AC: 02.06.2025 ITEM NO: 26.5

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for
Program: Master of Science
Course: M.SC. PART II(NEP)
Subject: ZOOLOGY

Choice Based Credit System (CBCS)
with effect from
Academic Year 2024-2025

PROGRAM OUTCOMES

PO	Description
A student completing Bachelor's Degree in Science Program will be able to	
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate Programme. Execute strong theoretical and practical understanding generated from the specific graduate Programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	**Research-related skills and Scientific temper:** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Performing dependently and collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

Deccan Education Society's
Kirti M. Doongursee College(autonomous)

Proposed Curriculum as per NEP 2020

Year of implementation- 2024-25

Name of the Department: MSc .Part II Zoology

Semester	Course Code	Course Title	Vertical	Credits
III	K24PSZOOMJ311	Paper I: on General, Physical, Chemical and Biological Oceanography –I	Major	4
	K24PSZOOMJ312	Paper II: Planktology, fish, fishery science and aquaculture-i	Major	4
	K24PSZOOMJP311	Practicals based on General, Physical, Chemical and Biological Oceanography -I And Planktology, Fish, Fishery Science and Aquaculture-I	Major	2
	K24PSZOOOEL331	Industrial fishery	Elective	2
	K24PSZOOEP331	Practical based on Industrial fishery	Elective	2
	K24PSZOORM341	RM	RM	4
	K24PSZOORP351	RP	Project	4
				Total Credits 22

Semester	Course Code	Course Title	Vertical	Credits
IV	K24PSZOOMJ411	Paper I: General, Physical, Chemical and Biological Oceanography --II	Major	4
	K24PSZOOMJ412	Paper II: Planktology, Fish, Fishery Science and Aquaculture -II	Major	4
	K24PSZOOMJP411	Practicals based on General, Physical, Chemical and Biological Oceanography -II and Planktology, Fish, Fishery Science and Aquaculture -II	Major Practical	2
	K24PSZOOEL431	Fish Processing Technology- Traditional and Modern fish processing	Elective	2
	K24PSZOOEP431	Practical based on Fish Processing Technology	Elective Practical	2
	K24PSZOOOJ451	RP/OJT	Project	8
				Total credits 22

Course Code	Sem III Major Paper 1	Credits	Lectures /Week
K24PSZOOMJ311	**General, Physical, Chemical and Biological Oceanography -I**	4	4

Course Outcomes

After completion of this course learner will be able to

- Outlining basic oceanographic concepts and key terminology related to oceanography and marine ecology.
- Interpret the relationships and data based on physical, chemical and biologicals aspects.
- Apply oceanographic principles to solve problems.
- Evaluate the effectiveness of different management strategies for addressing oceanographic challenges
- Design oceanographic experiments to test hypothesis about ocean processes or ecosystem dynamics

Unit	Topic	Lectures
I	General Oceanography 1.1 Terminology of submarine topography Continental shelf, continental slope, submarine canyons, submarine mountain ranges, Guyots and trenches with special reference to the Indian Ocean and adjacent seas. 1.2 A general knowledge of typical oceanographic research vessel and its equipments, oceanographic labs and stations of the world and India	15
II	Physical Oceanography 2.1 Physical properties of sea water: Salinity, Chlorinity, Temperature, Light, Density, Pressure, Salinity-Temperature- Density relationship (STD) . 2.2 Oceanographic circulation: Ekman spiral, geotropic current, westward intensification with dynamic topography	15
III	Chemical Oceanography 3.1 Composition of sea water- constancy of its composition and factors affecting the composition, major and minor constituents, trace ,salinity,chlorinity 3.2 Dissolved gases in the sea water and their role in the environment, CO2 system, dissolved O2 and oxygen profile, hydrogen sulphide. 3.3 Nutrients in the ocean, their cycles and factors influencing their distribution a) Nitrogen b) Phosphorus c) Silicon	15
IV	Biological Oceanography 4.1 Sea as a biological environment. 4.2 Division of marine environment. 4.3 a) Marine biotic diversity: Plankton, Nekton, Benthos- brief account Implications of species richness, measuring diversity, quadrants of species diversity, models explaining diversity gradient. b) Intertidal organisms and their zonation. 4.4 Effect of physical factors on marine life	15

	a) Light: photosynthesis, colouration, structural adaptations, bioluminescence . b) Temperature: tolerance, geographical distribution, size, calcium precipitation, metabolism, bipolarity, tropical submergence and periodicity c) Salinity: tolerance and distribution, size, buoyancy and osmoregulation. d) Currents: role in nutrition, transportation and propogation. e) Marine bacteria and their role.	

