservation of fishing gears. Advances in fishing methods. **Fish transportation:** Introduction of fish transportation methods (traditional and modern) for fish seeds, fingerlings, brooders and trout eggs. Use of chemicals in live fish transportation. Challenges in fish transportation. **Remote sensing:** Mechanism, satellites and cameras, Importance and Application of remote sensing in Aquatic biology.
Course Code	**AQBP**
Course Title	**Fisheries Technology: Practocal**
Course Practical Content	1. Identification and description of active fishing gears by models and images 2. Identification and description of passive fishing gears by models and images 3. Identification and description of traditional/non-mechanized crafts by models and images. 4. Mending and repair of fishing gears 5. Identification and description of modern/mechanized crafts by models and images 6. Determination of Age and Growth of fin fishes by hard parts (scale). 7. Biometric study of fishes. 8. Study of Remote sensing techniques with help of images 9. Identification and description of preserved and processed fish (Specimen/Images) 10. Field/farm/institute visit and report preparation.
Reference Books	• Agrawal, S. C. (1994). A Hand Book of Fish Farming. Narendra Publishing House, Delhi. • Balachandran, K. K. (1998). Advances and Priorities in Fisheries Technology. Cochin. • Biswas, S. P. (2002). Fundamentals of Ichthyology. Narendra Publishing House, Delhi. • Deekshatulu, B. L. and Rajan, Y. S. (1984). Remote Sensing. Indian Academy of Sciences, Banglore. • Felix, S. (2007). Aquaculture Management Techniques. Narendra Publishing House, New Delhi. • Gupta, S. K. and Gupta, P. C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Jhingran, V. G. (2007). Fish and Fisheries of India (3rd Ed.). Hindustan Publishing Corporation. New Delhi. • Krjstjonsson, H. (1959). Modern Fishing Gear of the World. Vol. I to III, Fishing news (books) Ltd., England. • Meenakumari, B. (2009). Handbook of Fishing Technology. Central Institute of Fisheries Technology, Cochin.

	• Moyle, P.B. (2002). Fishes-An Introduction to Ichthyology. Prentice Hall Inc. NJ 07458. • Nikolsky, G.V. (1999). Ecology of Fishes, Allied Scientific Publishers. • Rao, D.P. (1995). Remote Sensing for Earth Resources. Association of Exploration Geophysicists, Hyderabad. • Regenstein, J.M. and Regenstein, C.E. (1997). Introduction to Fish Technology. CBS Publishers and Distributors, New Delhi. • Sabins, F.F. (1997). Remote Sensing, Principles and Interpretation. W.H. Freeman & Co., New Delhi. • Sharma, O.P. (2009). Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur. • Sreekrishna, Y. and Shenoy, L. (2001). Fishing Gear and Craft Technology. Indian Council of Agricultural Research, New Delhi. • Welcomme, R.L. (2007). Inland Fisheries. Discovery Publishing House, New Delhi. • Yadav, B.N. (1997). Fish and Fisheries. Daya Publishing House, Delhi. • Yadav, N.K. (2009). Management Practices in Fish Farming. Manglam Publications, Delhi. • Ayappan, S. (2011). Handbook of Fisheries and Aquaculture. ICAR, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

<table>
<tr><th colspan="2">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td>Master of Science (Aquatic Biology)</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td>NCrF Credit Level</td><td>6.0</td></tr>
<tr><td>Course Type</td><td>Major</td></tr>
<tr><td>Course Subtype</td><td>Nil</td></tr>
<tr><td>Subject Type</td><td>Discipline Specific</td></tr>
<tr><td>Course Code</td><td>AQB 1003</td></tr>
<tr><td>Course Level</td><td>500-599</td></tr>
<tr><td>Course Title</td><td>Aquatic Pollution and Toxicology</td></tr>
<tr><td>Credit</td><td>Theory: 2 | Practical: 2 | Total: 4</td></tr>
<tr><td>Effective From</td><td>Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Explain water pollution concepts including sources, fate, interaction of pollutants, types of pollution and their biological effects with management strategies.
CO2: Analyze biological concerns (eutrophication, bioaccumulation, biomagnification) and evaluate effluents along with wastewater treatment methods, water quality standards and indices.
CO3: Understand the basic concepts of toxicology including principles, factors affecting toxicity and classification of toxicants such as metals, pesticides, teratogens, xenobiotics and biological toxins.
CO4: Evaluate toxicity through test procedures like bioassay, biostimulation and bioinhibition and interpret the role of biomarkers in aquatic systems.
CO5: Evaluate the micronuclei from fish blood and assess the pollution status in the water body.
CO6: 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.</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>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Content</td><td>Unit – I Aquatic pollution
Water pollution: Introduction, Sources and Fate of Pollutants, Interaction of pollutants in Aquatic resources.
Types of Pollution: Sources, Biological Effects and Management of Thermal pollution, Oil pollution, Radioactive pollution, Detergent pollution and Acid rain.
Biological concern: Eutrophication, Bioaccumulation and Biomagnification.
Effluents and their treatment: Introduction and characteristics of domestic, industrial and agricultural discharges. Important methods</td></tr>
</table>

