Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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ક્રમાંક :એસ./પરિપત્ર/૧૫૮૩૩/૨૦૨૪
તા.૩૦/૦૭/૨૦૨૪

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

વિષય:– એકવેટીક બાયોલોજી વિષયનાં સેમેસ્ટર–૧ થી ૪ ના અભ્યાસક્રમ અને PO, PSO તથા CO બાબત.

સુજ્ઞશ્રી,

સવિનય જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૪–૨૫ થી અમલમાં આવનાર M.Sc. Aquatic Biology વિષયનો સેમેસ્ટર–૧ થી ૪નો અભ્યાસક્રમ અને PO,PSO તથા CO એકવેટીક બાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૨૫/૦૭/૨૦૨૪ ની સભાના ઠરાવ ક્રમાંક : ૦૨ અન્વયે મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાના અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિદ્યાશાખાવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૦૧/૦૩/૨૦૨૪ની સભાના ઠરાવ ક્રમાંક:૧૦૪ અન્વયે માન.કુલપતિશ્રીને આપેલ સત્તા અંતર્ગત ઈ.ચા.માનનીય કુલપતિશ્રી દ્વારા મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

(બિડાણ: ઉપર મુજબ)

કુલસચિવ

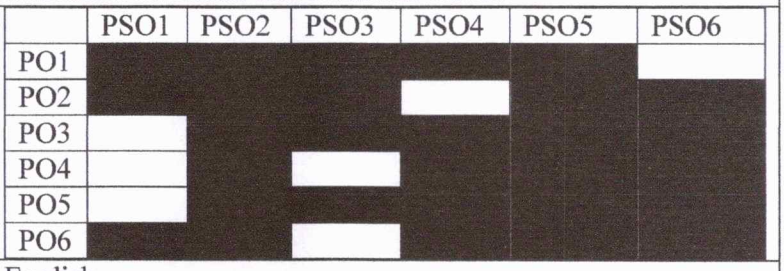
પ્રતિ,
૧) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા,
૨) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....જાણ સારૂ.

M. Sc. Sem. I						
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (Hrs)	Internal marks	External marks		
Theory papers :						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102:Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103:Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Paper						
AQB 104 A: Instrumentation AQB:104 B: Computer Application	04	03	30	70	100	04
Practicals :						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	10-15	50	100	150	06
Skill-based elective paper						
AQB 106: Aquarium management for employment or Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Master of Aquatic Biology

Name of Program	**Master of Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.

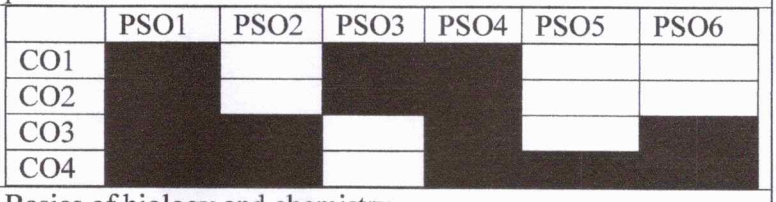
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	
Medium of Instruction	English
Programme structure	Semester-I

Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103:Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Paper						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals :						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	10-15	50	100	150	06
Skill-based elective paper						
AQB 106: Aquarium management for employment	02	00	20	30	50	02

or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)						
Total	30	Total	190	410	600	24

Subject Code [2203081301010001]

Semester I

Course Code	**101**
Course Title	**Aquatic Resources and their Management**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The main purpose of the course is to make students acquainted with concepts of different types of aquatic resources and the way to manage them.
Course Objective	The objective of the course is to make the student capable of understanding the types of aquatic ecosystems and aquatic resources along with the measures for their management.
Course Outcomes	**CO1:** Explain inland ecosystems and marine ecosystems to strengthen and develop the basic concepts to handle challenging situations in aquaculture sectors **CO2:** Explain the types of important aquatic faunal resources available in the water bodies to develop theoretical and practical aspects can be developed **CO3:** Explain the status of Ornamental fish farming and trading possibilities, their transportation and management **CO4:** Explain the management practices of aquatic resources including inland and marine to explore the aquaculture practices.
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	**Unit – I: Inland Environment:** Origin, classification and distribution of rivers, Major River system of India and Gujarat Origin, classification and distribution of lakes, Thermal stratification and thermal exchange in lakes. Origin, classification and distribution of ponds Classification and distribution of reservoir, important reservoir of Gujarat, transitional phases of reservoir Classification, morphology and distribution of Estuaries, Lagoons and Coastal inlets **Unit – II Marine Environment:** Introduction, origin and zonation of ocean, sea bottom topography: Abyssal, canyons and trenches Main physical (density, viscosity, surface tension, temperature) and chemical (major and minor constituents) properties of sea water Introduction, origin and types of tides, currents and waves

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

	16. Chapman, V.J. and D.J. Chapman, 1980. Seaweed and Their Use. Chapman & Hall, London 17. Greene, Thomas F. 2004. Marine Science: Marine Biology and Oceanography, 2nd Edition. Amsco School Publication, Inc. 18. Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited 19. Biswas, K.P. 1996. A Textbook of Fish, Fisheries and Technology. 2nd ed. Narendra Publishing House., India 20. Jayaram, K.C. 1999. The Freshwater Fishes of the Indian Region. Narendra Publishing Company., New Delhi 21. Khanna, S.S. & H.R. Singh 2006. A Textbook of Fish Biology and Fisheries. Narendra Publishing House., India 22. Meenakshi, J., N.K. Yadava & R.K. Gupta. 2010. Freshwater Ornamental Fishes. Mangalam Publications, Delhi
Teaching Methodology	Classwork, Discussion, Self-Study, models and Assignment
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

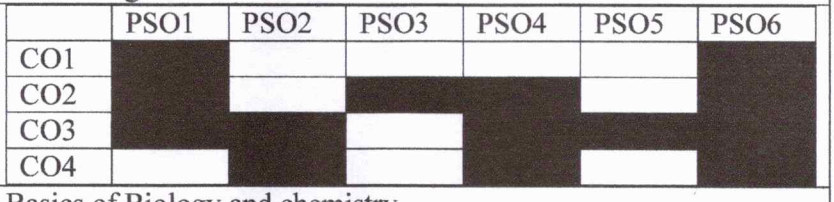
Name of Program	**Master of Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Program Outcome	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Specific Outcomes	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries

	Technology enables acquaintances of the students with the practical aspects.					
Mapping between POs and PSOs	**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.					
Medium of Instruction	English					
Programme structure	Semester-I					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102:Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103:Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals :						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	10-15	50	100	150	06
Skill-based elective paper						
AQB 106: Aquarium management for employment or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02

Total	30	Total	190	410	600	24

Subject Code [2203081301020001]

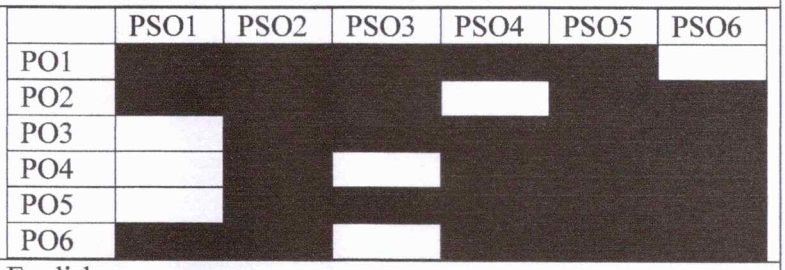
Semester I

Course Code	**102**
Course Title	**Aquatic Pollution and Toxicology**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to develop concepts of water pollution and toxicological studies and also to learn how to manage aquatic resources.
Course Objective	To develop skills in students to identify pollution load, biomarkers in aquatic resources and how to develop bioassays. To acquire knowledge to monitor aquatic resources and conduct toxicity tests.
Course Outcomes	**CO1:** To know about the sources of water pollution, the fate of pollutants in aquatic ecosystems, affluents, and their treatment and concept of toxicology. **CO2:** Acquire knowledge to monitor pollution load, control and prevention of pollution by various methods. **CO3:** Develop the skill to conduct toxicity tests i.e., Bioassay, Biostimulation and Bioinhibition **CO4:** Acquire skill to identify Biomarkers as water quality monitoring tool.
Mapping between COs with PSOs	
Pre-requisite	Basics of Biology and chemistry
Course Content	**Unit – I General Introduction:** Water pollution: Introduction, Sources and Fate of Pollutants Interaction of pollutants in Aquatic resources Role of Central Pollution Control Board (CPCB) and Gujarat Pollution Control Board (GPCB) in the management of pollution. **Unit – II Types of Pollution:** Sources, Fate, Biological Effects and Management of Thermal pollution, Oil pollution, Radioactive pollution, Detergent pollution and Acid rain **Unit – III Effluents and their treatment:** Introduction and characteristics of domestic, industrial and agricultural discharges. Biological concern: Eutrophication, Bioaccumulation and Biomagnification Important methods for wastewater treatment. Water quality standards and water quality indices. **Unit – IV Toxicology**: Toxicology: Introduction, concepts, principles and factors affecting the toxicity

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

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.

Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

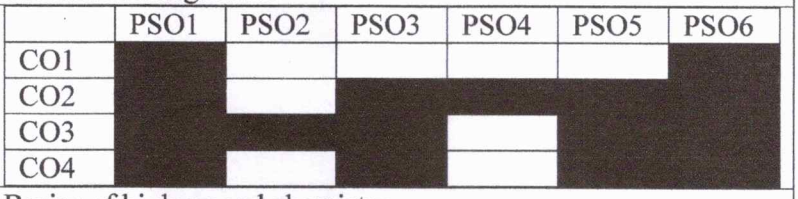
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						

Medium of Instruction	English					
Programme structure	Semester-I					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103: Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	10-15	50	100	150	06
Skill-based elective papers						

AQB 106: Aquarium management for employment or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code [2203081301030001]

Semester I

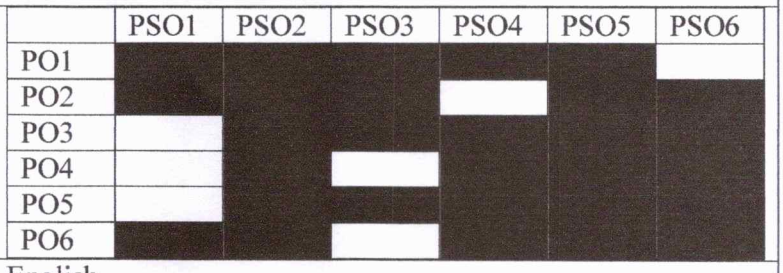
Course Code	**103**
Course Title	**Fish Physiology and Endocrinology**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The main purpose of the course is to make students acquainted with concepts of fish physiology, endocrinology and disease management in fishes.
Course Objective	The objective of the course is to make the student capable of understanding the general physiological functions like respiration, digestion, excretion, circulation, osmoregulation, reproduction and development and endocrinology in fishes. The course also makes students capable of managing fish diseases.
Course Outcomes	**CO1:** To understand the concept of fish physiological processes (digestion, respiration, circulation, excretion, osmoregulation, reproduction and development and endocrinology). **CO2:** Help the student to develop the skill for reproduction and breeding management in the fish farming sector **CO3:** Trains students to establish the breeding center for fishes which help to enhance the fish seed resources **CO4:** Trains students to develop careers in fish seed production and farm management.
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	**Unit – I** **Digestion:** Digestive system of fish and associated digestive glands (liver, pancreas and gall bladder), Mechanism of digestion. **Respiration:** Structure and function of gills, Mechanism of respiration, haemoglobin–oxygen uptake and dissociation, Accessory respiratory organs. **Unit - II** **Circulation:** Structure and function of heart, Composition of blood. **Excretion:** Structure and function of the kidney, Nitrogenous end products and pattern of excretion. **Osmoregulation:** Introduction, Osmoregulation in freshwater, brackish water and marine fish. **Unit - III** **Reproduction and Development:** Introduction of the reproductive system, types of reproduction, GSI, Structure, function and development of gonads.

	Fecundity, Fertilization, Incubation, Hatching, Larvae and Metamorphosis, Parental care in fishes. **Unit - IV** **Endocrinology:** Hormonal control of pineal, thyroid, pituitary gland in fishes, pancreatic hormone in fishes, pheromones in fishes, ecdysis in crustacean.
Reference Books	1. Evans, Devid H. (1998): Physiology of Fishes. R.R. Bowker Company, book trade association of Philadelphia. 2. Hoar, W. S. and Randal, D. J. (1993): Fish endocrinology Vol. I to VII. Academic press, INC (London) Ltd. 3. Hoar, W. S., Randal, D. J. and Farrell, A. P. (1992): Cardiovascular system, Vol. 12, Part 2 of Fish Physiology, Academic Press. INC London Ltd. 4. Khanna S.S. (1989): An Introduction to Fishes. Central Book Depot, Allahabad. 5. Khanna S.S. and Singh, H.R. (2003): A text book of fish biology and fisheries. Narendra publishing house, New Delhi – 110 006. 6. Nikolsky, G.Y. (1989): The ecology of fishes. Academic Press, London. 7. Pandey A.K. and Sandhu G.S. (1992): Encyclopedia of fishes and fisheries of India Vol. I & IV, Amol publication, New Delhi. 8. Prosser, C. L. (1973): Comparative Animal Physiology, W. B Sounders Co., Philadelphia 9. Smith, L.S. (1982): Introduction of fish physiology. Narendra publishing house, New Delhi. 10. Yadav, B. N. (2006): Fish & Fisheries, Daya Publishing House, New Delhi. 11. Yadav, B.N. (1995): Fish endocrinology. Daya Publishing House, New Delhi. 12. Anderson, D.P. (2003): Text book of fish Immunology, Narendra publishing house, Delhi 13. Austin, B. (1999): Bacterial fish pathogen-Disease of farmed and wild fish, Paraxis publishing Ltd., U.K 14. Conroy, D.A. (1997): Textbook pf fish diseases, Narendra publishing house, Delhi 15. Cornell, J.J. (1995): Control of fish quality, Fishing new books 16. Duijn, C.V. (2000): Diseases of fishes, Narendra publishing house, Delhi 17. Inglis, V. (1993): Bacterial diseases of fish, Blackwell science Ltd., Oxford, U.K. 18. Roberts, R.J. (1982): Microbial diseases of fish, Society for general microbiology academic press, New York, USA 19. Roberts, R.J. (1978): Fish pathology, Baillere Tindall, Landon 20. Sharma, O.P. (2009): Handbook of fisheries and aquaculture, Agrotech publishing academy, Udaipur

	21. Wedemeyer, G.K. (1999): Environmental stress and fish diseases, Narendra publishing house, Delhi 22. Woo, P.T.K. and Leatheland, F. (1998): Fish diseases and disorders, CABI publishers, Wallingford
Teaching Methodology	Classwork, Discussion, Self-Study, and Assignment
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programme is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.

Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

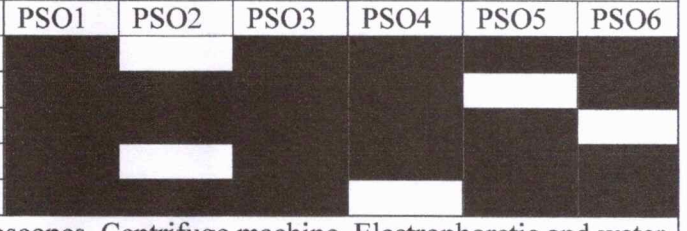
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	■	■	■	■	■	
PO2	■	■	■		■	■
PO3		■	■	■	■	■
PO4		■		■	■	■
PO5		■	■	■	■	■
PO6	■	■		■	■	■

Medium of Instruction	English					
Programme structure	Semester-I					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103: Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	10-15	50	100	150	06
Skill-based elective papers						

AQB 106: Aquarium management for employment or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code [2203081301040001]

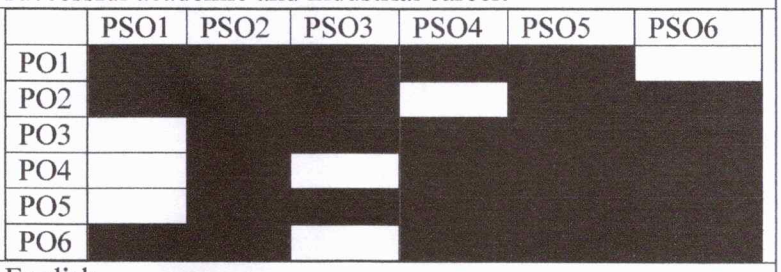
Semester 1

Course Code	**104 A**
Course Title	**Instrumentation (Elective paper)**
Credit	4
Teaching per week	4 hrs.
Minimum weeks per semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective from	2024-25
Purpose of course	The purpose of the course is to develop the operation skill of the instrument that helps to analyze the different physical, chemical and biological parameters.
Course Objective	To create awareness and apprise the instrument operation among the students.
Course Outcome	**CO1.** Aware and trained the students for safe work procedures and handling of the instruments in the laboratory. **CO2.** Elucidate the principle of instruments that help students to understand the instrument and analysis process. **CO3.** The students are proficient in using the advances technology and instruments to speed up the analysis process and error-free results. **CO4.** The working procedure of instruments is elaborated in detail which would enable us to learn about the application of different instruments in the field of Aquatic Biology. **CO5.** Care and maintenance of the laboratory instruments explained in the class help to longer uses of the instruments.
Mapping of COs with PSOs	
Course prerequisite	Microscopes, Centrifuge machine, Electrophoretic and water analyser unit
	Unit – I Microscopy: Microscopes: Introduction, principle and structural description Types of microscopes: Simple microscope, compound microscope (Student's microscope, Stereoscopic microscope, Phase contrast microscope, fluorescence microscope and interference microscope) and Electron microscope **Unit – II Photometry:** Introduction, principle and application of Colorimeter, Spectrophotometer, (Single bean & double beam), Infrared, NMR and Mass spectrometer **Unit – III Separation method:** **(A) Centrifuge and Centrifugation:** Centrifuge: Introduction, different parts and types of centrifuges

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

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.

Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

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

Medium of Instruction	English					
Programme structure	Semester-I					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103: Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	10-15	50	100	150	06
Skill-based elective papers						

AQB 106: Aquarium management for employment or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code [2203081301040002]

Semester I

<table>
<tr><td>Course Code</td><td>104-B</td></tr>
<tr><td>Course Title</td><td>Computer Application</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>16 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2024-25</td></tr>
<tr><td>Purpose of Course</td><td>The main purpose of the course is to make students acquainted with concepts of different types of computer applications and its use in research, presentation and management of aquatic resources</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is to make the student capable of understanding how the computer works and the importance of various components of computers. This course will also help students to process data and present it. After successful completion, students will be able to use different aspects of computer that are useful in research activities. Related to fisheries, pollution and aquatic resources management.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Reveal a basic understanding of computer hardware, software and operating system
CO2: Helps to gain problem-solving skills for managing aquatic environment and their resources
CO3: Capable of presenting research work effectively.
CO4: Capable of understanding basics of network principles.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><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>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of biology and chemistry</td></tr>
<tr><td>Course Content</td><td>Unit – I
Computer and GUI Based Operating System
Introduction, History of Computers, Characteristics of Computer System, Computer and Latest IT gadgets and their applications
Components of Computer System: Hardware, Software
Introduction to GUI Based Operating System
The User Interface: Task Bar, Icons, Start Menu, Running an application
Simple Setting of Operating System
Unit – II
Processing of Word, Excel and PowerPoint
Basics: Title Bar, Menu Bar, Toolbars & Sidebar, creating a New Document, Opening and Closing Documents, Save and Save As Document, Page Setup, Print Preview, Printing of Documents and Saving a Document as PDF file
Word</td></tr>
</table>

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

Teaching Methodology	Classwork, Discussion, Self-Study, models and Assignment
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.

Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

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

Medium of Instruction	English					
Programme structure	Semester-I					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103: Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	10-15	50	100	150	06
Skill-based elective papers						

AQB 106: Aquarium management for employment or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code *[2203081301050001]*

Semester I

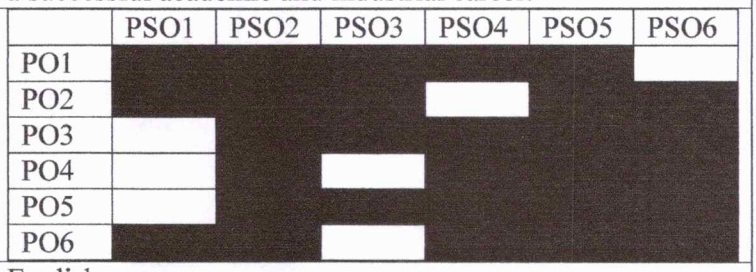
Course Code	**105**
Course Title	**Water & Sediment analysis, Instrumentation and Fish physiology**
Credit	6
Teaching per Week	12 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The main purpose of the course is to make students acquainted with the practical concepts. The student will gain the knowledge for analysis of water and sediment and the use of different types of instruments used for specific analysis. The purpose of the course is also to develop skill regarding fisheries technology.
Course Objective	The objective of the course is to make the student capable of analysing different physico chemical parameters in water and sediment. Students will be capable of handling instruments used for analysis of water and sediment parameters. Students will develop skill in feeding, breeding, growth aspects of fishes and the concept of anatomical structure of different organs of fishes
Course Outcomes	**CO1:** Students will be capable of estimating different physicochemical parameters in both water and Sediments for the management of fisheries **CO2:** Develop skills for standardization and measurement of water quality by using instruments like Turbidometer, pH meter, Colorimeter, Conductivity meter, Salinometer, Autoclave, Centrifuge, incubator, hot air oven, Spectrophotometer, Sechhi disc **CO3:** Gain practical knowledge by field visits to different sewage/water treatment plants **CO4:** Students will be able to develop the skill to find the feeding pattern of fish by dissecting the buccal cavity and associated structures (Gill rackers, Bucco pharynx), Gut content analysis, and GaSI. **CO5:** Students will be able to develop the skill to measure fecundity, egg diameter, and Gonadosomatic index of fishes **CO6:** Students will be capable of using different computer applications
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	**Unit I**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

	Titrimetric estimation: Dissolved oxygen, Carbon dioxide, Alkalinity (PA and TA), Hardness (Total, Ca and Mg) and Chloride **Colorimetric estimation of water and sediment:** Silicate, Ammonia, Nitrate, Nitrite and Inorganic Phosphate **Pollution indicator estimation:** TS, TSS, TDS, Sulphate, BOD and COD **Unit II** **Instrumentation:** Microscope, Colorimeter, Spectrophotometer, Centrifuge, Conductivity meter, pH meter, Salinometer, Turbidometer, Sechhi disc, Autoclave, Incubator, Hot air oven **Unit III** Preparations and observations of micronuclei in fish blood Structure of blood cells Study of haematological parameters (RBC, WBC, Haemoglobin content, Haematocrit value) **Unit IV** Gut content analysis and Gastrosomatic Index (GaSI) Study of buccal cavity and associated structures (Gill rackers, Bucco pharynx) Measurement of fecundity, egg diameter and Gonadosomatic Index (GSI) Word processing (MS word, MS excel and MS power point) Visit of sewage/water treatment plants
Reference Books	1. APHA (2005). Standard method for the examination of water and wastewater, American Public Health Association, E.G. Arnold, S.C. Lenore, A.E. Eaton (Eds.), Washington. 2. Trivedy, R.K. and Goel, P.K (1986). Chemical and biological methods for water pollution studies, Environmental publication, Karad. 3. Skoogs, H, P.and Nieman, M (2006). Principle of Instrumental analysis. Thomson Inc Ltd. 4. Brown, S.B (1980). An introduction to spectroscopy for Biochemists, Academic press, London, New York
Teaching Method	Practical performance and demonstration, Discussion, Self-Study, ICT, Field visit
Evaluation Method	Internal assessment (30%) and External assessment (70%) based on practical performance, journal preparation and viva-voce examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries

	Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	
Medium of Instruction	English
Programme structure	Semester-I

Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers						
Core papers						
AQB 101: Aquatic resources and their management	04	03	30	70	100	04
AQB 102: Aquatic Pollution and Toxicology	04	03	30	70	100	04
AQB 103: Fish physiology and Endocrinology	04	03	30	70	100	04
Elective Papers						
AQB 104 A: Instrumentation AQB 104 B: Computer Application	04	03	30	70	100	04
Practicals:						
AQB 105: Water & Sediment analysis, Instrumentation and Fish physiology	12	10-15	50	100	150	06
Skill-based elective papers						

AQB 106: Aquarium management for employment or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code *[2203081301060001]*

Semester I

Course Code	**106**
Course Title	**Aquarium Management for Employment**
Credit	2
Teaching per Week	2 Hrs.
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to make the student able of implementing the concepts and techniques of Aquarium management and develop the opportunity for employment.
Course Objective	To make students familiar about Introduction to aquaculture and ornamental fishes trading, Introduction to ornamental fishes, Construction of aquarium as well as Maintenance and management of aquarium.
Course Outcomes	**CO1:** Students will able to understand about world trading of ornamental fish and its potential in export for aquaculture entrepreneurship. **CO2:** Students will able to gain the basic knowledge about aquarium and it's accessories, aquarium plants as well as ornamental fishes in world for successful Aquarium management. **CO3:** This paper gives detail idea about public fresh water and marine aquaria as well as oceanarium which cover all aspects of aquarium construction. **CO4:** Explain and train students to deal with management of ornamental fish diseases and feeding which helps to enhance the fish quality for revenue generation.
Mapping between COs with PSOs	
Pre-requisite	Basics of Zoology and Fisheries
Course Content	**UNIT-I Introduction to Aquaculture and Ornamental Fishes Trading** Introduction, history and present scenario of aquaculture. World trading of ornamental fish and export potential. Ornamental fisheries new dimensions in aquaculture entrepreneurship. **UNIT- II Introduction to Ornamental Fishes** Introduction to aquarium and aquarium accessories. Basic knowledge of the profile of ornamental fishes in the world and Indian ornamental fishes. Profiles of some selected aquarium plants. **UNIT-III Construction of Aquarium** Design and construction of public fresh water and marine aquaria and oceanarium. Construction, settings and

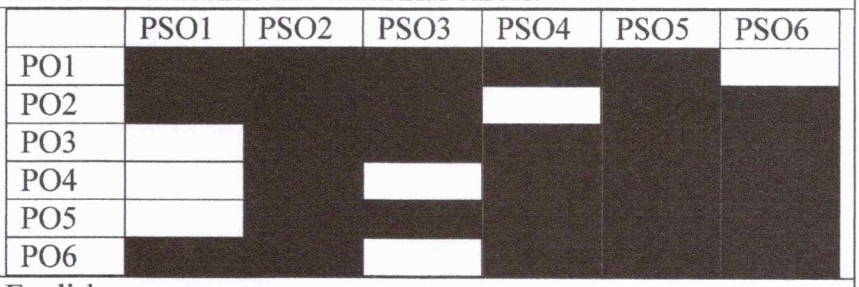
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

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

M. Sc. Sem. II						
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (Hrs)	Internal marks	External marks		
Theory papers :						
Core papers						
AQB 201: Fisheries Technology	04	03	30	70	100	04
AQB 202: Fish Nutrition and feed Technology	04	03	30	70	100	04
AQB 203: Fish Genetics and Biotechnology	04	03	30	70	100	04
Elective Paper						
AQB 204 A: Fisheries Legislation AQB 204 B: Biostatistical analysis	04	03	30	70	100	04
Practicals :						
AQB 205: Fisheries Technology and Biostatistics	12	10-15	50	100	150	06
Skill based elective paper						
AQB 206: Fish products and Byproducts or Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments, etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries

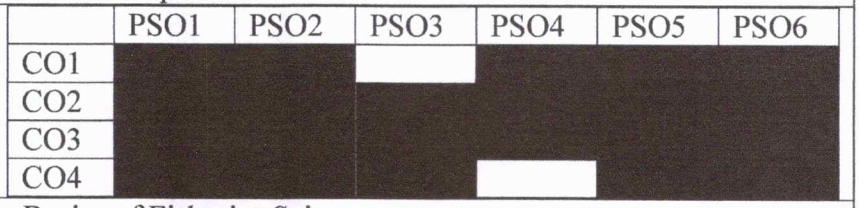
	Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	
Medium of Instruction	English
Programme structure	Semester-II

Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	4	3	30	70	100	4
AQB 202: Fish Nutrition and feed Technology	4	3	30	70	100	4
AQB 203: Fish Genetics and Biotechnology	4	3	30	70	100	4
Elective papers						
AQB: 204 A: Fisheries legislation	4	3	30	70	100	4
AQB: 204 B: Biostatistical Analysis	4	3	30	70	100	4
Practical:						
AQB 205: Fisheries Technology and Biostatistics	12	10-15	50	100	150	6
Skilled based elective paper						

AQB- 206 Fish Products and Byproducts or Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	2	0	20	30	50	2
Total	30		190	410	600	24

Subject Code [2303081302010002]

Semester II

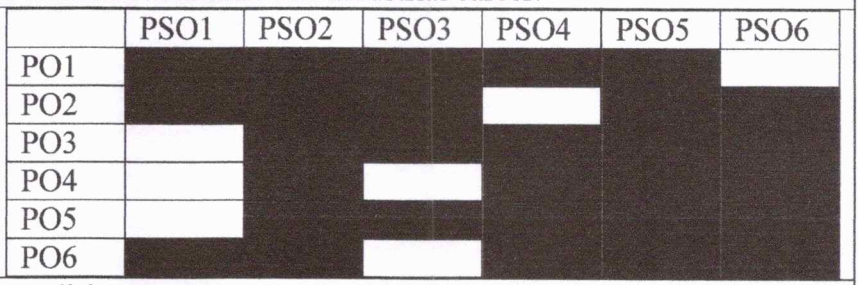
Course Code	**201**
Course Title	**Fisheries Technology**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to introduce different fisheries technologies and its applications which would help and develop the skill among students for development of fisheries sectorin scientific way.
Course Objective	To introduce different fisheries technologies which would be helpful in finding, harvesting, handling, processing and distribution of aquatic resources and their products.
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 waterbodies efficiently for fishery research and management. **CO4:** This paper deals with post-harvest technology which helps to maintain quality (appearance, texture, flavour and nutritive value) to protect food safety, and to reduce losses between harvest and consumption.
Mapping between COs with PSOs	
Pre-requisite	Basics of Fisheries Science
Course Content	**Unit – I** **Hatcheries:** Types of Traditional, Circular, Vertical hatcheries, Shrimp/Prawn hatcheries and hatchery Management (Japanese, Galveston, Indian). **Induced breeding:** Selection of brooders, extraction of pituitary gland, preparation of dosage and injection, spawning and fertilization, stripping method, use of inducing agents in induced breeding, Eyestalk ablation technique in shrimp. **Unit – II** **Transportation:** Causes of mortality during transportation, methods for transportation of fish seeds, fingerlings, brooders and trout eggs, use of chemicals in live fish transportation.

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

	14. Nikolsky, G. V. (1999). Ecology of Fishes, Allied Scientific Publishers. 15. Rao, D. P. (1995). Remote Sensing for Earth Resources. Association of Exploration Geophysicists, Hyderabad. 16. Regenstein, J. M. and Regenstein, C. E. (1997). Introduction to Fish Technology. CBS Publishers and Distributors, New Delhi. 17. Sabins, F. F. (1997). Remote Sensing, Principles and Interpretation. W.H. Freeman & Co., New Delhi. 18. Sharma, O. P. (2009). Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur. 19. Sreekrishna, Y. and Shenoy, L. (2001). Fishing Gear and Craft Technology. Indian Council of Agricultural Research, New Delhi. 20. Welcomme, R. L. (2007). Inland Fisheries. Discovery Publishing House, New Delhi. 21. Yadav, B. N. (1997). Fish and Fisheries. Daya Publishing House, Delhi. 22. Yadav, N. K. (2009). Management Practices in Fish Farming. Manglam Publications, Delhi. 23. ICAR (2011). Handbook of Fisheries and Aquaculture. ICAR, New Delhi.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT, Field visit
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programme is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries

	Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

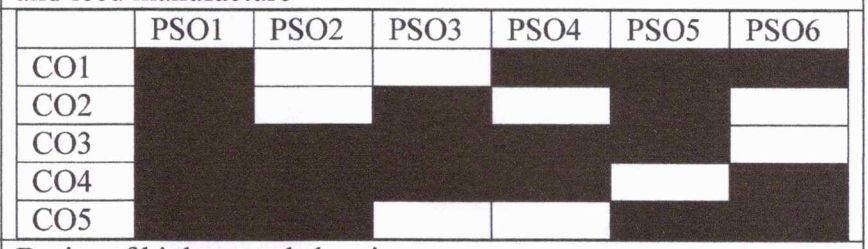
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	4	3	30	70	100	4
AQB 202: Fish Nutrition and feed Technology	4	3	30	70	100	4
AQB 203: Fish Genetics and Biotechnology	4	3	30	70	100	4
Elective papers						
AQB: 204 A: Fisheries legislation	4	3	30	70	100	4
AQB 204 B: Biostatistical Analysis	4	3	30	70	100	4
Practical:						
AQB 205: Fisheries Technology and Biostatistics	12	10-15	50	100	150	6
Skilled based elective papers						

AQB 206: Fish Products and Byproducts or Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	2	0	20	30	50	2
Total	30		190	410	600	24

Subject Code [2303081302020004]

Semester II

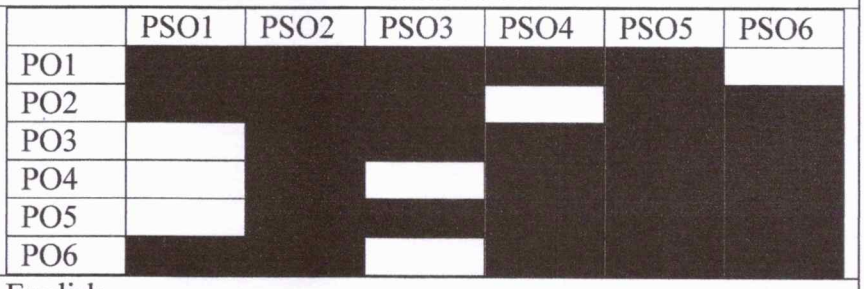
Course Code	**202**
Course Title	**Fish Nutrition and Feed Technology**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The main purpose of the course is to make students acquainted with concepts of Fish Nutrition, fish Biochemistry and Feed Technology
Course Objective	The objectives of the course is to make the student capable of understanding the general fish nutrition, biochemistry, Chemical and Biological analysis and different methods used in fish feed Technology.
Course Outcomes	**CO1:** The course explains the fish nutrition requirements to manage the fishery resources **CO2:** Enhance the knowledge regarding proximate and biological analysis of feed and fish. **CO3:** Explain the skills required in feed technology. **CO4:** Explain the skill to measure Gastro-somatic Index (GaSI), Feed Conversion Ratio (FCR), Food Conversion Efficiency (FCE), Protein Efficiency Ratio (PER), Productive Protein Value (PPV), Net Protein Utilization (NPU) to manage fish resources in natural resources and farms **CO5:** Explain the process of feed formulation, feed processing and feed manufacture
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	**Unit – I** **Fish nutrition:** Introduction and Principles of nutrition. Nutritional requirements of fin fish and shellfish, Factors affecting nutritional requirements Feeding evaluation: Feed dispensing devices, ration size/feeding rate, feeding frequency, check trays, restricted feeding, mixed feeding. **Unit - II** **Biochemistry:** Introduction, classification and function of nutritional compounds (Protein, Lipid, Carbohydrates, Vitamins and Minerals) **Nutritive value of live food:** Algae, Artemia, Cladocerans, Ostracods, Rotifers and Copepods as fish food

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

	12. Keith Wilson and John Walker. (1995). Principles and Techniques of Practical Biochemistry. Cambridge University Press. 13. Lovell, R.T. (1998). Nutrition and Feeding of Fishes, Chapman & Hall, New York. 14. New, M.B. (1987). Feed and feeding of fish and shrimp. A manual on the preparation and preservation of compound feeds for shrimp and fish in aquaculture. F.A.O. Rome – 15. Rechcigl, M. (1977). CRC Handbook series in nutrition and food. CRC press. 16. Rechcigl, M. (1981). Handbook of nutritional supplements in a functional context. CRC press. 17. Sena S. De Silva, Trevor A. Anderson. (1995). Fish Nutrition in Aquaculture, Chapman & Hall Aquaculture Series, London 18. Guillame, J., Kaushik, S., Berqot, P. and Metallier, R. 2001. Nutrition and Feeding of Fish and Crustaceans. Springer Praxis Publishing, Chichester, U. K.
Teaching Methodology	Classwork, Discussion, Self-Study and Assignment
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programe is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries

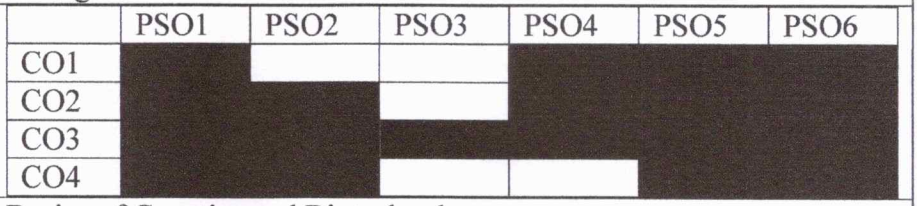
	Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	
Medium of Instruction	English
Programme structure	Semester-II

Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	4	3	30	70	100	4
AQB 202: Fish Nutrition and feed Technology	4	3	30	70	100	4
AQB 203: Fish Genetics and Biotechnology	4	3	30	70	100	4
Elective papers						
AQB 204 A: Fisheries legislation	4	3	30	70	100	4
AQB 204 B: Biostatistical Analysis	4	3	30	70	100	4
Practical:						
AQB 205: Fisheries Technology and Biostatistics	12	10-15	50	100	150	6
Skilled based elective papers						

AQB 206: Fish Products and Byproducts or Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	2	0	20	30	50	2
Total	30		190	410	600	24

Subject Code [2303081302030002]

Semester II

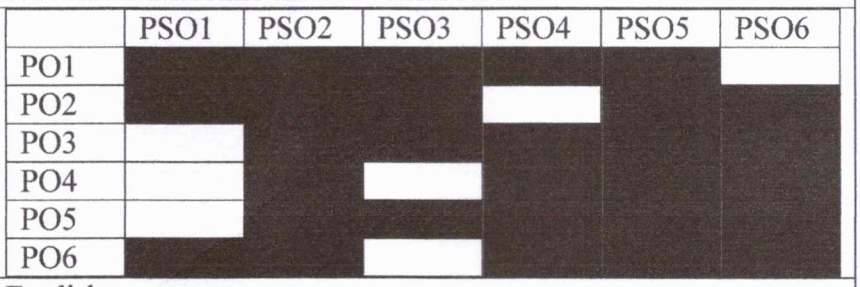
Course Code	**203**
Course Title	**Fish Genetics and Biotechnology**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to develop the skill about executing the different scientific methods of Fish genetics and biotechnology in field of Aquatic Biology with reference to improving aquaculture production and quality.
Course Objective	To make the students acquaint regarding fundamentals of molecular biology, principle of fish genetics, fish biotechnology, bioinformatics, nanotechnology and its applications.
Course Outcomes	**CO1:** Inculcate students about fundamentals of Molecular biology like structure of DNA and RNA, DNA replication, mutation, transcription and translation to understand formations, actions, and regulations of various parts of cells which can be used to efficiently target new drugs, diagnose disease and understand the physiology of the cell. **CO2:** Explain students about structure of chromosome with help of banding techniques, fish as a cytogenetic model, application of molecular biology techniques like sex-reversion, chromosomal manipulation and transgenic fish for increasing aquaculture production by genetically modifying aquatic organisms and fish population management. **CO3:** This paper describes scope and application of fish biotechnology with the help of different techniques like PCR, cryopreservation and vaccination which helps in mmolecular and genetic diagnostics as well as genetic upgradation of cultivable species with minimum risk of infection. **CO4:** Train students to deal with bioinformatics and nanotechnology in the field of Aquatic Biology. It provides the skillful digital database information which certainly required for aquatic resource management.
Mapping between COs with PSOs	
Pre-requisite	Basics of Genetics and Biotechnology
Course Content	**Unit - I** **Fundamentals of Molecular Biology** DNA as a genetic material, DNA replication and Mutations, Structure and Types of RNA, Transcription, Protein synthesis. Recombinant DNA technology, DNA barcoding. **Unit - II**