Textbooks

1. Svedrup et al., The Oceans.
2. Nair N.B. and Thampi D.H., Atextbook of marine ecology, T-M-H.
3. Harold Thurman, Introductory oceanography, Prentice Hall. London.
4. Qasim S.Z., Glimpses of Indian Ocean, Sangum Bodes Ltd. London. Navya Printers, Hyderabad.
5. Michael King, Fisheries Biology assessment and management, Fishing News Publishers, 1995.
6. R. Gordob Pirje, Oceanography.
7. Newell and Newell, Marine Plankton.
8. Jhingran, Fish and fisheries
9. P. Michal, Ecologival methods for field and laboratory investigations.
10. R.V. Tait, Marine zoology, Oxford press.
11. David Ross, Introduction to Oceanography.
12. Carl Schliper, Research method in marine biology.
13. B.F. Chapgar, Sea Shore life of India, SIDGWICK and JACKSON, London
14. D.V. Bal and K.V. Rao, Marine fisheries of India, T-M-H.
15. Russel and Young, The Seas
16. Kurian and Sebastian, Prawn and prawn fisheries of India.
17. M. Krishna Pillai. Introduction to Planktology, Himalaya Publishing
18. A.A. Fincham. Basic marine biology, British Museum Natural History.
19. Latha Shenoy. Course manual in fishing technology, CIFE, Versova, Mumbai.
20. Jefferey F. Raymond, Plankton and productivity, Vol. I and II.
21. J.S.Levington, Marine Biology, Function, biodiversity, ecology. Oxford University Press.
22. Wealth of India, Vol. IV, CSIR Publications.
23. S.P. Biswas, Manual of methods in fish biology, South Asian publishers private Ltd., New Delhi.
24. J.P. Rilcy and R, Chester, Introduction to marine chemistry, Academic Press, London and New Delhi.
25. American Public Health Association-2000.
26. J.V.R. Pillai, Aquaculture principles and plasia, Blackwell Scientific pub.
27. Das P. and Jhingran A.C.G., Fish genetics in India.
28. Colin E. Purdon, Genetics and Fish breeding, Chapman and Hall.
29. Schroder J.J., Genetics and Mutagenesis of fish, Chapman and Hall.
30. P. Bensam. Development of marine fishery sciences in India, Daya publishing House.

Course Code	Sem III Major Paper II	Credits	Lectures /Week
K24PSZOOMJ312	**Planktology, Fish, Fishery Science And Aquaculture-I**	4	4

Course Outcomes

After completion of this course learner will be able to

- Recall the classification and diversity and life cycles of planktonic, nektonic and benthic organisms.
- Explain ecological roles of plankton in aquatic ecosystems ,including their contributions to food webs and nutrient cycling
- Apply sampling techniques and utilize fishery modeling tools to assess environmental impacts
- Evaluate the impacts of environmental factors on availability of fish growth, reproduction and distribution.
- Develop aquaculture management plans that optimize production efficiency while minimizing environmental impacts.

Unit	Topic	Lectures
I	**Planktology** 1.1. Classification of Plankton. Adaptation to planktonic life. Factors influencing the distribution and abundance, plankton bloom, patchiness, vertical distribution and red tide. 1.2. Diurnal migration of zooplankton. Inter-relationship between phyto and zooplankton	15
II	**Fish And Fisheries Science** 2.1. An overview of fish classification as per Francis Day and FAO. 2.2. a) Major commercial fisheries: Elasmobranchs (shark and ray) Teleosts: Sciaenoids, Indian salmon, Seer fish, Mackerel, Sardine, Carangids, Tuna, Sole fish, Harpodon, Ribbon fish fisheries. b) Crustacean fisheries: Prawns (penaeid and non penaeid), Shrimps, Lobster and Crab. c) Molluscan fisheries	15
III	**Biotechnology In Fishery And Biometric Studies** 3.1. Fish stock improvement through selective hybridization. 3.2. Gene transfer technology in fish: General steps for developing transgenic fishes. Gene transfer by microinjection, electroporation, transfer of transgenes by injection with pantropic retroviral viruses, fish antifreeze protein gene, promoter in the	15

	production of growth hormone. Characterization of transgenic fish. (Identification of transgenic fish and expression of transgenes). Gene transfer in common carp and channel fish.	
IV	**Aquaculture** **4**.1. History, scope and importance of aquaculture. Aquaculture practices in India. Cultivable organisms for aquaculture and criterion for their selection. Culture, Running Water Aquaculture, Raft Culture,Aquaranching.. 4.2. Different systems of aquaculture such as Pond Culture, Cage Culture, Pen 4.3. Impact of aquaculture on environment	15
Textbooks 1.Newell and Newell, Marine Plankton. 2.Jhingran, Fish and fisheries 3.J.V.R. Pillai, Aquaculture principles and plasia, Blackwell Scientific pub. 4.. Das P. and Jhingran A.C.G., Fish genetics in India.		