	for wastewater treatment, Water quality standards and water quality indices. **Unit – II Toxicology** **Toxicology:** Introduction, principles and factors affecting the toxicity. **Classification of toxicants:** Metals, Pesticides, Teratogens, Xenobiotics, Toxins of animal and plant origin. **Toxicity test procedures:** Bioassay, Biostimulation and Bioinhibition. Biomarkers in Aquatic system.
Course Code	**AQBP 1003**
Course Title	**Aquatic Pollution and Toxicology: Practical**
Course Practical Content	1. Titrimetric method for the estimation of Biochemical Oxygen Demand (BOD) in a water sample. 2. Titrimetric method for the estimation of Chemical Oxygen Demand (COD) in a water sample. 3. Colorimetric/Photometric method for the estimation of nitrate in a water sample. 4. Colorimetric/Photometric method for the estimation of nitrite in a water sample. 5. Colorimetric/Photometric method for the estimation of inorganic phosphate in a water sample. 6. Colorimetric/Photometric method for the estimation of sulphate in a water sample. 7. Estimate the concentration of total suspended solids (TSS) in a water sample. 8. Find out the median lethal concentration (LC_{50}) of a toxicant using bioassay technique. **OR** Toxicity study in reference to LC_{50}. 9. Study of micronuclei from fish blood. 10. Visit of sewage or water treatment plant.
Reference Books	• Agarwal, S.K. (2008). Water Pollution, ABH Publishing Corporation, New Delhi. • Albert, A. (1951). Selective Toxicity, John Wiley and Sons, Chichester. (Where????) • Ghosh, G.K. (2002). Water of India, A.P.H. Publishing Corporation, New Delhi. • Goel, P.K. (2006). Water Pollution, New Age International Publishers, New Delhi. • Kukal S.S. and Dhaliwal, G.S. (2005). Essential of Environmental Science, Kalyani Publishers, Ludhiana. • Prabhakar, V.K. (2001). Marine Ecology and Pollution, Anmol Publications, New Delhi. • Rand, G.M. (1995). Fundamentals of Aquatic toxicology, Taylor and Francis, Washington, D.C. • Rao, M.K. (2007). Environnemental Pollution & Toxicology, Manglam Publishers, Delhi. • Salpekar, A.C. (2008). Marine Pollution, Jnanada Prakashan, New Delhi.

	• Schmitz, R.J. (1995). Introduction to Water Pollution Biology, Gulf Publishing Company, Texas. • Sinha, P.C. (1998). Marine Pollution, Anmol Publications, New Delhi. • Trivedi, R.K. and Goel, P.K. (1984). Chemical & Biological Methods for Water Pollution Studies, Environmental Publications, Karad. • Trivedi, R.K. (2001). Aquatic Pollution and Toxicology, ABD Publishers, Jaipur. • Gupta, P., Chanjta, A. and Mehta, Y. (2024). Environmental Toxicology, CRC Press. • Knasmueller, S. and Fenech, M. (2019). Micronucleus Assay in Toxicology, Vol. 39, Royal Society of Chemistry. • Rand, G.M. and Petrocelli, S.R. (1985). Fundamentals of Aquatic Toxicology: Methods and Applications, Hemisphere Publishing Corporation. (Where????) • Padhy, B.M. (2000). Environmental Toxicology Assessment, New Age International Publishers.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1004
Course Level	500-599
Course Title	**Bhartiya knowledge system in Aquatic Sciences**
Credit	**Theory:** 4 **Practical:** 0 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Helps to create the foundations, scope, and relevance of the Bharatiya Knowledge System (BKS) with special reference to aquatic sciences and natural ecosystems. **CO2:** Enhance to examine aquatic knowledge documented in Vedic, Puranic, and Ayurvedic texts and analyze the cultural and ecological significance of rivers, lakes, oceans, and indigenous classifications of aquatic organisms. **CO3:** Increase the indigenous water management systems and traditional aquaculture and fisheries practices for their scientific basis, sustainability, and biodiversity conservation potential. **CO4:** Integrate Bharatiya aquatic knowledge systems with modern aquatic biology to address contemporary challenges in conservation, sustainable aquaculture, climate resilience, and resource management.
Course Content	**Unit – 1 BKS and Aquatic Environment** Concept, scope and relevance of BKS in aquatic sciences. Aquatic resources in Indian tradition: Rivers, lakes, tanks, temple ponds, step wells, sacred groves and oceans. **Unit – 2 Traditional Systems in Aquatic Resource Management** Traditional systems of aquatic resource and water quality management. Ethics of water uses, conservation and stewardship in Indian traditions. Role of community practices in sustaining aquatic ecosystems. **Unit – 3 Ethno-Ichthyology and Aquaculture Practices** Ethno-ichthyology: Folk taxonomy and indigenous classification of fishes. Introduction and principles of indigenous aquaculture practices. Indigenous aquaculture systems in India (Pokkali rice–fish farming system, Loktak Lake phumdis fisheries, Bheri fisheries). **Unit – 4 Cultural Scopes of Aquatic Ecosystems** Aquatic symbolism in Indian art, folklore, and literature. Rituals, festivals associated with aquatic ecosystems. Interrelationship between culture, biodiversity, and conservation
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