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

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

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries

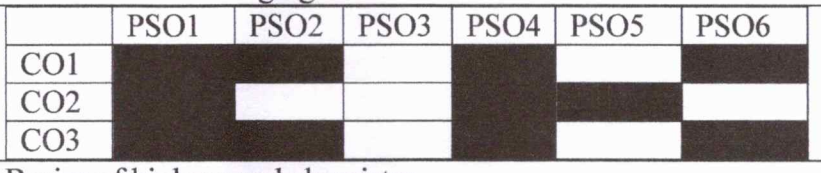
	Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	4	3	30	70	100	4
AQB 202: Fish Nutrition and feed Technology	4	3	30	70	100	4
AQB 203: Fish Genetics and Biotechnology	4	3	30	70	100	4
Elective papers						
AQB 204 A: Fisheries legislation	4	3	30	70	100	4
AQB 204 B: Biostatistical Analysis	4	3	30	70	100	4
Practical:						
AQB 205: Fisheries Technology and Biostatistics	12	10-15	50	100	150	6
Skilled based elective papers						

AQB 206: Fish Products and Byproducts or Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	2	0	20	30	50	2
Total	30		190	410	600	24

Subject Code [2303081302040003]

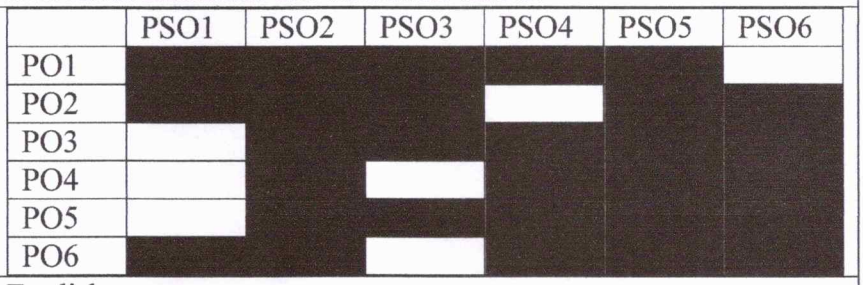
Semester II

Course Code	**204 A**
Course Title	**Fisheries Legislation**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The main purpose of the course is to make students acquainted with concepts of different types of laws and regulations of the fisheries resources which would be helpful for the formation of the database and resources management.
Course Objective	The objective of the course is to make the student capable of understanding about the fisheries resource's regulations.
Course Outcomes	CO1. The course acquaints students' knowledge about role of different regulatory bodies in aquatic resource management. CO2. The inland fisheries policies implemented by the state and central government are elaborated to students to improve their technical knowledge. CO3. The explanation regarding the marine fisheries regulation and international law of the sea develop the knowledge and awareness for managing marine resources.
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	**Unit – I** **Fisheries legislation:** Introduction, History and Importance in aquatic resources management. **Unit – II** **Inland Fisheries Regulation and Development:** Inland Fisheries Act, Leasing policies for water bodies. Issues of property rights in Inland water bodies. **Unit – III** **Marine fisheries legislations in India and Gujarat:** Coastal Aquaculture legislations (Environmental Protection Act, Biodiversity Act and Aquaculture Authority Act). Maritimes Zones of India Act 1981, Coastal Regulation Zone (CRZ) and Integrated Coastal Zone Management. **Unit – IV** **International Law of the Sea:** Historical perspectives. Exclusive Economic Zone, Regulatory and developmental issues concerning deep sea fishing – Guidelines for operation Indian deep sea fishing vessels in Indian EEZ.

Reference Books	1. Branson, E.J. (2008). Fish welfare. Pub. Blackwell Publication, Oxford. 2. Malhotra, S.P. and Sinha, V.R.P. (2007). Indian Fisheries and Aquaculture in a Globalizing Economy, 2 Vols. Narendra publishing house New Delhi. 3. Coupes, A., and Edgar, H. (1987). The marine environment and sustainable development; law, policy and science law of the sea institute, Honolulu. 4. G.W. (2009). Towards Sustainable Fisheries Law: A Comparative Analysis. IUCN Environmental Policy and Law Paper No. 74. IUCN publication Service, Switzerland 5. Neler, A.P., Rangnar Ameson and Nina Mollett. (1997). Right Based Fishing. Klupner Academic Publisher. 6. O'Connell, D.P. (1982). The international law of the sea. Clarendon press. 7. William E, Devid F, and Elly G. (2001). Legislating for Sustainable Fisheries: A Guide to Implementing the 1993 FAO Compliance Agreement and 1995 UN Fish Stocks Agreement Published by World Bank.
Teaching Methodology	Classwork, Discussion, Self-Study, models and Assignment
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries

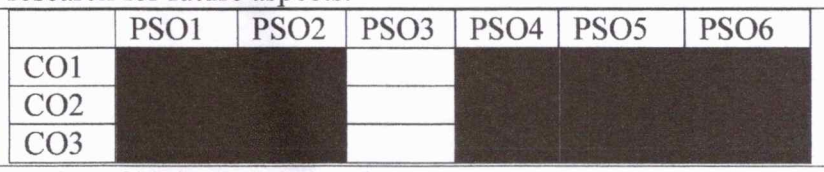
	Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	
Medium of Instruction	English
Programme structure	Semester-II

Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	4	3	30	70	100	4
AQB 202: Fish Nutrition and feed Technology	4	3	30	70	100	4
AQB 203: Fish Genetics and Biotechnology	4	3	30	70	100	4
Elective papers						
AQB 204 A: Fisheries legislation	4	3	30	70	100	4
AQB 204 B: Biostatistical Analysis	4	3	30	70	100	4
Practical:						
AQB 205: Fisheries Technology and Biostatistics	12	10-15	50	100	150	6
Skilled based elective papers						

AQB 206: Fish Products and Byproducts or Swayam/ Mooc /Other Courses (Course can be taken from any faculty)	2	0	20	30	50	2
Total	30		190	410	600	24

Subject Code [2303081302040004]

Semester II

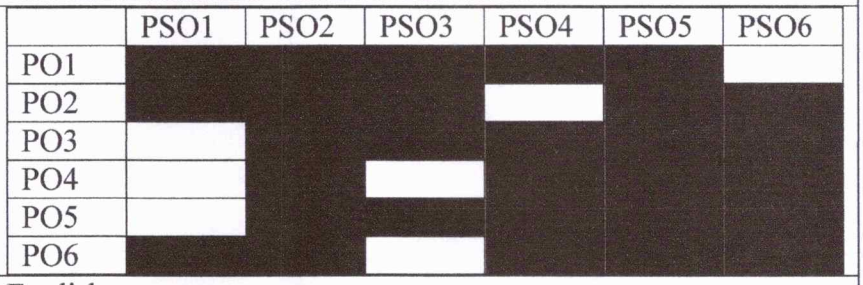
Course Code	**204- B**
Course Title	**Biostatistical analysis**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to develop the analysis methodology, dissemination methods of the innovations and regulations of the fisheries resources which would be helpful for the formation of the database and resources management.
Course Objective	To acquaint the students about the biostatical methods, innovation dissemination and fisheries resources regulations.
Course Outcomes	CO1: The application of computer, different software and bio-statistical analysis in the field of aquatic biology help for resource management. CO2: To help students acquire knowledge on different methods of data collection for research studies. CO3: The course would help students to apply statistical analysis in fisheries management and to predict the outcomes of the research for future aspects.
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	**UNIT – I** **Fundamental of Biostatistics:** Introduction and Scope of biostatistics, Concepts of population and sample, Sampling and its types, Primary and Secondary data, Classification and tabulation of data, Frequency distribution, Graphic representation of data- bar diagram, histograms, pie diagram, frequency polygon and Ogive. Measures of central tendency: mean, median, mode. Measures of Dispersion: variance, standard deviation, coefficient of variation, Skewness, kurtosis and moments Methods of Data Collection – Quantitative and qualitative Quantitative Methods: Questionnaire (mail method, interviews through telephone, internet and computers), interview schedule Questionnaire/interview schedule design and construction: Principles of constructing a questionnaire/interview schedule, Types of questions, framing of questions, sequencing of sections and questions and Interview techniques Qualitative Method: Walk through and observation (participatory and non-participatory), Social mapping, key informant interview, In-depth interviews, Focus group discussion, content analysis,

	free listing, pile sorting, mechanical devices (camera, tape recorder) Applications of statistics in fisheries **UNIT – II** **Probability and hypothesis:** Probability and probability distributions-definition of probability - binomial, Poisson and normal distributions Hypothesis testing and its applications in biological data-Null and Alternate Hypotheses, Errors in Hypothesis Testing-Critical Region and error probabilities Level of Significance-One Tailed and Two Tailed tests **Unit - III** **Statistical test:** Bivariate Data: Scatter diagram. Correlation coefficient and its properties, Correlation ratio. Rank– Spearman's and Kendall's measures of correlation. Principle of least squares, linear regression, fitting of curves reducible to polynomials by transformation. Multiple regression, Multiple and partial correlation coefficients. Tests of significance: Z test, t test, F test, Chi-square test, ANOVA (one way and two way) Non parametric test: Wilcoxon test, Mann-Whitney U-test, Kruskal and Wallis test and Friedman's test **Unit - IV** **Use of computer software for data analysis:** Computer applications: Analyses of data using Microsoft Excel and SPSS
Reference Books	1. Chakravorti S.R. and Giri N. (1997): Basis Statistics South Asian Publishers New Delhi 2. Clarke G.M. and Cooke D. (1994): A Basic Course in Statistics Arnold London. 3. Goon A.M. Gupta M.K. and Dasgupta B. (1985): Fundamental of Statistics Vol. I. The World Press Private Ltd. Calcutta. 4. Gupta S.C. and Kapoor V.K. (1986): Fundamental of Mathematical Statistics Sultan Chand and Sons Publishers 5. Whitlock, C. & Schluter, D. (2014). The analysis of biological data, 2nd Edition. Roberts and Company Publishers. ISBN 978-1936221486. 6. Dutta, N. K. (2004). Fundamentals of Biostatistics, Kanishka Publishers. 7. Gurumani N. (2005). An Introduction to Biostatistics, MJP Publishers. 8. Daniel, W. W. (2007). Biostatistics- A Foundation for Analysis in the Health Sciences,Wiley

	9. Bhatt B R, Srivenkatramana T and Rao Madhva K S (1996): Statistics: A l Beginner's Text, Vol1, and New Age International (P) Ltd.
Teaching Methodology	Classwork, Discussion, Self-Study, models and Assignment
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

Name of Program	**Master of Aquatic Biology**
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programme is to prepare the students for productive career in Aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries department etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with the basic knowledge of the subject matter in order to capable students develop research skills which include laboratory techniques, aqua farm field techniques, disease management in aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and use of techniques and instruments to develop remedies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that is being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects to identify aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program capable students for analysis, conceptualizing the real-world problems. It also enables students understand the Regulation and Development in managing aquatic sources. **PO5: Research and Project Development** Development of factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skill prepares students for employable and industry ready environment. **PO6: Group discussion, field visits, presentation and confidence Development** The designed syllabi enable students be capable of group discussion, sharing ideas and views. This enables to develop

	confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments and fisheries Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the students capable for handling instruments and use of latest technology to find remedial measures with respect to fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situation in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for successful academic and industrial career.
Mapping between POs and PSOs	
Medium of Instruction	English
Programme structure	Semester-II

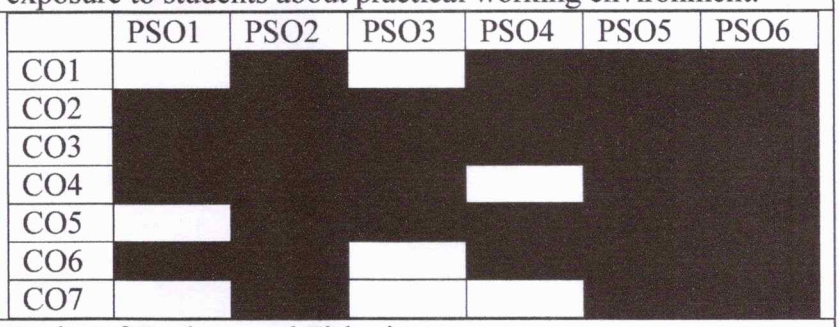
Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	4	3	30	70	100	4
AQB 202: Fish Nutrition and feed Technology	4	3	30	70	100	4
AQB 203: Fish Genetics and Biotechnology	4	3	30	70	100	4
Elective papers						
AQB 204 A: Fisheries legislation	4	3	30	70	100	4
AQB 204 B: Biostatistical Analysis	4	3	30	70	100	4
Practical:						
AQB 205: Fisheries Technology and Biostatistics	12	10-15	50	100	150	6

Skilled bases elective papers						
AQB 206: Fish Products and Byproducts or Swayam/ Mooc /Other Courses (Course can be taken from any faculty)	2	0	20	30	50	2
Total	30		190	410	600	24

Subject Code [2303081302050002]