Course Code	Sem III Major Practical	Credits	Lectures /Week
K24PSZOOMJP311	**Practicals based on General, Physical, Chemical and Biological Oceanography - I** **And** **Planktology, Fish, Fishery Science and Aquaculture-I**	2	2

Course Outcomes

After completion of this course learner will be able to

- Know the various parameters contributing towards physical chemical and biological factors of the ocean
- Recognize the relationships in between physical chemical and biological factors of the ocean
- Interpret the problems existing and the interdependence of various parameters in the survival of ocean biota
- Compare the collected data to assess species diversity, abundance, and distribution patterns in different marine habitats.
- Synthesize the experimental findings to propose hypotheses about the impacts of these processes on biological productivity.

Unit	Topic	Lectures
	1) Physical and chemical oceanography: (Uniform methods for all colleges to be followed) Determination of physico-chemical parameters: 1) Salinity (Argentometric and conductivity method) 2) Dissolved oxygen,	

	3) Carbon dioxide. 4) Nitrates-nitrites. 5) Silicates. 6) Phosphate-phosphorus. **2) Textural features:** Sediment analysis- size fraction (sand, silt, clay) **3) Identification of foraminiferans and radiolarians from sand.** **4) Estimation of primary productivity by light and dark bottle.** **5) Identification of intertidal organisms:** a) Rocky shore- Patella, Chiton, Fissurella, Mytilus species, *Perna viridis,* Cardium, Balanus, Gorgonids, Littorina and Corals. b) Sandy shore: Solen, Umbonium, Oliva, Pea crab, Fiddler crab, Molluscan shells, Star fish and Balanoglossus. c) Muddy shore: Lingula, Chaetopterus, Arenicola, Tubiculus worm and Mud skipper. PLANKTOLOGY, FISH, FISHERY SCIENCE AND AQUACULTURE **1)** Laboratory procedure for quantitative estimation of plankton settling method, wet weight method, weight displacement method, counting method. **2)** Identification of Zooplankton permanent slides (Noctiluca, Obelia medusa, Zoea, Zoea porcelina, Copepods, Mysids, Echinoderm larvae, Nauplius, Sagitta, Doliolum, Salpa, Fish eggs and larvae, Jelly fish, Physalia, Porpita) **3)** Study of fecundity-maturation studies. **4)** Plotting the frequency polygon by ova diameter measurement. **5)** Identification and classification of Marine fishes **List of Marine fishes** **Elasmobranchs** 1. Family- Carcharidae *Carcharias* sps. *Zygaena malleus* 2. Family- Rhinobatidae *Rhynchobatus djeddensis* 3. Family- Trygonidae *Trygon uarnak* **Teleost** 4. Family- Percidae *Lutianus johnii, Therapon* sps., *Pristipoma maculatum, Synagris japonicus,* *Gerres filamentosus* 5. Family- Squamipinnes *Scatophagus argus* 6. Family – Mullidae *Upenoides vittatus* 7. Family- Polynemidae	

	Polynemus tetradactylus 8. Family- Sciaenidae *Pseudosciaena diacanthus, Sciaena* sps. 9. Family- Trichuridae *Trichurus savala/ haumela* 10. Family- Carangidae *Caranx rottleri, Chorinemus toloo* 11. Family- Stromatidae *Pampus chinensis, Pampus argenteus* 12. Family- Scombridae *Rastrelliger kanagurta, Cybium guttatum* 13. Family- Trachinidae *Sillago sihama* 14. Family- Cottidae *Platycephalus punctatus* 15. Family- Gobidae *Periophthalmus* sps., *Boleophthalmus* sps. 16. Family- Sphyraenidae *Sphyraena acutippinis* 17. Family- Mugillidae *Mugil* sps. 18. Family- Gadidae *Bregmaceros* sps. 19. Family- Pleuronectidae *Psettodes erumei, Cynoglossus elongatus* 20. Family- Siluridae *Arius dussumieri* 21. Family- Scopelidae *Saurida tumbil, Harpodon nehereus* 22. Family- Sombresocidae *Belone stongylurus, Hemiramphus* sps. 23. Family- Clupeidae *Pellona feligera, Clupea longiceps* 24. Family- Chirocentridae *Chirocentrus dorab* 25. Family- Muraenesox *Muraenesox* sps. **Note: Minimum number of animals to be used for experiment**	