	CO4
Reference Books	• Agarwal, A., & Narain, S. (1997). Dying wisdom: Rise, fall and potential of India's traditional water harvesting systems. Centre for Science and Environment (India). • Altekar, A. S. (2009). Education in ancient India (Reprint Ed.). Motilal Banarsidass Publishers, New Delhi. • Bandyopadhyay, B. K. (2023). Fundamentals of freshwater fish and fisheries of India. New India Publishing House, New Delhi. • Berkes, F. (2012). Sacred ecology (3rd Ed.). Routledge, New York • Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications, Montana (USA) • Chakraborty, C., Mukherjee, M., & Lepcha, R. F. (2011). Fish and fisheries of Himalayan and Terai region of West Bengal: With ornamental touch. Daya Publishing House / Astral International, New Delhi. • Gadgil, M., & Guha, R. (1992). This fissured land: An ecological history of India. Oxford University Press, London (UK) • Mishra, A. (1993). Aaj Bhi Khare Hain Talaab [The ponds are still relevant]. Prabhat Prakashan, New Delhi • Radhakrishnan, S. (2008). Indian philosophy: Volume I. Oxford University Press, London (UK) • Radhakrishnan, S. (2008). Indian philosophy: Volume II. Oxford University Press, London (UK) • The Matsya Mahāpuranam (2007). Sanskrit text with English translation and notes (2 vols.), Parimal Publications, Delhi • Talwar, P. K., & Jhingran, A. G. (1991). Inland fishes of India and adjacent countries (Vols. 1–2). Oxford & IBH Publishing, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (50 T + 0 P) Marks External Assessment: Total 50 (50 T + 0 P) Marks

<table>
<tr><th colspan="4">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td colspan="3">Master of Science in Aquatic Biology</td></tr>
<tr><td>Semester</td><td colspan="3">I</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="3">6.0</td></tr>
<tr><td>Course Type</td><td colspan="3">Multidisciplinary Coourse</td></tr>
<tr><td>Course Subtype</td><td colspan="3">Nil</td></tr>
<tr><td>Subject Type</td><td colspan="3">Discipline Specific</td></tr>
<tr><td>Course Code</td><td colspan="3">AQB 1005</td></tr>
<tr><td>Course Level</td><td colspan="3">500-599</td></tr>
<tr><td>Course Title</td><td colspan="3">Instrumentation</td></tr>
<tr><td>Credit</td><td>Theory: 4</td><td>Practical: 0</td><td>Total: 4</td></tr>
<tr><td>Effective From</td><td colspan="3">Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">CO1: Aware and train the students for safe work procedure and handling of the instruments in the laboratory.
CO2: Elucidate principle of instruments that help to students to understand the instrument and analysis process.
CO3: The students are proficient to use the advances technology and instruments to speed up the analysis process and error free results.
CO4: The working procedure of instruments are elaborated in details that would be able 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.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td colspan="3"><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>
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<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>Course Content</td><td colspan="3">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 turbidometer, Colorimeter, Spectrophotometer (Single bean & double beam), Infrared, NMR and Mass spectrometer
Unit – III Separation techniques
(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 Electrophoresis:
Chromatography: Introduction, Principle and types of chromatography.
Electrophoresis: Introduction, Principle and types of electrophoresis
Blotting: Introduction, types and function
Unit – IV Water quality analysers</td></tr>
</table>

	Introduction, structure, principle and operation of water quality analysers (Conductivity meter, pH meter, Salino meter, DO meter, COD reflaxor (close and open) and BOD analyser)
Reference Books	• Brown, S.B. (1980). An introduction to spectroscopy for Biochemists. Academic press, London, New York. • Robertis, E.D.P. and Robertis, E.M.F. (2001). Cell and Molecular Biology. Lippincott Williams & Wilkins, London. • Hawcroft, D.M. (1996). Electrophoresis. The Basics IRL press, Oxford. • Jenning, W.G. (1993). Analytical Gas chromatography. Academic Press. New York. • Skoogs, H.P. and Nieman, M. (2006). Principle of Instrumental analysis. Thomson Inc. Ltd.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 50 + P 00) Marks External Assessment: Total 50 (T 50 + P 00) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	SEC
Course Subtype	Skill Enhancement Course
Subject Type	Discipline Specific
Course Code	AQB 1006
Course Level	500-599
Course Title	**Technology for Fish Products**
Credit	**Theory:** 2 **Practical:** 0 **Total:** 2
Effective Form	Academic Year: 2026-27
Course Outcomes	**CO1**: Students will be able to explain preparation methods and uses of fish products, by-products and value-added products**.** **CO2**: Students will be able to differentiate between fish products, by-products and value-added products based on raw materials, processing techniques and applications. **CO3**: Students will be able to describe and evaluate various packaging technologies used for fish products, by-products and value-added products. **CO4**: Students will be able to analyze the role of appropriate packaging in ensuring quality, safety, shelf life and marketability of fish products and their derivatives.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	**Unit – I Fish products, By-Products and Value-Added Products** Introduction, methods of preparation and use of various fish products (fish oil, fish roe), by-products (fish liver oil, fish meal, fish manure, fish silage, fish glue, fish gelatin, isinglass, chitosan, pearl essence) and value added products (fish oil capsule, fish flour, fish protein powder, fish hydrolysate, caviar, fish fin soup, fish sausage, fish ham, fish pickles, surimi, fish sauce, battered and braided products). **Unit – II Packaging** Packaging of fish products (polythene wrapping, vacuum packaging, Modified Atmosphere Packaging, frozen packaging, active packaging), fish by-products (bulk packaging, airtight packaging, light-resistant packaging) and value-added products (vacuum-sealed packaging, retort packaging, aseptic packaging, tray packaging, canning and bottling)
Reference Books	• Gupta, S.K. and Gupta, P.C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Joseph, J. (2009). Postharvest Technology of Freshwater Fish. Central Institute of Fisheries Technology, Cochin. • Ninawe, A. and Rathnakumar, K. (2008). Fish Processing Technology and Product Development. Narendra Publishing House.