Semester II

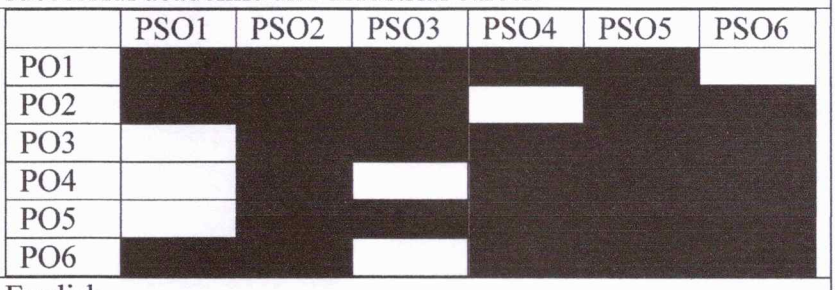
Course Code	**205**
Course Title	**Fisheries Technology and Biostatistics**
Credit	6
Teaching per Week	12 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to develop the skill about executing the different scientific methods of Biochemistry and Genetics in field of Aquatic Biology with reference to improving aquaculture production and quality. The purpose of the course is to introduce different fisheries technologies and its applications which would help and develop the skill among students for development of fisheries sector in scientific way. The purpose of the course is to make students acquainted with analysis methodology which would be helpful for the formation of the database and resources management.
Course Objective	To acquaint the students about the biochemical quantification of fish and feed, Quantitative estimation of DNA, staining of DNA and RNA, banding techniques, Determination of Age and Growth of fin fishes, Biometric study of fish, Study of different gears and crafts, Remote sensing techniques, fish products and by-products as well as biostatistical methods.
Course Outcomes	CO1: Biochemical quantification of fish and feed is essential for consumption purpose to make legitimate comparisons of best suitable feeds and fish on the basis of nutritional requirements of human being. CO2: Quantitative estimation of DNA, staining of DNA and RNA as well as study of banding techniques helps in aquatic resource management. CO3: Students will be aware age and growth of fish which are essential for sustainable fish farming and population studies. CO4: The students will be able to acquire knowledge about fishing techniques to catch fish in large scale from waterbodies efficiently for fishery research and management. CO5: This paper deals with post-harvest technology which helps to maintain quality (appearance, texture, flavour and nutritive value) to protect food safety and to reduce losses between harvest and consumption. CO6: The application of bio-statistical analysis in the field of aquatic biology which helps for resource management to develop. Understanding and application of expertise in the preparation and presentation of data for scientific studies. CO7: Explore students through field and institute visits which make them to understand the interaction between their chosen

	fields of study to the rest of the world. It also provides an exposure to students about practical working environment.
Mapping between COs with PSOs	
Pre-requisite	Basics of Zoology and Fisheries
Course Content	**Unit – I** Biochemical quantification of Protein, Lipid, Sugar, moisture and ash in fish Biochemical quantification of Protein, Lipid, Sugar, moisture and ash in feed Feed formulation by Pearson square formula Salt content in fish (optional) **Unit - II** DNA staining in aquatic plants RNA staining in aquatic plants (Pyronine-Y and toluidine blue) Study of chromosomal banding techniques in fish with the help of images Isolation of DNA from aquatic organism (Demonstration) **Unit - III** Determination of Age and Growth of fin fishes Biometric/ morphometric study of fish Study of different gears and crafts (models/ drawing) Study of remote sensing techniques (Images) Study of fish products and by-products (Samples and images) **Unit - IV** A. Data analysis: Standard deviation, CV, SE, Independent t-test, Paired t-test, Chi-square test, correlation, regression, ANOVA B. Data presentation: Graphs (Bar, Pie, Line, Histogram) and table formation Visit to research laboratory/ processing plant
Reference Books	1. Ravindranath, M. H. (1981). Manual of Research Methods for Crustacean Biochemistry and Physiology. CMFRI, Cochin-682018. 2. Nielsen, S. S. (2017). Food Analysis. Purdue University, Springer International Publishing. 3. Bioseparation Technology Laboratory. Department of Biotechnology, SRM University. 4. Lodish, H., Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M., Scott, M. P. and Lutz, C. G. (2003). Practical Genetics for Aquaculture. Wiley-Blackwell.

	5. Cummings, S. A. and Thorgaard, G. H. (1994). Extraction of DNA from fish blood and sperm. Biotechniques, 17(3): 426-430. 6. Sumner, A. T. (1990). Chromosome Banding. Unwin Hyman, London; Boston. 7. Sharma, L. L., Sharma, S. K., Saini, V. P. and Sharma B. K. (2008). Management of Freshwater Ecosystems. Agrotech Publishing Academy, Udaipur, India. 8. Sreekrishna, Y. and Shenoy, L. (2001). Fishing Gear and Craft Technology, Indian Council of Agricultural Research, New Delhi. 9. Gupta, S.K. and Gupta, P.C. (2002): General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. 10. Sabins, F.F. (1997): Remote sensing, Principles and Interpretation. W.H. Freeman and Co., New Delhi 11. Sachindra, N. M. and Mahendrakar, N. S. (2014). Fish Processing By-products: Quality Assessment and Application. Studium Press, LLC, US. 12. Balachandran, K. K. (2016). Post-Harvest Technology of Fish and Fish Products. Daya Publishing House. 13. Raghavarao, D. (1983): Statistical Techniques in Agricultural and Biological Research. Oxford and IBH Publishing Co., Mumbai.
Teaching Method	Practical performance and demonstration, Discussion, Self-Study, ICT, Field visit
Evaluation Method	Internal assessment (30%) and External assessment (70%) based on practical performance, journal preparation and viva-voce examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programme is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries

	Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

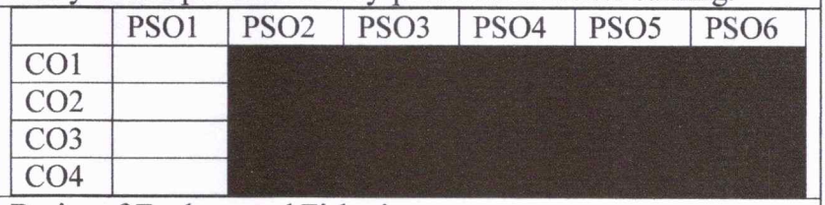
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						

Medium of Instruction	English					
Programme structure	Semester-II					
Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 201: Fisheries Technology	4	3	30	70	100	4
AQB 202: Fish Nutrition and feed Technology	4	3	30	70	100	4
AQB 203: Fish Genetics and Biotechnology	4	3	30	70	100	4
Elective papers						
AQB 204 A: Fisheries legislation	4	3	30	70	100	4
AQB 204 B: Biostatistical Analysis	4	3	30	70	100	4
Practical:						
AQB 205: Fisheries Technology and Biostatistics	12	10-15	50	100	150	6
Skilled based elective papers						

AQB 206: Fish Products and Byproducts or Swayam/ Mooc / Other Courses (Course can be taken from any faculty)	2	0	20	30	50	2
Total	30		190	410	600	24

Subject Code [2303081302060004]

Semester II

Course Code	**206**
Course Title	**Fish Products and By-products**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to make the student able of implementing the principle and techniques of fish preservation and processing which develops the opportunity for self-employment.
Course Objective	To make students familiar about fish preservation and processing by different methods, Methods of preparation, packaging and storage of various fish products and by-products as well as quality dimensions of seafood.
Course Outcomes	CO1: Students will able to understand about fish preservation and processing which helps to keep fishes in best quality. CO2: Students will able to develop the skill about packaging and storage of various fish products which enhance the shelflife of products for good revenue generation. CO3: This paper gives detail idea about packaging and storage of various fish by-products for nutritional enhancement. CO4: Explain and train students to deal with importance of fish quality and application of HACCP concept in surveillance and quality assurance program for packaged and freeze-dried products to reduce contamination in fish as well as improving safety of fish products and by-products for better earning.
Mapping between COs with PSOs	
Pre-requisite	Basics of Zoology and Fisheries
Course Content	**UNIT - I** Principle of fish preservation and processing. Processing of fish by traditional methods – salting, sun drying, smoking, marinading and fermentation. Theory of salting, methods of salting – wet salting and dry salting. Drying and dehydration – theory, importance of water activity in relation to microbial growth. Sun drying and artificial drying – solar dryer. **UNIT - II** Principles, specification, methods of preparation, packaging and storage of various fish products - Fish and prawn pickles, fish sauce and fish paste, fish sausage, fish ham, surimi, fish cake, kamaboko battered and braided products fish finger, fish cutlet, fish wafer, fish soup powder etc.

	UNIT - III Principles, specification, methods of preparation, packaging and storage of various fish byproducts - Fish oil, chitosan, fish protein concentrate, fish hydrolysate, fish silage, fish maws, shark leather, fish glue, fish gelatin, isinglass, pearl essence, shark fin rays, beach-de-mer etc. **UNIT - IV** Quality dimensions of seafood – sensory, intrinsic, quantitative and affective parameters. Importance of quality, definitions and terminologies. Application of HACCP concept in surveillance and quality assurance program for packaged and freeze-dried products.
Reference Books	1. Gupta, S.K. and Gupta, P.C. (2002): General and Applied Ichthyology (Fish and Fisheries). S. Chand and Company, New Delhi. 2. Joseph, J. (2009): Post Harvest Technology of Freshwater Fish. Central Institute of Fisheries Technology, Cochin. 3. Ninawe, A. and Rathnakumar, K. (2008). Fish Processing Technology and Product Development. Narendra Publishing House. 4. Sachindra, N. M. and Mahendrakar, N. S. (2014). Fish Processing Byproducts: Quality Assessment and Application. Studium Press, LLC, US. 5. Balachandran, K. K. (2016). Post Harvest Technology of Fish and Fish Products. Daya Publishing House. 6. Martin, R. E., Carter, E. P., Flick, G. J. and Davis, L. M. (2000). Marine and Freshwater Products Handbook, CRC Press. 7. Balasundari, S., Raghu, G. and Felix, S. (2020). Fish Products and Value Addition. Daya Publishing House.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

M. Sc. Sem III						
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (Hrs)	Internal marks	External marks		
Theory papers :						
Core papers						
AQB 301: Aquatic Microbiology &Disease Management	04	03	30	70	100	04
AQB 302: Aquaculture Practices	04	03	30	70	100	04
AQB 303: Planktonology	04	03	30	70	100	04
Elective Papers						
AQB 304 A: Fisheries Extension Education AQB 304 B: Research methodology and Writing skill	04	03	30	70	100	04
Practicals :						
AQB 305: Aquaculture management and Extension Education	12	10-15	50	100	150	06
Skill based elective papers						
AQB 306: Entrepreneurship development in Fisheries or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources.

	PSO2: Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

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

Medium of Instruction	English					
Programme structure	Semester-III					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (Hrs)	Internal marks	External marks		
Theory papers :						
Core papers						
AQB 301: Aquatic Microbiology and Disease Management	04	03	30	70	100	04
AQB 302: Aquaculture Practices	04	03	30	70	100	04
AQB 303: Planktonology	04	03	30	70	100	04
Elective papers						
AQB 304 A: Fisheries Extension Education AQB 304 B: Research methodology and Writing skill	04	03	30	70	100	04
Practical :						
AQB 305: Aquaculture management and Extension Education	12	10-15	50	100	150	06
Skill-based elective paper						
AQB 306: Entrepreneurship development in Fisheries Or swayam/ Mooc/ Other Courses	02	00	20	30	50	02

(Course can be taken from any faculty)						
Total	30	Total	190	410	600	24

Subject Code [2303081303010003]

Semester 3

Course Code	**301**
Course Title	**Aquatic Microbiology and Disease Management**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to make the student able of implementing the concepts and techniques of Aquatic microbiology and develop the skill to identify fish diseases and its associated organisms as well as to find out its remedies for disease management.
Course Objective	To make students familiar about microorganisms associated with aquatic environment and its role in biogeochemical cycle, different methods of studying microorganisms, quality control of fish, fish diseases and health management and etiology.
Course Outcomes	CO1: Students will able to understand about type of microorganisms with biogeochemical cycle to understand their role in aquatic environment. CO2 : The counting and identification techniques like SPC, MPN and Qualitative methods help to determine the importance and safety level of microorganisms in concern to aquatic production and environment. Explain and train students to deal with post mortem changes of fish, fish pathogens and their prevention and control, microbial quality control of fish products and HACCP to reduce contamination in fish as well as improving safety of fishery products. CO3: This paper helps student to develop the skill for health and disease management in fish farming sector. CO4: This paper gives idea regarding physical, chemical and physiological defense mechanisms in fishes, diagnostic tools like histopathological methods, PCR, ELISA and therapy of fish diseases which helps students to recognize the causes of diseases as well as prophylactic and therapeutic treatment.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Pre-requisite	Basics of Microbiology, Zoology and Fisheries
Course Content	**Unit – I** **Microorganisms associated with Aquatic Ecosystem:** General structure and characteristics of microbes (bacteria, fungi, algae and virus). General classification of microbes (conventional and modern methods) in Aquatic environment. **Biogeochemical Cycles:** Carbon, Nitrogen, Phosphorus and Sulphur cycles and their significance. **Unit - II**

	Methods of Studying Microorganisms Quantitative estimation of microorganisms in aquatic ecosystems. Collection, isolation, cultivation and characterization of microorganisms. Introduction and significance of Biofilm. Nutrition, growth and preservation of aquatic microorganisms. **Quality Control of Fish** Post mortem changes (Hypermia, Riger mortis, Autolysis, Microbial Pultrification, Auto oxidation) in fishes, Prevention and control of fish pathogens, Microbial quality control of processed fish products, HACCP. **Unit - III** **Fish Diseases and Health Management** Non-pathogenic diseases: symptoms and control - Environmental, Nutritional and Hereditary diseases. Pathogenic diseases: symptoms and control - Bacterial, Fungal, Viral and Algal diseases in fin fishes and shell fishes. Parasitic diseases: symptoms and control - Protozoan, Crustacean, and Worm diseases in fin fishes and shell fishes. **Unit - IV** **Etiology** Physical, chemical and physiological defence mechanisms in fishes, Methods of pathological examination of fish, Disease diagnosis: Histopathological and Biotechnological (PCR and ELISA) methods.
Reference Books	1. Frazier, W. C and Westnoff, D. C. (2008). Food Microbiology. Tata McGraw Hill Publishing Company, New Delhi. 2. Modi, H. A. (1995). Elementary Microbiology. Ekta Prakashan, Nadiyad. 3. Mukundan, M. K. and Balasubramaniam, S. (2007). Seafood Quality Assurance. Central Institute of Fisheries Technology, Cochin. 4. Rheinheimer, G. C. (1974). Aquatic Microbiology. John Wiley and sons, England. 5. Sigee, D. C. (2005). Freshwater Microbiology. John Wiley and Sons, England. 6. Surendran, P. K., Thampuran, N., Nambiar, N. V. and Laliha, K. V. (2009). Microbiological Examination of Seafood. Central Institute of Fisheries Technology, Cochin. 7. Whitman, K. A. (2004). Finfish and Shellfish Bacteriology. CBS Publishers, New Delhi. 8. Mitra, A. and Banerjee, K. (2004). Marine Microbiology. Narendra Publishing House, Delhi. 9. Pelezar, M. J., Cahn, E. C. S. and Krieg, H. R. (1981). Elements of Microbiology. McGraw Hill Book Co., NY. 10. Tortora, G. J., Funke, B. R. and Case, C. L. (2007). Microbiology. Dorling Kindersley (India) Pvt. Ltd., New Delhi, India.