Textbooks

2. Nair N.B. and Thampi D.H., Atextbook of marine ecology, T-M-H.
3. Harold Thurman, Introductory oceanography, Prentice Hall. London.
4. Qasim S.Z., Glimpses of Indian Ocean, Sangum Bodes Ltd. London. Navya Printers, Hyderabad.
5. Michael King, Fisheries Biology assessment and management, Fishing News Publishers,
1995.
6. R. Gordob Pirje, Oceanography.
7. Newell and Newell, Marine Plankton.
8. Jhingran, Fish and fisheries

9. P. Michal, Ecologival methods for field and laboratory investigations.
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15. Russel and Young, The Seas
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29. Schroder J.J., Genetics and Mutagenesis of fish, Chapman and Hall.
30. P. Bensam. Development of marine fishery sciences in India, Daya publishing House.

N.B :

I) It is pertinent to note that we have to adhere strictly to the directions as given in the
UGC Circular F14-4/2006 (CPP-II).

II)Apart from the institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college
should constitute the following Committees :

1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
2) A Dissection Monitoring Committee (DMC)

Composition of DMC shall be as follows :

i) Head of the Concerned Department (Convener/Chairperson)
ii) Two Senior Faculty Members of the concerned Department
iii) One Faculty of related department from the same College
One or two members of related department from neighboring colleges

Practicals paper pattern

Course Code	Sem III Elective	Credits	Lectures /Week
K24PSZOOEL331	**Industrial fishery**	2	2

Course Outcomes

- Recognize and name commercially important fish species targeted by industrial fisheries, including both marine and freshwater species.
- Understand the principles and practices of fisheries management, including sustainable harvesting, stock assessment methods, and the precautionary approach.
- Apply fishery management tools such as quotas, size limits, gear restrictions, and closed seasons to achieve conservation and sustainability goals.
- Formulate adaptive management strategies for fisheries and inculcate entrepreneurship utilization of fishery wastes and their nutritional value

Unit	Topic	Lectures
I	**Packaging Methods for Fish Products and By-products** 1.1 Food packaging 1.1.1 Purposes of food packaging 1.1.2 Technological aspects of packaging of fishery products 1.1.3 Packing of fresh and frozen fish for consumers 1.1.4 Packaging for transport, shipping and institutional supplies 1.1.5 Packaging standards for domestic and international trade 1.2 Packaging materials 1.2.1 Basic films and laminates, their manufacture and identification 1.2.2 Resistance of packaging materials 1.2.3 Development of protective packaging for fishery products 1.3 Modified atmosphere packaging 1.3.1 Controlled packaging and aseptic packaging 1.3.2 Flexible packing, retort pouch processing of fish and fishery products principles and techniques 1.4 Labelling and printing of packaging materials. 1.4.1 Labeling requirements – national and international, legislation on labeling 1.4.2 Labeling for product traceability 1.4.3 Type of labeling for organic foods, specific foods like organic foods, GM foods, irradiated foods, vegetarian and non-vegetarian foods. Label design specification – size, colour 1.5 Biodegradable plastics, Edible packaging and Bio-composites 1.6 Environmental Concerns: Recycling and Disposal of Plastic waste 1.7 Paper and Paper-based materials, Corrugated Fiber Board box (CFB)	15
II	**Entrepreneurship and Marketing**	15

	2.1 Role of Government and other organizations in promoting entrepreneurship 2.1.1 Government schemes and incentives for Small and Medium enterprises (SMEs) 2.1.2 Small Scale Industries (SSIs), START Ups, Women entrepreneurs 2.2 Science and Technology in Entrepreneurship Development (STED project of NSTEDB), Agribusiness Incubation Centre (ICAR), National Fisheries Development Board (NFDB), National Bank for Agriculture and Rural Development (NABARD), Entrepreneurship Development Institute of India (EDII), National Co-operative Development Corporation (NCDC), Small Industry Development Organization (SIDO), National Institute for Entrepreneurship and Small Business Development (NIESBUD), National Alliance Young Entrepreneur (NAYE), Self Employed Women Association (SEWA), Self Help Groups (SHGs) 2.3 Fish Market 2.3.1 Structure, Functions and Types 2.3.2 Marketing channels & supply chains 2.3.3 Consumer behaviour 2.3.4 Marketing research 2.4 Fish markets & marketing in India: 2.4.1 Problems of fish marketing in India 2.4.2 Cold storage & other marketing infrastructure in India 2.4.3 Marketing organization and improvement 2.4.4 E-marketing 2.4.5 Role of Government and Co-operatives in fish marketing, Export and import of fish & fishery products, Role of MPEDA	

Textbooks

Adcock D, Bradfield R, Halborg A & Ross C. 1995. Marketing Principles and Practice. Pitman
Publ.