	• Sachindra, N. M. and Mahendrakar, N. S. (2014). Fish Processing Byproducts: Quality Assessment and Application. Studium Press, LLC, US. • Martin, R. E., Carter, E. P., Flick, G. J. and Davis, L. M. (2000). Marine and Freshwater Products Handbook, CRC Press. • Balasundari, S., Raghu, G. and Felix, S. (2020). Fish Products and Value Addition. Daya Publishing House. • Shitole, P. B., and Sarang, N. S. (2017). Fish processing technology. Narendra Publishing House. • Balachandran, K. K**.** (2001). Post-harvest technology of fish and fish products. Daya Publishing House. • Sen, D. P. (2005). Advances in fish processing technology. Allied Publishers. • Venugopal, V. (2009). Marine products for healthcare: Functional and bioactive nutraceutical compounds from the ocean. CRC Press. • Rustad, T. (2010). Utilization of marine by-products. Electronic Journal of Environmental, Agricultural and Food Chemistry. • Park, J. W. (2013). Surimi and surimi seafood. (3rd Ed.), CRC Press.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment : Total 25 (T 25 + P 0) Marks External Assessment : Total 25 (T 25 + P 0) Marks

SYLLABUS
(2026-27)

Postgraduate Programme
In
AQUATIC BIOLOGY

M. Sc. (Aquatic Biology)
2 Years (Four Semester) Degree Programme

DEPARTMENT OF AQUATIC BIOLOGY
VEER NARMAD SOUTH GUJARAT UNIVERSITY
SURAT (GUJARAT) 395007

Structure of Program (Semester I)

PG Programm (2 Year) with Research Work (2 Semester course work and 2 Semester Research Work) for 3 Year UG students

Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours / Week		Exam Duration (Hr.)		Credit		Internal Marks		External Marks		Total Marks	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
Major	AQB 1001	Aquatic Resources and their management	Aquatic Resources and their management	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1001	Aquatic Resources and their management: Practical	Aquatic Resources and their management: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1002	Fisheries Technology	Fisheries Technology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1002	Fisheries Technology: Practical	Fisheries Technology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1003	Aquatic Pollution and toxicology	Aquatic Pollution and toxicology	500-599	2	-	1	-	2	-	25	-	25	-	50	-
	AQBP 1003	Aquatic Pollution and toxicology: Practical	Aquatic Pollution and toxicology: Practical	500-599	-	4	-	4	-	2	-	25	-	25	-	50
	AQB 1004	Bhartiya knowledge system in Aquatic Sciences	Bhartiya knowledge system in Aquatic Sciences	500-599	4	-	2	-	4	-	50	-	50	-	100	-
MDC	AQB 1005	Fundamentals of Cyber Security	Fundamentals of Cyber Security	500-599	4	-	2	-	4	-	50	-	50	-	100	-
SEC	AQB 1006	Technology for Fish Products	Technology for Fish Products	500-599	2	-	1	-	2	-	25	-	25	-	50	-
Total					**16**	**6**	**8**	**12**	**16**	**6**	**200**	**75**	**200**	**75**	**400**	**150**

MDC is Multidisciplinary Course and SEC is Skill Enhancement Course

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT PROGRAM TITLE	
Name of Program	**Master of Science in Aquatic Biology**
Program Abbreviation	**AQB**
Duration	2 Year (Four Semester)
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree with honours in Zoology, Botany, Fisheries or any allied subject in Biological and Environmental Sciences
Pre-requisite	B. Sc. in biological and Environmental Science
Medium of Instruction	English
Objective of Program	The main objective of the M.Sc. (Aquatic Biology) 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)	**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 start-ups 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 (PSO)	**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						

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT SYLLABUS						
Program Name	Master of Science (Aquatic Biology)					
Semester	I					
NCrF Credit Level	6.0					
Course Type	Major					
Course Subtype	Nil					
Subject Type	Discipline Specific					
Course Code	AQB 1001					
Course Level	500-599					
Course Title	**Aquatic Resources and their Management**					
Credit	**Theory:**	2	**Practical:**	2	**Total:**	4
Effective From	Academic Year: 2026-27					
Course Outcomes	**CO1:** Explain inland ecosystems and marine ecosystems to strengthen and develop the basic concepts to handle challenging situations in aquaculture sectors. **CO2:** Student will understand the management practices of aquatic resources including inland and marine animals and plants to explore the aquaculture practices. **CO3:** Explain the types of important aquatic faunal resources available in the water bodies to develop theoretical and practical aspects. **CO4:** Student will able to perform and evaluate various water properties. **CO5:** Student will understand various commercially important fishes, weed fishes and predatory fishes. They even able to identify various important seaweeds. **CO6:** 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						
Course Content	**Unit – 1 Aquatic Resources** Introduction, origin, classification and distribution of Inland (Rivers, Ponds, Lakes and Reservoirs), Brackish water (Estuaries, Lagoons and Coastal inlets) and Marine resources of India and Gujarat. Introduction, Biology, Distribution and Importance of fin fishes: (catla, rohu, mrigal, Indian magur, singhi, hilsa, mullet, sardine, mackerel), Shell fishes (Prawn, shrimp and mollusks), Sport fishes (Golden Mahseer, Brown trout and Rainbow trout), Ornamental fishes (Barb sp. Danio sp. Puntius sp. Channa sp.) and Aquatic plants: (freshwater higher vascular plants, sea weeds, sea grasses and mangroves). **Unit – 2 Aquatic Resources Management** Management of Aquatic resources: Utilization, regulation,						