	11. Willey, J., Sherwood, L. and Woolverton, J. (2017). Presscot, Harley and Klein's Microbiology. McGraw Hill Education. 12. Patel, R. J. (2000). Experimental Microbiology. Aditya, Ahemdabad, India, Vol. I & II. 13. Cheesbrough, M. (2002). District Laboratory Practice in Tropical Countries. Cambridge University press, USA. 14. Holt, J. G., Krieg N. R., Sneath, P. H. A., Staley, J. T. and Williams, S.T. (1994). Bergey's Manual of Determinative Bacteriology (9th ed.). Williams and Wilkins, USA. 15. Schaperclaus, W. (2001). Fish Diseases. Vol I & Vol II, Oxonian Press Pvt. Ltd., New Delhi. 16. Cornell, J. J. (1995). Control of Fish Quality. Fishing New Books. 17. Duijn, C. V. (2000). Diseases of Fishes. Narendra Publishing House, Delhi. 18. Wedemeyer, G. K. (1999). Environmental Stress and Fish Diseases. Narendra Publishing House, Delhi. 19. Woo, P. T. K. and Leatheland, F. (1998). Fish Diseases and Disorders. CABI Publishers, Wallingford.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources.

	PSO2: Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

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

Medium of Instruction	English					
Programme structure	Semester-III					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers :						
Core papers						
AQB 301: Aquatic Microbiology and Disease Management	04	03	30	70	100	04
AQB 302:Aquaculture Practices	04	03	30	70	100	04
AQB 303:Planktonology	04	03	30	70	100	04
Elective papers						
AQB 304 A: Fisheries Extension Education AQB 304 B: Research methodology and Writing skill	04	03	30	70	100	04
Practicals :						
AQB 305: Aquaculture management and Extension Education	12	10-15	50	100	150	06
Skill based elective paper						
AQB 306:Entrepreneurship development in Fisheries Or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code [2303081303020002]

Semester 3

Course Code	**302**
Course Title	**Aquaculture practices**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to gain knowledge about culture techniques for freshwater organisms for commercial purposes and farm construction.
Course Objective	To gain knowledge for aquafarm design and construction. To acquire knowledge for culturing freshwater organisms for commercial purposes.
Course Outcomes	CO1: Students will be familiar with advancements in aquaculture, pond farm preparation, criteria for selection of species for aquaculture, culture techniques for freshwater aquatic organisms, and equipment used in aquafarm. CO2: Students will develop skills for freshwater culture techniques for freshwater animals, microalgae and vascular plants. CO3: Students will be aware of best aquaculture management practices, improvement in fish quality and more revenue generation. CO4: Students will be able to apply use of microalgae and higher vascular plants for wastewater treatment.
Mapping between COs with PSOs	
Pre-requisite	Basics of Biology and chemistry
Course Content	**UNIT I** Introduction, culture methods, harvesting and marketing of important major carps, catfishes and freshwater prawns Fish culture practices with reference to Composite fish culture, Integrated fish culture and Sewage fed fish culture **UNIT II** Introductions, types and advances in brackish water aquaculture Introduction, culture methods, harvesting and marketing of important brackish water fin fishes and shell fishes (Mullet, Milk fish, Sea bass, peal spot and shrimp) **UNIT III** Introductions, types and advances in marin water aquaculture. Introduction, culture methods, harvesting and marketing of Edible oyster, Pearl oyster and techniques of pearl production, Lobster and Clam. **Unit-IV** Taxonomy of economically important seaweeds. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques of sea weeds (*Gracilaria, Caulerpa*), Products from seaweeds, *Spirulina, Chlorella*

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Reference Books	1. Bardach, E.J. Rhyther, J.H. and W.O. McLarney (1972): Aquaculture. The Farming and Husbandry of freshwater and Marine Organisms. John Wiley and Sons. New York 2. Brown, E.E., Gratzek, J.B. (1980): Fish Farming Hand Book. AVI Publishing Company, West port USA 3. Fast, A.W. and Lester, L.J. (1992): Marine Shrimp culture – Principles and Practices. Elsvier Science Publishers, Amsterdams 4. James, P. McVey (1983): Handbook of Mariculture Vol. I. Crustacean Aquaculture. CRC Press. Inc. Florida; 442 pp. 5. Korring, P. (1976): Farming of marine fishes and shrimp. Elsvier Science Publishers, NY 6. Landau, M. (1992): Introduction to Aquaculture, John Wiley and Sons, New York. 7. Mathew, L. (1992): Introduction to Aquaculture, John Wiley and sons, INC, New York 8. Oren, O.H. (1981): Aquaculture of Grey Mullets. Cambridge University Press, London 9. Pillay, T.V.R. and Kutty, M.N. (2005): Aquaculture – Principles and Practices, Black Well Sciences, U.K. 10. Takeo, I. (1978): Aquaculture in shallow seas. Progress in shallow. Sea culture, Amerind Publishing Co. Pvt. Ltd. New Delhi. 613 pp. 11. Chapman, V.J. and Chapman, P.J. (1980): Seaweeds and their uses. Chapman and Hall with Methuen Inc., New York. 12. Dawes, C.J. (1981): Marine Botany. John Wiley and sons. 13. Dawson, R.Y (1966): Marine Botany. An Introduction Holt, Reinhart and Winston Inc., U.S.A. 14. Desikachary, T.V. (1975): Marine Plants. C.S.I.R., New Delhi. 15. Dring, M.J. (1982): The Biology of Marine Plants. Edward Arnold Publishers, London. 16. Kapraun, D.F. (1980): An illustrated guide to the benthic marine algae of coastal North Carolina- Rhodophyta. University North Carolina Press. 17. Levring, T. (1981): Proceedings of 10th International seaweed symposium, Goteborg, Sweden, Academic Press Walter de Guyter, Berlin
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT, Field visit
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources.

	PSO2: Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

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

Medium of Instruction	English					
Programme structure	Semester-III					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers :						
Core papers						
AQB 301: Aquatic Microbiology and Disease Management	04	03	30	70	100	04
AQB 302: Aquaculture Practices	04	03	30	70	100	04
AQB 303: Planktonology	04	03	30	70	100	04
Elective Paper						
AQB 304 A: Fisheries Extension Education AQB 304 B: Research methodology and Writing skill	04	03	30	70	100	04
Practicals :						
AQB 305: Aquaculture management and Extension Education	12	10-15	50	100	150	06
Skill based elective paper						
AQB 306:Entrepreneurship development in Fisheries Or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code [2303081303030002]

Semester 3

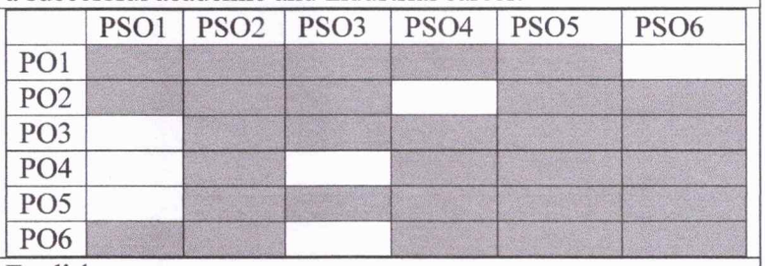
Course Code	**303**
Course Title	**Planktonology**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	16 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to develop concepts of planktonology and learn their implementation in aquaculture sectors, commercial sector and aquatic resource management.
Course Objective	To acquire skills in students to identify plankton and their implementation as bioindicators. To measure productivity and its application in aquaculture sectors, commercial sector and aquatic resource management.
Course Outcomes	CO1: Develop a concept among the students for the importance of plankton and Productivity. Different adaptations found in plankton and its application in science. Ecological and Commercial Importance of primary producers and secondary producers. CO2: After learning this course, students will be able to develop skills to identify plankton and measure productivity and its application in aquaculture sectors and aquatic resource management as well as extracted material from plankton that has importance in the commercial sector. CO3: Students will also be able to learn about the importance of plankton as one of the bioindicators of the environmental condition and their use as one of the biomarkers.
Mapping between COs with PSOs	
Pre-requisite	Basics of Fisheries Science
Course Content	**Unit - I Introduction of plankton:** Introduction and General classification of plankton, general account of instruments and nets employed for collection of plankton, Methods of fixation and preservation of plankton. **Unit - II Productivity:** Method of estimation of Primary productivity, secondary and tertiary productivity, factors affecting productivity. Estimation of standing crop: wet and dry weight estimation, plankton volume settling and displacement method. Oxidation as carbon. (as organic matter) **Unit - III Mechanisms in plankton:** Adaptation of plankton – structural (weight, increases of surface area, floatation) and physiological (specific gravity, water content, fat content, defensive vacuoles, gas, mono and divalent ions) mechanisms, Interrelation of phytoplankton and zooplankton, Harmful algal blooms - its causes and effects **Unit – IV Ecological and Commercial Importance of Primary Producers:**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

	Effects of plankton production in the aquatic environment. Microalgae as a source of protein. Periphyton - Importance of Periphyton in the aquatic environment, Biofuel and other commercial products from algae. Types of larvae and their distribution, chemical communication and settlement of larvae of marine benthic organisms.
Reference Books	1. Edmondson, W.T. (1976). Freshwater Biology. 2nd Ed. John Wiley (Ed) and sons Inc. 2. Hutchinsn, G.E. (1976). A treatise on limnology. Vol. I & II John Wiley & Sons. 3. Jhingran, V.G. (1985). Fish and fisheries of India. Hindustan Publication Corp., New Delhi. 4. Nybakken, J.W. (2001). Marine Biology an Ecological Approach 4th edition. Addison Wesley Edu. Pub. Inc. 5. Peter McRoy, C. and G. Helferich (1977). Sea grass Ecosystems. A scientific perspective. Marcel Dekker Inc. New York 6. Sumich, J. l. (1999). Introduction to the biology of marine life 7th Edition. The McGraw hill Companies Inc. 7. Welch. P.S. (1952). Limnology. 2nd Ed. McGraw Hill Book Co.
Teaching Methodology	Classwork, Discussion, Self-Study, Assignment, ICT, Field visit
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programme is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources.

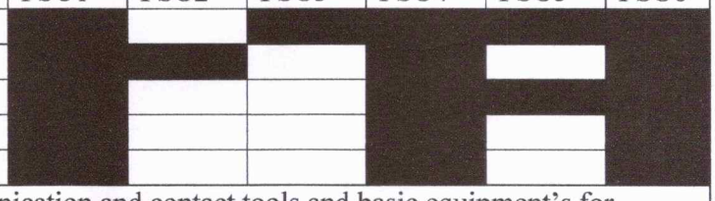
	PSO2: Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

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

Medium of Instruction	English					
Programme structure	Semester-III					
Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (Hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 301: Aquatic Microbiology and Disease Management	04	03	30	70	100	04
AQB 302: Aquaculture Practices	04	03	30	70	100	04
AQB 303: Planktonology	04	03	30	70	100	04
Elective Paper						
AQB 304 A: Fisheries Extension Education AQB 304 B: Research methodology and Writing skill	04	03	30	70	100	04
Practical :						
AQB 305: Aquaculture management and Extension Education	12	10-15	50	100	150	06
Skill based elective paper						
AQB 306: Entrepreneurship development in Fisheries or Swayam/ Mooc/ Other Courses (Courses can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code [2303081303040002]

Semester III

Course Code	**304 A**
Course Title	**Fisheries Extension Education**
Credit	4
Teaching per week	4 Hrs
Minimum weeks per semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective from	2024-25
Purpose of course	The purpose of the course is to develop the analysis methodology and dissemination methods of the innovations and regulations of the fisheries resources which would be helpful for the formation of the database and resources management.
Course objective	To acquaint the students with the extension methods, innovation dissemination, and fisheries resources regulations.
Course Outcome	**CO1:** The application of extension education in the field of aquatic biology helps for resource management. **CO2:** The innovations are not essential but its application at the needful field are also useful and it would be possible to teach the students about fisheries extension education. **CO3:** The fisheries extension education essential to develop communication skills, training strategies, contact methods etc. certainly helps to disseminate the innovation and technologies to beneficiaries. **CO4:** The knowledge regarding inland fisheries policies implemented by the state and central government are elaborated to students to improve the knowledge and technical skill. **CO5:** The dissemination of advanced technologies and awareness for fisheries management among the farmers.
Mapping of COs with PSOs	
Course prerequisite	Communication and contact tools and basic equipment's for aquaculture.
Course Content	**UNIT I** **Extension Education:** Definition, meaning, history, objectives, scope, concepts, philosophy and principles of fisheries extension education. Pioneering Extension efforts and their implications of Extension systems ICAR, SAU, State Departments and NGOs. **UNIT II** **Communication process:** concept, elements, functions and models of communication. **Teaching strategies and models:** Meaning and various types of teaching strategies. Models of Teaching – Characteristics, Functions and elements. **UNIT III** **Diffusion and innovation:** concept and meaning, elements. Adoption: adoption process, adopter categories and factors influencing adoption. **UNIT IV**