2. Ahvenainen, R. (Ed.) Novel Food Packaging Techniques, CRC Press, 2003.

3. Amarchand D &Varadharajan B. 1979. An Introduction to Marketing. Vikas Publ.

4. Athalye, A.S. (1992), Plastics in Packaging, Tata McGraw –Hill Publishing Co., New Delhi.

5. Bakker, M. (1986) The Wiley Encyclopedia of Packaging Technology, John Willey & Sons.
Inc; New York.

6. Balachandran KK. 2001. Post-Harvest Technology of Fish and Fish Products. Daya Publ.

7. Chaston I. 1983. Marketing in Fisheries and Aquaculture. Fishing News Books.

8. Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) Food Packaging Technology, CRC Press,

2003.
9. Dayanandan, R. - Entrepreneurship Development and Small Business Enterprises.
10. Dennis A, Brandfield R, Al Halhorg & Ross C. 2004. Marketing Principles and Practice.
Pitman Publ. Ian C. 1984. Marketing in Fisheries and Aquaculture. Fishing News Books.
11. Food Packaging Technology Handbook. NIIR Board, National Institute of Industrial Research, 2003.
12. Gopakumar K. (Ed.). 2002. Text Book of Fish Processing Technology. ICAR.
13. Govindan, T.K. Fish Processing Technology, Oxford-IBH, 1985.
14. Hall GM. (Ed.). 1992. Fish Processing Technology. Blackie.
15. Han, J.H. (Ed.) Innovations in Food Packaging, Elsevier Academic Press, 2005.
16. Jolson MA. 2004. Marketing Management. Macmillan Publ.
17. Khanka S. S. - Entrepreneurial development – S. Chand publication.
18. Kotler P & Armstrong GM. 2006. Marketing: An Introduction. Prentice Hall.
19. Kotler P. 2005. Marketing Management. Prentice Hall of India.
20. Mascarenhas Romeo S. – Entrepreneurship – Vipul Publication Mumbai
21. Nambudiri DD. 2006. Technology of Fishery Products. Fishing Chimes.
22. Paine FA and Paine HY, A Handbook of Food Packaging, Blackie Academic.
23. Phillip K & Armstrong G. 2007. Principles of Marketing. Prentice Hall.
24. Phillip K. 2008. Marketing Management. 12th Ed. Prentice Hall of India.
25. Prof. D. M. Sarwate (1996) Entrepreneurial Development Concept And Practices Paperback -
Everesty publishing house Professional, 1992.
26. Robertson GL, Food Packaging – Principles and Practice, CRC Press Taylor and Francis.
27. Robertson, G.L. (2006). Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis.
28. Rooney, M. L. (1995). Active Food Packaging, Blacki Academic & Professional, Glasgow, UK.
29. Sacharow, S. and Griffin, R.C. (1980) Principles of Foods Packaging, 2nd Ed., Avi, Publication Co. Westport, Connecticut, USA.
30. Sen DP. 2005. Advances in Fish Processing Technology. Allied Publ.
31. Vasant Desai - Small Scale Industries & Entrepreneurship.
32. Wheaton FW & Lawson TB. 1985. Processing Aquatic Food Products. John Wiley & Sons.
33. Windsor M & Barlow. 1981. Introduction to Fishery Byproducts. Fishing News (Books).http://ecoursesonline.iasri.res.in/mod/page/view.php?id=4458
34. Balachandran K.K. Post Harvest Technology of Fish and Fishery Products
35. Brody J. Fishery Byproduct Technology
36. Chicheste C.O. and Graham H.D. Microbial Safety of fishery Products
37. Amerien M.A. et.al. Principles of sensory evaluation of Food.

Course Code	SemIII Elective Practical	Credits	Lectures /Week
K24PSZOOEP331	Practical based on **Industrial fishery**	2	4

Course Outcomes

- Recognize and name commercially important fish species targeted by industrial fisheries, including both marine and freshwater species.
- Understand the principles and practices of fisheries management, including sustainable harvesting, stock assessment methods, and the precautionary approach.
- Apply fishery management tools such as quotas, size limits, gear restrictions, and closed seasons to achieve conservation and sustainability goals.
- Formulate adaptive management strategies for fisheries and inculcate entrepreneurship utilization of fishery wastes
- and their nutritional value