	conservation and development of aquatic system. Strategies and policy frameworks for sustainable management of aquatic resources at the Global and National levels.
Course Code	**AQBP 1001**
Course Title	**Aquatic Resources and their Management : Practical**
Course Practical Content	1. Determination of organic carbon present in a soil sample 2. Determination of Phosphorous present in a soil sample 3. Determination of Nitrogen, present in a soil sample 4. Determine the pH and Electrical conductivity of the soil sample 5. Water quality estimation (Physical): Temperature, Light and Turbidity 6. Water quality estimation (Titrimetric estimation): DO, pH, Hardness, Alkalinity 7. Water quality estimation (Colorimetric estimation): Salinity, ammonia, Nitrite, Nitrate, silicate 8. Determination of Lake morphometric parameters () by graphimetric and gravimetric method. 9. Determine the shore line length and shore line development index. 10. Determine the water quality index from given data. 11. Visit of the aquatic resources (Dam, Lake, Pond, Estuaries etc.).
Reference Books	• Korring, P. (1976). Farming of marine fishes and shrimp. Elsvier Science Publishers, NY. • Oren, O.H. (1981). Aquaculture of Grey Mullets. Cambridge University Press, London. • Pillay, T.V.R. and Kutty, M.N. (2005). Aquaculture – Principles and Practices. Black Well Sciences, U.K. • Barnes R.S.K. (1999). Introduction to Marine Ecology. Blackwell Science, Oxford UK. • Hutchinson, G.E. (1976). A Treatise on limnology. Vol. I &II John Wiley sons. • Levinton, J. S. (2000). Marine Ecology, Biodiversity and Function. Oxford, UK • Jhingaran, V.G. (1985). Fish and Fisheries of India. Hindustan publication Corp., New Delhi. • Lecren, E.D. and Lowe-Mac Connel, R.H. (1980). The functioning of freshwater ecosystem. Cambridge University Press, UK. • Perkins, E.J. (1980). The Biology of Estuaries and coastal water. Academic Press, London. • Mishra, S. R. (2002). Management of Aquatic Habitats, Daya Publishing House, Delhi • Mackie, G. (2005). Applied Aquatic Ecosystem Concepts (2^{nd} Ed.), Kendall/Hunt Publishing, Dubuque, Lowa. • Greene, Thomas F. (2004). Marine Science: Marine Biology and Oceanography. (2^{nd} Ed.), Amsco School Pub. Inc. • Biswas, K.P. (1996). A Textbook of Fish, Fisheries and Technology. (2^{nd} Ed.), Narendra Publishing House, India. • Jayaram, K.C. (1999). The Freshwater Fishes of the Indian Region. Narendra Publishing Company, New Delhi. • Khanna, S.S. and Singh, H.R. (2006). A Textbook of Fish

	Biology and Fisheries. Narendra Publishing House. India.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1002
Course Level	500-599
Course Title	**Fisheries Technology**
Credit	**Theory:** 2 **Practical:** 2 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**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 water bodies efficiently for fishery research and management. **CO4:** Students will be aware age and growth of fish which are essential for sustainable fish farming and population studies**.** **CO5:** This paper deals with post-harvest technology which helps to identify the preserved fish products and maintain quality (appearance, texture, flavor and nutritive value) to protect food safety and to reduce losses between harvest and consumption. **CO6:** 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						

Course Content	**Unit – I** **Hatcheries:** Introduction and types of hatcheries (Traditional, Circular, Vertical, Shrimp/Prawn hatchery). Hatchery management practices. **Induced breeding:** Selection and conditioning of brooders, Use of inducing agents, pituitary gland extraction dosage, injection, courtship, spawning and fertilization. Other methods of induced breeding (Stripping, Eyestalk ablation, Thermal and Chemical stimulation). **Age and growth of fishes:** Application and utility of different methods for determining the age and growth, study of maturity,

	mortality and yield. Factors affecting age and growth of fishes. **Unit – II** **Fishing Technique and:** Introduction and types of fishing crafts (mechanized and non-mechanized) and gears (traditional and modern), Maintenance and preservation of fishing gears. Advances in fishing methods. **Fish transportation:** Introduction of fish transportation methods (traditional and modern) for fish seeds, fingerlings, brooders and trout eggs. Use of chemicals in live fish transportation. Challenges in fish transportation. **Remote sensing:** Mechanism, satellites and cameras, Importance and Application of remote sensing in Aquatic biology.
Course Code	**AQBP**
Course Title	**Fisheries Technology: Practocal**
Course Practical Content	1. Identification and description of active fishing gears by models and images 2. Identification and description of passive fishing gears by models and images 3. Identification and description of traditional/non-mechanized crafts by models and images. 4. Mending and repair of fishing gears 5. Identification and description of modern/mechanized crafts by models and images 6. Determination of Age and Growth of fin fishes by hard parts (scale). 7. Biometric study of fishes. 8. Study of Remote sensing techniques with help of images 9. Identification and description of preserved and processed fish (Specimen/Images) 10. Field/farm/institute visit and report preparation.
Reference Books	• Agrawal, S. C. (1994). A Hand Book of Fish Farming. Narendra Publishing House, Delhi. • Balachandran, K. K. (1998). Advances and Priorities in Fisheries Technology. Cochin. • Biswas, S. P. (2002). Fundamentals of Ichthyology. Narendra Publishing House, Delhi. • Deekshatulu, B. L. and Rajan, Y. S. (1984). Remote Sensing. Indian Academy of Sciences, Banglore. • Felix, S. (2007). Aquaculture Management Techniques. Narendra Publishing House, New Delhi. • Gupta, S. K. and Gupta, P. C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Jhingran, V. G. (2007). Fish and Fisheries of India (3rd Ed.). Hindustan Publishing Corporation. New Delhi. • Krjstjonsson, H. (1959). Modern Fishing Gear of the World. Vol. I to III, Fishing news (books) Ltd., England. • Meenakumari, B. (2009). Handbook of Fishing Technology. Central Institute of Fisheries Technology, Cochin.