	Information communication technology: Concept, role in fisheries development and types of ICTs (print and electronic media, video, teleconferencing, computer assisted instructions, touch screen and web technologies). **Cooperatives:** Introduction, Concept of Co-operation, Objectives of Co-operative Movement, Models of Co-operatives and types of Co-operatives.
References	1. Dahama, O.P. (1983): Extension and rural welfare. Ramprasad and Son's, Agra 2. Dhote, A.K. (1989): Fisheries Management and Extension: Inland fisheries, instructional cum practical manual (VI) NCERT, New Delhi 3. Lynton P.R. and Pareek, U. (1978): Training for development, Kumarian Press, 29 Bishop Road, West Hartford, Connecticut 06119 4. Ray, G.I. (1991): Extension communication and management, Naya Prakash, Kolkatta 5. Srivastva, U. K. and Vathsals, S. (1985): Strategy for development of Inland fishery resources in India: Key issues in production and marketing concept Pub. Co. New Delhi. 6. Supe, S.V. (1986): An introduction to extension education, Oxford and IBH Publishing Co., New Delhi. 7. Gupta CB. 2001. Management Theory and Practice. Sultan Chand & Sons. Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy 8. Gallagher K. 1999. Farmers Field School (FFS) – A Group Extension Process based on Non-Formal Education Methods. Global EPM Facility, FAO. 9. Ganesan R, Iqbal IM & Anandaraja N. 2003. Reaching the Unreached: Basics of Extension Education. Associated Publishing Co. 10. Jalihal KA & Veerabhadraiah V. 2007. Fundamentals of Extension Education and Management in Extension. Concept Publ. 11. Khan PM. 2002. Textbook of Extension Education. Himalaya Publ. Ray GL. 2006. Extension Communication and Management. Kalyani Publ 12. Dahama OP & Bhatnagar OP. 2005. Education and Communication for Development. Oxford & IBH. 13. Grover I, Kaushik S, Yadav L & Varma SK. 2002. Communication and Instructional Technology. Agrotech Publ. Academy 14. O. P. Sharma, 2012. Development Perspectives of Extension Education, Agrotech Publishing Academy, Udaipur-313001
Teaching methods	Chalk and talk, Discussion, Videos, Self-study, Seminars and Assignments
Evaluation methods	Internal assessment (30%) based on the internal exam, attendance and assignments. External assessment (70%) based on the university examination at the end of the semester.



Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the programme is to prepare the students for productive career in Aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries department etc.
Program Outcome	**PO1 : Basic Knowledge Enhancement** The designed Program enhances students with the basic knowledge of the subject matter in order to capable students develop research skills which include laboratory techniques, aqua farm field techniques, disease management in aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2 : Skill Development** The program develops the skills of managing aquatic resources and use of techniques and instruments to develop remedies to manage aquatic resources. **PO3 : Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that is being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects to identify aquatic problems in the natural environment. **PO4 : Skill in analysis technique with Extension Education** The program capable students for analysis, conceptualizing the real-world problems. It also enables students understand the Regulation and Development in managing aquatic sources. **PO5 : Professional skill Development through personal experience** Placement and training enhance confidence of students, gain practical knowledge and experience of work in the aquatic sector related industries. The professional skill prepares students for employable and industry ready environment. **PO6 : Group discussion, field visits, presentation and confidence Development** The designed syllabi enable students be capable of group discussion, sharing ideas and views. This enables to develop confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments and fisheries

	Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	PSO1: Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. PSO2: Develop the professional and entrepreneurship skills to be confident in the practical aspects. PSO3: Raising the students capable for handling instruments and use of latest technology to find remedial measures with respect to fisheries and pollution. PSO4: Develop students for self-learning and challenging situation in aquaculture sectors and extension education. PSO5: Enable students to use recent technologies for analysing the research and practical concepts. PSO6: Development for continuous learning and research for successful academic and industrial career.
Mapping between POs and PSOs	

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

Medium of Instruction	English					
Programme structure	Semester-III					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (Hrs)	Internal marks	External marks		
Theory papers:						
Core papers						
AQB 301: Aquatic Microbiology &Disease Management	04	03	30	70	100	04
AQB 302: Aquaculture Practices	04	03	30	70	100	04
AQB 303: Planktonology	04	03	30	70	100	04
Elective Papers						
AQB 304 A: Fisheries Extension Education AQB 304 B: Research methodology and Writing skill	04	03	30	70	100	04
Practicals :						
AQB 305: Aquaculture management and Extension Education	12	10-15	50	100	150	06
Skill based elective papers						

AQB 306: Entrepreneurship development in Fisheries Or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code **[2303081303040003]**

Semester III

Course Code	**304 B**
Course Title	**Research methodology and Writing skill**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to acquaint knowledge on research methodology and problem selecting methods of the research. Students would be capable of drawing inferences of the research and write the scientific literatures.
Course Objective	To acquaint the students about the research methods, research design and formulation along with skill of scientific writing.
Course Outcomes	CO1: The application of different research methods for research work and analysis CO2: To help students acquire knowledge on different methods of sample collection and hypothesis formulation for research studies. CO3: The course would help students to apply statistical analysis tools, data presentation, interpretation and predict the outcomes of the research for future aspects. CO4: The course would help students capable of writing scientific literatures
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Pre-requisite	Basics of biology and chemistry
Course Content	**Unit – I** **Research**: Meaning, definitions, objectives, characteristics of Research Criteria of Good Research Types of Research **Research Problem & Formulation** Selecting the Problem, Sources of the Problem, Defining a Problem, Statement of a Problem Hypothesis: Qualities of a good Hypothesis –Types of Hypotheses, Hypothesis Testing and interpretation **Research Design**: Features of a good research design, Concept, types and application of Exploratory Research Design, Descriptive Research Design and Experimental research Design **Unit – II** **Data Collection and analysis:** Methods of data collection, Sampling Methods, Sampling Errors Data Processing and Analysis strategies: Data presentation, statistical analysis and interpretation of data, types of analysis,

	simple regression analysis, correlation, coefficient of determination, (r^2), z-test, t-test, ANOVA, Chi-square test, multi-variate analysis of data and multiple regression. **Unit - III** **Report and thesis writing:** Structure and components of scientific reports, types of report Thesis writing - different steps and software tools (LaTeX.) in the design and preparation of thesis, layout, structure (chapter plan) and language of typical thesis, Illustrations and tables, bibliography, referencing and footnotes. The Review of Literature: Meaning, need, objectives, sources and the functions of Review of Literature, pattern of writing review of Literature Oral presentation - planning, software tools, creating and making effective presentation, use of visual aids **Unit - IV** **Research Paper Writing:** Layout of a Research Paper, Journal selection, Impact factor of Journals, Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Use of Encyclopaedias, Research Guides, Handbook etc. for paper writing Use of tools and techniques for Research: methods to search required information effectively, Reference Management Software like Zotero and Mendeley, paper formatting tools, Software for detection of Plagiarism
Reference Books	1. Bhattacharyya D. K (2006) Research Methodology, Excel Books. 2. Gurumani. N. (2006) Research Methodology for Biological Sciences,MJP Publishers, Chennai 3. Day Robert (.2002) How to write and publish a scientific paper, Cambridge University Press 4. Janice Matthews and Robert Matthwes (2008). Successful Scientific Writing, Cambridge University Press 5. Matt Young (2006). The Technical Writer's Handbook, Viva Books Private Limited, India 6. Fisher, R. A. (1970) Statistical Methods for Research Workers, l4th Edition, Oliver and Boyd Publ. 7. Cohen, L. Lawrence, M., & Morrison, K. (2005). Research Methods in Education (5th edition)., Oxford: Oxford University Press. 8. Denscombes, M. (2010). The Good Research Guide: For small-scale social research projects.,Maiden-Read: Open University Press. 9. Dornyei, Z. (2007). Research Methods in Applied Linguistics. Oxford: Oxford University Press. 10. Kothari, C. R. (1980). Research Methodology: Research and techniques, New Delhi: New Age, International Publishers.
Teaching Methodology	Classwork, Discussion, Self-Study, models and Assignment

Evaluation Method	Internal assessment (30%) based on the internal exam, attendance and assignments. External assessment (70%) based on the university examination at the end of the semester.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.

Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

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

Medium of Instruction	English					
Programme structure	Semester-III					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (Hrs)	Internal marks	External marks		
Theory papers :						
Core papers						
AQB 301: Aquatic Microbiology & Disease Management	04	03	30	70	100	04
AQB 302: Aquaculture Practices	04	03	30	70	100	04
AQB 303: Planktonology	04	03	30	70	100	04
Elective Papers						
AQB 304 A: Fisheries Extension Education AQB 304 B: Research methodology and Writing skill	04	03	30	70	100	04
Practical :						
AQB 305: Aquaculture management and Extension Education	12	10-15	50	100	150	06
Skill based elective papers						
AQB 306: Entrepreneurship development in Fisheries or swayam/ Mooc/ Other Courses	02	00	20	30	50	02

(Course can be taken from any faculty)						
Total	30	Total	190	410	600	24

Subject Code [2403081303050004]

Semester 3

Course Code	**305**
Course Title	**Aquaculture management and Extension Education**
Credit	6
Teaching per Week	12 Hrs
Minimum weeks per Semester	16 (Including laboratory work, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	1. The purpose of the course is to make the student able of implementing the methods of planktonology and microbiology as well as develop the skill to count and identify plankton and microorganisms in the field of Aquatic Biology. 2. The purpose of the course is to make students capable of identifying and culture of aquatic organisms. 3. The purpose of the course is to develop skills of the students regarding writing research paper and preparation of AV aids.
Course Objective	1. To make students familiar about Preparation of media, Isolation methods for bacteria, Identification of bacteria by Gram's staining technique, Assessment of microbiological quality of water bodies, fish and fish products using SPC technique, Assessment of microbiological quality of water bodies using MPN technique, Isolation and identification of pathogenic bacteria from fish and Study of diseased specimens/images. 2. To acquaint the students about Identification fresh water higher vascular plants, sea weeds, aquatic insects, prawn larvae, seed stages (eggs, spawns, fry and fingerlings), cultivable fin fishes, shell fishes, predatory and weed fishes, Hatching and culturing of Artemia and Culture of Microalgae. 3. To make the students understand about Collection, preservation and Identification of plankton (freshwater and marine water), Quantitative estimation of plankton (counting method) & chlorophyll estimation. 4. To make the student capable of understanding about Preparation of AV aids (Pamphlets and folders) and research paper.
Course Outcomes	CO1: The counting and identification of microorganisms through SPC, MPN, and Gram's staining technique aids to determine the importance and safety level of microorganisms in concern to aquatic production and environment. CO2: Students will be able to identify sea weeds, fresh water higher vascular plants, aquatic insects and prawn larvae, seed stages (eggs, spawns, fry and fingerlings), cultivable fin fishes, shell fishes, predatory and weed fishes which are closely related to Aquaculture management.

	CO3: The paper gives detail idea about culture of Artesia which gives different food alternatives for fishes during culture and more revenue generation. CO4: Students will be develop skill for production of live feeds, seeds and microalgae in the field of Aquatic biology which can be helpful for entrepreneurship and business development. CO5: Preparation of AV aids and research paper writing improves learning, teaching and writing skill.
Mapping between COs with PSOs	<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>
Pre-requisite	Basics of Microbiology, Zoology and Fisheries
Course Content	**Unit I** Preparation of media Isolation methods for bacteria (streak plate, spread plate and pour plate method) Cultivation of bacteria by broth culture technique Identification of bacteria by Gram's staining technique Assessment of microbiological quality of water bodies, fish and fish products using SPC technique Assessment of microbiological quality of water bodies using MPN technique Demonstration: Isolation and identification of pathogenic bacteria from fish Study of diseased fish with the help of images **Unit II** Identification freshwater higher vascular plants Identification of sea weeds Identification of aquatic insects and prawn larvae Identification of seed stages (eggs, spawns, fry and fingerlings) Identification of cultivable fin fishes, shell fishes, predatory and weed fishes Hatching and culturing of Artemia Culture of Microalgae **Unit III** Collection, preservation and Identification of plankton (freshwater and marine water) Quantitative estimation of plankton (counting method) & chlorophyll estimation **Unit IV** Preparation of farm literature (Leaflet, Pamphlet and Folder) Preparing of research paper Visit of Induced breeding farms/ Krishi Vigyan Kendra/ ATIC
Reference Books	1. Patel, R. J. (2000). Experimental Microbiology. Aditya, Ahmedabad, India, Vol. I & II. 2. Surendran, P. K., Thampuran, N., Nambiar, N. V. and Laliha, K. V. (2009). Microbiological Examination of

	Seafood. Central Institute of Fisheries Technology, Cochin. 3. Pelezar, M.J., Cahn, E. C. S. and Krieg, H. R. (1981). Elements of Microbiology. McGraw Hill Book Co., NY. 4. Tortora, G.J., Funke, B. R. and Case, C. L. (2007). Microbiology. Dorling Kindersley (India) Pvt. Ltd., New Delhi, India. 5. Cheesbrough, M. (2002). District Laboratory Practice in Tropical Countries. Cambridge University press, USA. 6. Pillai, N.K. (1986). Introduction to Planktonology. Himalaya Publishing House, Bombay. 7. Day, F. (1875-78). The fishes of India; being a natural history of the fishes known to inhabit the seas and fresh waters of India, Burma and Ceylon. Bernard Quaritch, London. 8. FAO, (1992). Manual of seed production of carps. FAO Pub., Manila 9. Jhingran, V.G. (1991). Fish and Fisheries of India, Hindustan Publishers. 10. Pillay, T.V.R. and Kutty, M.N. (2005): Aquaculture – Principles and Practices. Black Well Sciences, U. K 11. Sher Singh, B. and Sikarwar, T. K (2014): Hand book for writing research paper. Bharati Publications, New Delhi.
Teaching Methodology	Practical performance and demonstration, Discussion, Self-Study, ICT
Evaluation Method	Internal assessment (30%) and External assessment (70%) based on practical performance, journal preparation and viva-voce examination.