	Topic	Lectures
	Preparation of value added products: a) Fish/Prawn Pickle b) Fish Chakli and wafers c) Artificial products/crabs streaks d) Fish Kabab e) Fish cuttlet f) Fish fillets 2. Preparation of fish by-products: a) Fish Protein Concentrate b) Fish body oil c) Fish meal d) Chitosan e) Isinglass 3. Identification of packaging materials: a) Simple & Lacquered Cans b) Polyolefin Films c) Waxed Duplex cartons d) Retort Pouches e) Corrugated Fibre Board box 4. Fish market survey to study (any one): a) Fluctuations in the availability and price of fish b) Various preserved & processed fish / prawns c) The availability of various by products, value added products and its price d) Various packaging materials used in fish processing industries	

Course Code	Sem IV Major	Credits	Lectures /Week
K24PSZOOMJ411	**General, Physical, Chemical and Biological Oceanography -** -II	4	4

Course Outcomes

After completion of this course learner will be able to

- Observe and memorize different oceanographic phenomena
- Use oceanographic instruments to measure parameters of aquatic environment
- Collect data and interpret the results in terms of water quality and marine ecosystem health.
- Evaluate the causes and consequences of oceanographic-climatic phenomena
- Design oceanographic research projects addressing interdisciplinary questions.

Unit	Topic	Lectures
I	**General Oceanography** 1.1 Oceanographic instruments: Grab (Peterson and Van veen) for benthos collection, naturalist's dredge (Ekman Sanders deep sea anchor dredge), trawl, plankton nets and continuous plankton sampling system, Reversing Nansen bottles, Reversing thermometer, Salinometer, Secchi disc, Stempel's pipette and dilution jar, underwater photography, remote sensing and satellite imaging, SCUBA apparatus. 1.2 Oceanographic Expeditions: Challenger, Indian Ocean and Antarctic. 1.3 Law of sea**.**	15
II	**Physical Oceanography** 2.1 Vertical circulation: wind induced circulation, Thermohaline circulation and upwelling of water. 2.2 Waves: Characteristics of waves, deep water and shallow water waves, transitional waves, wind generated waves, internal waves and Tsunami 2.3 Tides: Tides generating forces, equilibrium theory of tides, dynamic theory of tides, tides as a source of power. 2.4 Currents: Types of currents, major currents of the world, Coriolis effect and El Nino effect.	15
III	**Chemical Oceanography** 3.1 Impact of anthropogenic activities**:** A) a) Pollution- Domestic sewage, industrial/heavy metals. Agricultural- fertilizers and pesticides.	15

	b) Oil pollution. c) Ocean dumping. d) Radioactive and Thermal waste. B) Reclamation.	
IV	**Biological Oceanography** 4.1 Resources from the sea: A) Mineral resources: a) Continental margin. b) Deep sea mud oozes and manganese nodules. c) Oil, gas and sulphur deposits and role of ONGC. B) Bioactive compounds from the sea. C) Scientific and economical aspect of seabed exploration and mining.	15

Textbooks

1. Svedrup et al., The Oceans.
2. Nair N.B. and Thampi D.H., Atextbook of marine ecology, T-M-H.
3. Harold Thurman, Introductory oceanography, Prentice Hall. London.
4. Qasim S.Z., Glimpses of Indian Ocean, Sangum Bodes Ltd. London. Navya Printers, Hyderabad.
5. Michael King, Fisheries Biology assessment and management, Fishing News Publishers,
1995.
6. R. Gordob Pirje, Oceanography.
7. Newell and Newell, Marine Plankton.
8. Jhingran, Fish and fisheries
9. P. Michal, Ecologival methods for field and laboratory investigations.
10. R.V. Tait, Marine zoology, Oxford press.
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13. B.F. Chapgar, Sea Shore life of India, SIDGWICK and JACKSON, London
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15. Russel and Young, The Seas
16. Kurian and Sebastian, Prawn and prawn fisheries of India.
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27. Das P. and Jhingran A.C.G., Fish genetics in India.
28. Colin E. Purdon, Genetics and Fish breeding, Chapman and Hall.

29. Schroder J.J., Genetics and Mutagenesis of fish, Chapman and Hall.
30. P. Bensam. Development of marine fishery sciences in India, Daya publishing House.

Course Code	Sem Major	Credits	Lectures /Week
K24PSZOOMJ412	**Planktology, Fish, Fishery Science and Aquaculture** -II	4	4

Course Outcomes

After completion of this course student will be able to

- Recall the classification and diversity and life cycles of planktonic, nektonic and benthic organisms
- Summarize the principles and practices of sustainable aquaculture.
- Implement aquaculture techniques for the cultivation of fish and shellfish species and apply sampling techniques to collect and analyze plankton samples.
- Evaluate the impacts of fishing practices on fish stocks and ecosystem and Assess the economic feasibility and environmental sustainability of aquaculture operations.
- Create sustainable aquaculture models tailored to specific species and environmental conditions.