	• Moyle, P.B. (2002). Fishes-An Introduction to Ichthyology. Prentice Hall Inc. NJ 07458. • Nikolsky, G.V. (1999). Ecology of Fishes, Allied Scientific Publishers. • Rao, D.P. (1995). Remote Sensing for Earth Resources. Association of Exploration Geophysicists, Hyderabad. • Regenstein, J.M. and Regenstein, C.E. (1997). Introduction to Fish Technology. CBS Publishers and Distributors, New Delhi. • Sabins, F.F. (1997). Remote Sensing, Principles and Interpretation. W.H. Freeman & Co., New Delhi. • Sharma, O.P. (2009). Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur. • Sreekrishna, Y. and Shenoy, L. (2001). Fishing Gear and Craft Technology. Indian Council of Agricultural Research, New Delhi. • Welcomme, R.L. (2007). Inland Fisheries. Discovery Publishing House, New Delhi. • Yadav, B.N. (1997). Fish and Fisheries. Daya Publishing House, Delhi. • Yadav, N.K. (2009). Management Practices in Fish Farming. Manglam Publications, Delhi. • Ayappan, S. (2011). Handbook of Fisheries and Aquaculture. ICAR, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment : Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

<table>
<tr><th colspan="2">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td>Master of Science (Aquatic Biology)</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td>NCrF Credit Level</td><td>6.0</td></tr>
<tr><td>Course Type</td><td>Major</td></tr>
<tr><td>Course Subtype</td><td>Nil</td></tr>
<tr><td>Subject Type</td><td>Discipline Specific</td></tr>
<tr><td>Course Code</td><td>AQB 1003</td></tr>
<tr><td>Course Level</td><td>500-599</td></tr>
<tr><td>Course Title</td><td>Aquatic Pollution and Toxicology</td></tr>
<tr><td>Credit</td><td>Theory: 2 | Practical: 2 | Total: 4</td></tr>
<tr><td>Effective From</td><td>Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Explain water pollution concepts including sources, fate, interaction of pollutants, types of pollution and their biological effects with management strategies.
CO2: Analyze biological concerns (eutrophication, bioaccumulation, biomagnification) and evaluate effluents along with wastewater treatment methods, water quality standards and indices.
CO3: Understand the basic concepts of toxicology including principles, factors affecting toxicity and classification of toxicants such as metals, pesticides, teratogens, xenobiotics and biological toxins.
CO4: Evaluate toxicity through test procedures like bioassay, biostimulation and bioinhibition and interpret the role of biomarkers in aquatic systems.
CO5: Evaluate the micronuclei from fish blood and assess the pollution status in the water body.
CO6: 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.</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>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Content</td><td>Unit – I Aquatic pollution
Water pollution: Introduction, Sources and Fate of Pollutants, Interaction of pollutants in Aquatic resources.
Types of Pollution: Sources, Biological Effects and Management of Thermal pollution, Oil pollution, Radioactive pollution, Detergent pollution and Acid rain.
Biological concern: Eutrophication, Bioaccumulation and Biomagnification.
Effluents and their treatment: Introduction and characteristics of domestic, industrial and agricultural discharges. Important methods</td></tr>
</table>

	for wastewater treatment, Water quality standards and water quality indices. **Unit – II Toxicology** **Toxicology:** Introduction, principles and factors affecting the toxicity. **Classification of toxicants:** Metals, Pesticides, Teratogens, Xenobiotics, Toxins of animal and plant origin. **Toxicity test procedures:** Bioassay, Biostimulation and Bioinhibition. Biomarkers in Aquatic system.
Course Code	**AQBP 1003**
Course Title	**Aquatic Pollution and Toxicology: Practical**
Course Practical Content	1. Titrimetric method for the estimation of Biochemical Oxygen Demand (BOD) in a water sample. 2. Titrimetric method for the estimation of Chemical Oxygen Demand (COD) in a water sample. 3. Colorimetric/Photometric method for the estimation of nitrate in a water sample. 4. Colorimetric/Photometric method for the estimation of nitrite in a water sample. 5. Colorimetric/Photometric method for the estimation of inorganic phosphate in a water sample. 6. Colorimetric/Photometric method for the estimation of sulphate in a water sample. 7. Estimate the concentration of total suspended solids (TSS) in a water sample. 8. Find out the median lethal concentration (LC_{50}) of a toxicant using bioassay technique. **OR** Toxicity study in reference to LC_{50}. 9. Study of micronuclei from fish blood. 10. Visit of sewage or water treatment plant.
Reference Books	• Agarwal, S.K. (2008). Water Pollution, ABH Publishing Corporation, New Delhi. • Albert, A. (1951). Selective Toxicity, John Wiley and Sons, Chichester. (Where????) • Ghosh, G.K. (2002). Water of India, A.P.H. Publishing Corporation, New Delhi. • Goel, P.K. (2006). Water Pollution, New Age International Publishers, New Delhi. • Kukal S.S. and Dhaliwal, G.S. (2005). Essential of Environmental Science, Kalyani Publishers, Ludhiana. • Prabhakar, V.K. (2001). Marine Ecology and Pollution, Anmol Publications, New Delhi. • Rand, G.M. (1995). Fundamentals of Aquatic toxicology, Taylor and Francis, Washington, D.C. • Rao, M.K. (2007). Environnemental Pollution & Toxicology, Manglam Publishers, Delhi. • Salpekar, A.C. (2008). Marine Pollution, Jnanada Prakashan, New Delhi.