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries. Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources. **PSO2:** Develop the professional and entrepreneurship skills to be confident in the practical aspects.

	PSO3: Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.

Mapping between POs and PSOs

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

Medium of Instruction	English					
Programme structure	Semester-III					
Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (Hrs)	Internal marks	External marks		
Theory papers :						
Core papers						
AQB 301: Aquatic Microbiology &Disease Management	04	03	30	70	100	04
AQB 302:Aquaculture Practices	04	03	30	70	100	04
AQB 303:Planktonology	04	03	30	70	100	04
Elective Paper AQB 304 A: Fisheries Extension Education AQB 304 B: Research methodology and Writing skill	04	03	30	70	100	04
Practical :						
AQB 305: Aquaculture management and Extension Education	12	10-15	50	100	150	06
Skill based elective papers						
AQB 306: Entrepreneurship development in Fisheries or Swayam/ Mooc/ Other Courses (Course can be taken from any faculty)	02	00	20	30	50	02
Total	30	Total	190	410	600	24

Subject Code *[2303081303060003]*

Semester 3

Course Code	**306**
Course Title	**Entrepreneurship development in Fisheries**
Credit	02
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to develop entrepreneurship skill among the students in fisheries sector.
Course Objective	To familiarize the students about the concept of entrepreneurship, different government schemes in the fisheries sector and scope in this sector to develop independent career
Course Outcomes	CO1: The course will familiar the students with the knowledge of entrepreneurship development in the fisheries sector CO2: To help students know about different policies and incentive schemes in developing entrepreneurship in farm development and value-added products CO3: The course would help students to be familiar with the present condition and challenging situation in Indian fisheries sector
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	**Unit – I** Concept of entrepreneurship; entrepreneurial and managerial characteristics; motivation and entrepreneurship development; managing competition; entrepreneurship development programs; Entrepreneurship process. Women entrepreneurship: concept, problems and development of women entrepreneurs **Unit -II** Government schemes and incentives for promotion of entrepreneurship, Government policy on Small and Medium Enterprises Financial Management: Financing procedure and financial incentives, Banking norms as in vogue. Financial ratios & and their significance, Costing and Pricing. Fund flow and Cash flow concept. Preparation of enterprise budget for fish farming. Fiscal and monetary policies and their impact on entrepreneurship. **Unit – III** Infrastructural and other financial requirements for fishery entrepreneurship. Contract farming and joint ventures, public-private partnerships. Overview of fisheries inputs industry. Characteristics of Indian fisheries processing and export industry. Production Management: Elements of production process, Production Planning and Control, Product development, Testing

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

	facilities, Patents, Quality Assurance, Total Quality Management **Unit – IV** Supply chain management- meaning, advantages, stages, process, drivers and scope of aqua-supply chain management
Reference Books	1. Kumar A., Poornima. S., Mini S C., Abraham K. and Jayashree K. (2003). Entrepreneurship Development, New Age International Publishers, New Delhi. 2. Gupta, C.B. (2001). Management, Theory and Practice. Sultan Chand and Sons, New. Delhi. 3. Indu G. (2008). Handbook on Empowerment and Entrepreneurship. Agrotech, Public Academy, Udaipur. 4. Khanka, S.S. (1999). Entrepreneurial Development, S. Chand and Co., New Delhi. 5. Mary C. (2008). Entrepreneurship in Action. Prentice Hall of India Pvt. Ltd., New Delhi. 6. Mohanty S.K. (2009). Fundamentals of Entrepreneurship. Prentice Hall of India Pvt. Ltd., New Delhi. 7. Prasad R. (2003). Entrepreneurship - Concepts and Cases. ICFAI Publications, Hyderabad. 8. Mondal S. and Ray, G.L. (2009). Text Book of Entrepreneurship and Rural, Development. Kalyani publishers, Ludhiana. 9. Singh D. (1995). Effective Managerial Leadership. Deep and Deep Publications, New Delhi. 10. Desai, V. (1997). Small Scale Industries and Entrepreneurship. Himalaya Publishing House, New Delhi. 11. Desai. V. (2000). Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, New Delhi
Teaching Methodology	Classwork, Discussion, Self-Study, models and Assignment
Evaluation Method	Internal assessment (30%) based on class attendance, assignments, class test, group discussion, MCQ etc. and External assessment (70%) based on university examination.

Veer Narmad South Gujarat University, Surat
Department of Aquatic Biology
M. Sc. (Aquatic Biology)
Syllabus - Semester-IV
Teaching and examination scheme

Papers	Exam Schedule		Total marks	Credit
	Internal marks	External marks		
AQB 401: Dissertation	100	250	350	14
AQB 402: Seminar (Topic based on Aquatic Biology)	25	75	100	4
AQB 403: Licensing and certification of Aquaculture practices	25	50	75	3
AQB 404: Educational excursion/project submission/ Field work	25	50	75	3
Total	175	425	600	24

Licenses and Certificates: (BAP, CAA, SIP, EU, ASC, MPEDA etc.)

Master of Aquatic Biology

Name of Program	Master of Aquatic Biology
Abbreviation	**AQB**
Duration	**2 Years (Four Semester)**
Eligibility Criteria	A candidate who has obtained his/her bachelor's degree in science except maths and physics.
Objective of Program	The main objective of the program is to prepare the students for productive careers in aquatic resources management and sustainable utilization of aquatic resources by providing an outstanding environment of teaching and research in the specific aspects of the designed program. This structured course will facilitate a career in various institutions such as research and development centers of private limited, public companies, Aquaculture sectors, farms, fisheries departments etc.
Program Outcome	**PO1: Basic Knowledge Enhancement** The designed Program enhances students with basic knowledge of the subject matter to capable students developing research skills which include laboratory techniques, aqua farm field techniques, disease management in the aquaculture sector, feed technology, biochemistry, microbiological assessment, fish genetics, biotechnology and bioinformatics, aquarium setup, ornamental fisheries, marine and freshwater fisheries and Planktonology. **PO2: Skill Development** The program develops the skills of managing aquatic resources and the use of techniques and instruments to develop strategies to manage aquatic resources. **PO3: Familiar with Advanced Emerging Technologies** The program trains students with the latest technologies that are being used in the aquaculture sectors and aquatic pollution management. The designed syllabi enrich students with the technical aspects of identifying aquatic problems in the natural environment. **PO4: Skill in analysis technique with Extension Education** The program is capable of preparing students for analyzing, and conceptualizing real-world problems. It also enables students to understand the regulation and development in managing aquatic sources. **PO5: Research and Project Development The** Development of the factual project provides the learner's exposure to work in the demanding environment of the industry. The research and project development skills prepare students for an employable and industry-ready environment. **PO6: Group discussion, field visits, presentation, and confidence Development** The designed syllabi enable students to be capable of group discussion, and sharing ideas and views. This enables to development of confidence among the students. Healthy discussion in recent technology and legislations, pollution amendments, and fisheries Technology enables acquaintances of the students with the practical aspects.
Program Specific Outcomes	**PSO1:** Develop and strengthen the basic knowledge and concepts that are required to manage aquatic resources.

	PSO2: Develop the professional and entrepreneurship skills to be confident in the practical aspects. **PSO3:** Raising the student's capability for handling instruments and use of the latest technology to find remedial measures concerning fisheries and pollution. **PSO4:** Develop students for self-learning and challenging situations in aquaculture sectors and extension education. **PSO5:** Enable students to use recent technologies for analyzing the research and practical concepts. **PSO6:** Development for continuous learning and research for a successful academic and industrial career.
Mapping between POs and PSOs	

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

Medium of Instruction	English			
Programme structure	Semester-IV			
Theory Paper /Practical	Exam Schedule		Total marks	Credit
	Internal marks	External marks		
AQB 401: Dissertation	100	250	350	14
AQB 402: Seminar (Topic based on Aquatic Biology)	25	75	100	4
AQB 403: Licensing and certification of Aquaculture practices	25	50	75	3
AQB 404: Educational excursion/project submission/ Fieldwork	25	50	75	3
Total	175	425	600	24



Semester IV **Subject Code [2403081304010003]**

Course Code	**401**
Course Title	**Dissertation (Research Work)**
Credit	14
Teaching per Week	12 Hrs
Minimum weeks per Semester	16 (Including Dissertation (Research work), examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to make students capable of doing innovative research work. The course will provide experience of laboratory as well as fieldwork.
Course Objective	The objective of the course is to enhance the skills of students regarding effective project management.
Course Outcomes	CO1: Student is capable of identifying his or her area of interest, able to explore a subject in depth, managing a research project, defining a suitable question and using the appropriate research tools. CO2: Students will be able to develop research skills, communication, academic writing, data collation and analysis skills. CO3: Dissertation helps in paper publications which make students an expert in their field of knowledge.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Pre-requisite	Basics of biology and chemistry
Course Content	Research work along with dissertation writing will be carried out in the related field of Aquatic Biology. That would be carried out at the research laboratory of the department **OR** laboratory of other institutes and organizations. The research work must be presented in front of the examiners
Reference Books	-----
Teaching Methodology	Research guidance, Explanation, Discussion, Self-Study
Evaluation Method	Internal assessment (30%) based on class attendance, Research presentation, viva based evaluation and External assessment (70%) based on university examination (Research presentation)



Subject Code [2403081304020003]

Semester IV

Course Code	**402**
Course Title	**Seminar**
Credit	4
Teaching per Week	6 Hrs
Minimum weeks per Semester	16 (Including Seminar, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course is to create an effective learning environment and develop confidence in students.
Course Objective	The objective of the course is to bring students together in groups and focusing on some particular subject with active participation.
Course Outcomes	CO1: Seminar provides an opportunity for students to discuss and analyse a range of new material, ideas and concepts. CO2: This course is a great chance for the students to improve their language, interaction with experts from the specific field, learn about latest information and new skills related to the concerned topic. CO3: Students will be able to develop English speaking through fluency and conversational skill.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Pre-requisite	Basics of biology and chemistry
Course Content	Seminar should be prepared in the field of Aquatic Biology and presented in front of examiners
Reference Books	-----
Teaching Methodology	Explanation, Discussion, Self-Study
Evaluation Method	Internal assessment (30%) based on class attendance, Seminar presentation and External assessment (70%) based on university examination (Seminar presentation)

Semester IV

Subject Code [2303081304030003]

Course Code	**403**
Course Title	**Licensing and certification of Aquaculture practices**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	16 (Including Project formulation, Certification and Licensing for Aquaculture, examination, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	• The purpose of introducing project formulation for Aquaculture is to make students capable of examining the project idea from the stand point of its objectives, social impacts as well as financial and technical viability. • The purpose of the certification system in Aquaculture is to create awareness among students to ensure the sustainability of aquaculture products. • The purpose of introducing licensing in Aquaculture is to know about legislative act and detail legal conditions that surround the setting up of an aquaculture farm.
Course Objective	• The objective of the project formulation for aquaculture is to benefit from the desired outcomes and impact. • Certification programs in Aquaculture is to promote sustainable practices it is worthwhile to consider what sustainable aquaculture development, actually implies and how it might be objectively assessed. • The objective of licensing in Aquaculture is to aware students of this important tool in ensuring the orderly development of an aquaculture industry and providing rights.
lCourse Outcomes	CO1: Students will be capable of identifying and documenting specific project goals, outcomes, milestones, tasks, costs, and timeline dates specific to the project objectives. Certification programs creates awareness about environmental, social, food safety, animal health, and welfare— each step of the aquaculture production chain. CO3: Aquaculture Licence and the consenting process helps to regulate the aquaculture sector.
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	The procedural report has to be prepared to receive either Certificates or Licenses for assigned aquacultural practice.
Reference Books	-----
Teaching Methodology	Explanation, Discussion, Self-Study
Evaluation Method	Internal assessment (30%) based on class attendance, Report evaluation, Discussion and External assessment (70%) based on university examination (Report evaluation and Discussion)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Semester IV **Subject Code [2403081304040003]**

Course Code	**404**
Course Title	**Educational excursion/project submission/ Fieldwork**
Credit	3
Teaching per Week	6 Hrs
Minimum weeks per Semester	16 (Including Study Tour/Project work, preparation, holidays etc.)
Effective From	2024-25
Purpose of Course	The purpose of the course (study tour) is to help students open themselves to many possibilities that are not just contained in one geographical location or culture. Other purposes (project work) is to make students understand about specifies tasks and how goals will be achieved, identify, what resources will be needed, associated budgets and timelines for completion.
Course Objective	The objective of the course (study tour) is to visit new places and new environments which are good ways to awaken students' interest and learn by actually doing a hands-on experience. Another objective (project work) is to provide a learning experience in which students have the opportunity to synthesize knowledge from various areas of learning and apply it critically and creatively in research.
Course Outcomes	CO1: Study tour will give exposure to students to visit different Fisheries Institutes, processing plants, landing centers and Aquaculture farms. CO2: Study tour helps them better to realize the interaction between their chosen fields of study to the rest of the world. CO3: Project work-based learning not only provides opportunities for students to collaborate their own learning, but it also teaches them skills such as problem solving and helps to develop additional skills integral to their future, such as critical thinking and time management.
Mapping between COs with PSOs	
Pre-requisite	Basics of biology and chemistry
Course Content	Educational visits and tours have to be carried out in different Aquatic Biology related institutes, organizations, laboratories, farms, industries, etc. at the local, state, and national levels. The detailed tour report submitted by the students will be used for the internal and external exam evaluation. If such a tour or visit cannot be organized by the department or cannot be participated by any student (with valid reason) that condition student has to submit the project or perform field work in related subject
Reference Books	-----
Teaching Methodology	Explanation, Discussion, Self-Study
Evaluation Method	Internal assessment (30%) based on class attendance, tour report evaluation, discussion and External assessment (70%) based on university examination (Tour report evaluation and Discussion)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						