Unit	Topic	Lectures
I	**Planktology** 1.1. Marine algae and plankton in relation to fisheries. Indicator species 1.2. Methods of collection, preservation and analysis of plankton. 1.3. Marine Bio-deterioration: Fouling and Boring organisms.	15
II	**Fish And Fisheries Science** 2.1. Population Dynamics Abundance in population and fishery. Fishery catches and fluctuation. M.S.Y., Optimum Yield, Age Composition, Population Growth, Population Models. 2.2. Socio-economics of fishermen.	15
III	**Biotechnology In Fishery And Biometric Studies** 3.1. Statistical methods: Collection of data, Sampling methods, Presentation data, Measurement of central tendancy and dispersion, Frequency distribution, Analysis of variance and co-variance, Correlation regression, Theory of probability, Tests of significance, Chi-square test. 3.2. Measurement of fish:	15

	a) Measurement of length and weight b) Morphometric measurements c) Merestic counts d) Biometric index	
IV	**Aquaculture** 4.1. Hatchery and grow out practices for cultivable species of freshwater fishes (Indian major carps and exotic carps) and prawns (*Macrobrachium rosenbergii*), Culture of Air breathing fishes. 4.2. Integrated aquaculture and sewage fed fishery Hatchery and growout practices for the culture of brackish water fishes (*Chanos chanos* and *Lates calcarifer*), Prawns (*Penaeus monodon* and *Penaeus indicus*). 4.3. Present status of sea farming in India Culture of molluscs, clams, oyster (edible and pearl) and Mussels, Echinoderms (sea cucumber), sea weeds.	15

Textbooks

1. Svedrup et al., The Oceans.
2. Nair N.B. and Thampi D.H., Atextbook of marine ecology, T-M-H.
3. Harold Thurman, Introductory oceanography, Prentice Hall. London.
4. Qasim S.Z., Glimpses of Indian Ocean, Sangum Bodes Ltd. London. Navya Printers, Hyderabad.
5. Michael King, Fisheries Biology assessment and management, Fishing News Publishers,
1995.
6. R. Gordob Pirje, Oceanography.
7. Newell and Newell, Marine Plankton.
8. Jhingran, Fish and fisheries
9. P. Michal, Ecologival methods for field and laboratory investigations.
10. R.V. Tait, Marine zoology, Oxford press.
11. David Ross, Introduction to Oceanography.
12. Carl Schliper, Research method in marine biology.
13. B.F. Chapgar, Sea Shore life of India, SIDGWICK and JACKSON, London
14. D.V. Bal and K.V. Rao, Marine fisheries of India, T-M-H.
15. Russel and Young, The Seas
16. Kurian and Sebastian, Prawn and prawn fisheries of India.
17. M. Krishna Pillai. Introduction to Planktology, Himalaya Publishing
18. A.A. Fincham. Basic marine biology, British Museum Natural History.
19. Latha Shenoy. Course manual in fishing technology, CIFE, Versova, Mumbai.
20. Jefferey F. Raymond, Plankton and productivity, Vol. I and II.
21. J.S.Levington, Marine Biology, Function, biodiversity, ecology. Oxford University Press.
22. Wealth of India, Vol. IV, CSIR Publications.
23. S.P. Biswas, Manual of methods in fish biology, South Asian publishers private Ltd., New Delhi.

24. J.P. Rilcy and R, Chester, Introduction to marine chemistry, Academic Press, London and
New Delhi.
25. American Public Health Association-2000.
26. J.V.R. Pillai, Aquaculture principles and plasia, Blackwell Scientific pub.
27. Das P. and Jhingran A.C.G., Fish genetics in India.
28. Colin E. Purdon, Genetics and Fish breeding, Chapman and Hall.
29. Schroder J.J., Genetics and Mutagenesis of fish, Chapman and Hall.
30. P. Bensam. Development of marine fishery sciences in India, Daya publishing House

Course Code	Sem Major	Credits	Lectures /Week
K24PSZOOMJP411	**Practicals based on General, Physical, Chemical and Biological Oceanography** --II and **Planktology, Fish, Fishery Science and Aquaculture** -II	2	4

Course Outcomes

After completion of this course learner will be able to

- Identify major oceanographic features, planktonic organisms, fish species, and aquaculture practices.
- Interpret data related to oceanographic phenomena, plankton dynamics, fishery stocks, and aquaculture production.
- Utilize sampling techniques to collect and analyze plankton and fishery data and Implement fishery management strategies and aquaculture techniques to address environmental challenges and ensure sustainable resource use.
- Analyze data sets to identify trends and patterns in oceanographic phenomena, plankton communities, fish stocks, and aquaculture production
- Design research projects integrating concepts from oceanography, planktology, fishery science, and aquaculture to address interdisciplinary questions.