	• Schmitz, R.J. (1995). Introduction to Water Pollution Biology, Gulf Publishing Company, Texas. • Sinha, P.C. (1998). Marine Pollution, Anmol Publications, New Delhi. • Trivedi, R.K. and Goel, P.K. (1984). Chemical & Biological Methods for Water Pollution Studies, Environmental Publications, Karad. • Trivedi, R.K. (2001). Aquatic Pollution and Toxicology, ABD Publishers, Jaipur. • Gupta, P., Chanjta, A. and Mehta, Y. (2024). Environmental Toxicology, CRC Press. • Knasmueller, S. and Fenech, M. (2019). Micronucleus Assay in Toxicology, Vol. 39, Royal Society of Chemistry. • Rand, G.M. and Petrocelli, S.R. (1985). Fundamentals of Aquatic Toxicology: Methods and Applications, Hemisphere Publishing Corporation. (Where????) • Padhy, B.M. (2000). Environmental Toxicology Assessment, New Age International Publishers.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos), Laboratory work. Journal Preparation and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 25 + P 25) Marks External Assessment: Total 50 (T 25 + P 25) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	AQB 1004
Course Level	500-599
Course Title	**Bhartiya knowledge system in Aquatic Sciences**
Credit	**Theory:** 4 **Practical:** 0 **Total:** 4
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Helps to create the foundations, scope, and relevance of the Bharatiya Knowledge System (BKS) with special reference to aquatic sciences and natural ecosystems. **CO2:** Enhance to examine aquatic knowledge documented in Vedic, Puranic, and Ayurvedic texts and analyze the cultural and ecological significance of rivers, lakes, oceans, and indigenous classifications of aquatic organisms. **CO3:** Increase the indigenous water management systems and traditional aquaculture and fisheries practices for their scientific basis, sustainability, and biodiversity conservation potential. **CO4:** Integrate Bharatiya aquatic knowledge systems with modern aquatic biology to address contemporary challenges in conservation, sustainable aquaculture, climate resilience, and resource management.
Course Content	**Unit – 1 BKS and Aquatic Environment** Concept, scope and relevance of BKS in aquatic sciences. Aquatic resources in Indian tradition: Rivers, lakes, tanks, temple ponds, step wells, sacred groves and oceans. **Unit – 2 Traditional Systems in Aquatic Resource Management** Traditional systems of aquatic resource and water quality management. Ethics of water uses, conservation and stewardship in Indian traditions. Role of community practices in sustaining aquatic ecosystems. **Unit – 3 Ethno-Ichthyology and Aquaculture Practices** Ethno-ichthyology: Folk taxonomy and indigenous classification of fishes. Introduction and principles of indigenous aquaculture practices. Indigenous aquaculture systems in India (Pokkali rice–fish farming system, Loktak Lake phumdis fisheries, Bheri fisheries). **Unit – 4 Cultural Scopes of Aquatic Ecosystems** Aquatic symbolism in Indian art, folklore, and literature. Rituals, festivals associated with aquatic ecosystems. Interrelationship between culture, biodiversity, and conservation
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

	CO4
Reference Books	• Agarwal, A., & Narain, S. (1997). Dying wisdom: Rise, fall and potential of India's traditional water harvesting systems. Centre for Science and Environment (India). • Altekar, A. S. (2009). Education in ancient India (Reprint Ed.). Motilal Banarsidass Publishers, New Delhi. • Bandyopadhyay, B. K. (2023). Fundamentals of freshwater fish and fisheries of India. New India Publishing House, New Delhi. • Berkes, F. (2012). Sacred ecology (3rd Ed.). Routledge, New York • Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications, Montana (USA) • Chakraborty, C., Mukherjee, M., & Lepcha, R. F. (2011). Fish and fisheries of Himalayan and Terai region of West Bengal: With ornamental touch. Daya Publishing House / Astral International, New Delhi. • Gadgil, M., & Guha, R. (1992). This fissured land: An ecological history of India. Oxford University Press, London (UK) • Mishra, A. (1993). Aaj Bhi Khare Hain Talaab [The ponds are still relevant]. Prabhat Prakashan, New Delhi • Radhakrishnan, S. (2008). Indian philosophy: Volume I. Oxford University Press, London (UK) • Radhakrishnan, S. (2008). Indian philosophy: Volume II. Oxford University Press, London (UK) • The Matsya Mahāpuranam (2007). Sanskrit text with English translation and notes (2 vols.), Parimal Publications, Delhi • Talwar, P. K., & Jhingran, A. G. (1991). Inland fishes of India and adjacent countries (Vols. 1–2). Oxford & IBH Publishing, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (50 T + 0 P) Marks External Assessment: Total 50 (50 T + 0 P) Marks

<table>
<tr><th colspan="4">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td colspan="3">Master of Science in Aquatic Biology</td></tr>
<tr><td>Semester</td><td colspan="3">I</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="3">6.0</td></tr>
<tr><td>Course Type</td><td colspan="3">Multidisciplinary Coourse</td></tr>
<tr><td>Course Subtype</td><td colspan="3">Nil</td></tr>
<tr><td>Subject Type</td><td colspan="3">Discipline Specific</td></tr>
<tr><td>Course Code</td><td colspan="3">AQB 1005</td></tr>
<tr><td>Course Level</td><td colspan="3">500-599</td></tr>
<tr><td>Course Title</td><td colspan="3">Instrumentation</td></tr>
<tr><td>Credit</td><td>Theory: 4</td><td>Practical: 0</td><td>Total: 4</td></tr>
<tr><td>Effective From</td><td colspan="3">Academic Year: 2026-27</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">CO1: Aware and train the students for safe work procedure and handling of the instruments in the laboratory.
CO2: Elucidate principle of instruments that help to students to understand the instrument and analysis process.
CO3: The students are proficient to use the advances technology and instruments to speed up the analysis process and error free results.
CO4: The working procedure of instruments are elaborated in details that would be able 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.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td colspan="3"><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>
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<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>Course Content</td><td colspan="3">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 turbidometer, Colorimeter, Spectrophotometer (Single bean & double beam), Infrared, NMR and Mass spectrometer
Unit – III Separation techniques
(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 Electrophoresis:
Chromatography: Introduction, Principle and types of chromatography.
Electrophoresis: Introduction, Principle and types of electrophoresis
Blotting: Introduction, types and function
Unit – IV Water quality analysers</td></tr>
</table>

	Introduction, structure, principle and operation of water quality analysers (Conductivity meter, pH meter, Salino meter, DO meter, COD reflaxor (close and open) and BOD analyser)
Reference Books	• Brown, S.B. (1980). An introduction to spectroscopy for Biochemists. Academic press, London, New York. • Robertis, E.D.P. and Robertis, E.M.F. (2001). Cell and Molecular Biology. Lippincott Williams & Wilkins, London. • Hawcroft, D.M. (1996). Electrophoresis. The Basics IRL press, Oxford. • Jenning, W.G. (1993). Analytical Gas chromatography. Academic Press. New York. • Skoogs, H.P. and Nieman, M. (2006). Principle of Instrumental analysis. Thomson Inc. Ltd.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment: Total 50 (T 50 + P 00) Marks External Assessment: Total 50 (T 50 + P 00) Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	Master of Science (Aquatic Biology)
Semester	I
NCrF Credit Level	6.0
Course Type	SEC
Course Subtype	Skill Enhancement Course
Subject Type	Discipline Specific
Course Code	AQB 1006
Course Level	500-599
Course Title	**Technology for Fish Products**
Credit	**Theory:** 2 **Practical:** 0 **Total:** 2
Effective Form	Academic Year: 2026-27
Course Outcomes	**CO1**: Students will be able to explain preparation methods and uses of fish products, by-products and value-added products**.** **CO2**: Students will be able to differentiate between fish products, by-products and value-added products based on raw materials, processing techniques and applications. **CO3**: Students will be able to describe and evaluate various packaging technologies used for fish products, by-products and value-added products. **CO4**: Students will be able to analyze the role of appropriate packaging in ensuring quality, safety, shelf life and marketability of fish products and their derivatives.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	**Unit – I Fish products, By-Products and Value-Added Products** Introduction, methods of preparation and use of various fish products (fish oil, fish roe), by-products (fish liver oil, fish meal, fish manure, fish silage, fish glue, fish gelatin, isinglass, chitosan, pearl essence) and value added products (fish oil capsule, fish flour, fish protein powder, fish hydrolysate, caviar, fish fin soup, fish sausage, fish ham, fish pickles, surimi, fish sauce, battered and braided products). **Unit – II Packaging** Packaging of fish products (polythene wrapping, vacuum packaging, Modified Atmosphere Packaging, frozen packaging, active packaging), fish by-products (bulk packaging, airtight packaging, light-resistant packaging) and value-added products (vacuum-sealed packaging, retort packaging, aseptic packaging, tray packaging, canning and bottling)
Reference Books	• Gupta, S.K. and Gupta, P.C. (2002). General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. • Joseph, J. (2009). Postharvest Technology of Freshwater Fish. Central Institute of Fisheries Technology, Cochin. • Ninawe, A. and Rathnakumar, K. (2008). Fish Processing Technology and Product Development. Narendra Publishing House.

	• Sachindra, N. M. and Mahendrakar, N. S. (2014). Fish Processing Byproducts: Quality Assessment and Application. Studium Press, LLC, US. • Martin, R. E., Carter, E. P., Flick, G. J. and Davis, L. M. (2000). Marine and Freshwater Products Handbook, CRC Press. • Balasundari, S., Raghu, G. and Felix, S. (2020). Fish Products and Value Addition. Daya Publishing House. • Shitole, P. B., and Sarang, N. S. (2017). Fish processing technology. Narendra Publishing House. • Balachandran, K. K**.** (2001). Post-harvest technology of fish and fish products. Daya Publishing House. • Sen, D. P. (2005). Advances in fish processing technology. Allied Publishers. • Venugopal, V. (2009). Marine products for healthcare: Functional and bioactive nutraceutical compounds from the ocean. CRC Press. • Rustad, T. (2010). Utilization of marine by-products. Electronic Journal of Environmental, Agricultural and Food Chemistry. • Park, J. W. (2013). Surimi and surimi seafood. (3rd Ed.), CRC Press.
Teaching Methodology	Class work, Discussion, Self-Study, Projects, Seminars or / and Assignment, ICT (Slides/Photomicrographs/Videos) and Field visit
Evaluation Method	Internal Assessment : Total 25 (T 25 + P 0) Marks External Assessment : Total 25 (T 25 + P 0) Marks