Unit	Topic	Lectures
	GENERAL, PHYSICAL, CHEMICAL AND BIOLOGICAL-2 1) Oceanographic instruments: a) Nansen reversing bottle. b) Deep sea reversing thermometer. c) Bathythermometer. d) Drift bottle. e) Ekman's current meter. f) Secchi disc. g) Plankton nets: Standard net, Hensen net and Clarke Bumpus net. h) Stemple pipette and counting slide. i) Nekton sampling device-trawls. j) Benthic sampling devices-dredges, grabs and corers. 2) Detection of heavy metals: a) Zinc b) Lead	

	c) Copper. 3) Food and feeding in fish. 4) Identification of crafts and gears. **OCEANOGRAPHY PLANKTOLOGY, FISH, FISHERY SCIENCE AND AQUACULTURE-2** 1) Preparation of Zooplankton mountings. 2) Biometric studies of fish/ prawn A. Study of relationship between total length and standard length/head length/body depth length/body weight. B. Calculate correlation (standard length and total length, head length and total length, body depth and total length). Calculate the index values for various relationships. 4) Identification of fouling and boring organisms (*Limnoria* sps., *Lepas, Balanus, Caprella, Teredo, Littorina, Crassostrea, Pellaria/* *Sertularia*). 5) Identification and classification of fresh water fishes, Crustacean fishery, Molluscan fishery (Rohu, Catla, Mrigal, Tilapia, Gourami) and fresh water giant prawn (*Macrobrachium* *rosenbergii*). (*Penaeus monodon, P. indicus, M. monoceros, P. stylifera, Solenocera indica,* *Nematopaleomon, Acetes indicus*).(*Meretrix, Perna viridis, Katelysia sps., Crassostria sps., Xancus pyrum, Solen kempi, Cuttle fish* and gastropods). 6) Visit to aquaculture centres, boat building yards, processing plants and marine biological institutions (Excursions or study tours)	

Textbooks

1. Svedrup et al., The Oceans.
2. Nair N.B. and Thampi D.H., Atextbook of marine ecology, T-M-H.
3. Harold Thurman, Introductory oceanography, Prentice Hall. London.
4. Qasim S.Z., Glimpses of Indian Ocean, Sangum Bodes Ltd. London. Navya Printers, Hyderabad.
5. Michael King, Fisheries Biology assessment and management, Fishing News Publishers,
1995.
6. R. Gordob Pirje, Oceanography.
7. Newell and Newell, Marine Plankton.
8. Jhingran, Fish and fisheries
9. P. Michal, Ecologival methods for field and laboratory investigations.
10. R.V. Tait, Marine zoology, Oxford press.
11. David Ross, Introduction to Oceanography.
12. Carl Schliper, Research method in marine biology.
13. B.F. Chapgar, Sea Shore life of India, SIDGWICK and JACKSON, London

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17. M. Krishna Pillai. Introduction to Planktology, Himalaya Publishing
18. A.A. Fincham. Basic marine biology, British Museum Natural History.
19. Latha Shenoy. Course manual in fishing technology, CIFE, Versova, Mumbai.
20. Jefferey F. Raymond, Plankton and productivity, Vol. I and II.
21. J.S.Levington, Marine Biology, Function, biodiversity, ecology. Oxford University Press.
22. Wealth of India, Vol. IV, CSIR Publications.
23. S.P. Biswas, Manual of methods in fish biology, South Asian publishers private Ltd., New Delhi.
24. J.P. Rilcy and R, Chester, Introduction to marine chemistry, Academic Press, London and
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25. American Public Health Association-2000.
26. J.V.R. Pillai, Aquaculture principles and plasia, Blackwell Scientific pub.
27. Das P. and Jhingran A.C.G., Fish genetics in India.
28. Colin E. Purdon, Genetics and Fish breeding, Chapman and Hall.
29. Schroder J.J., Genetics and Mutagenesis of fish, Chapman and Hall.
30. P. Bensam. Development of marine fishery sciences in India, Daya publishing House

Course Code	SemIV Elective	Credits	Lectures /Week
K24PSZOOEL431	**Fish Processing Technology- Traditional and Modern fish processing**	2	2

Course Outcomes

After the completion of this course learner will be able to

- Identify various types of fish processing equipment and their functions.
- Explain the principles behind common fish processing methods and interpret quality attributes of fish products and understand factors affecting product quality during processing.
- Utilize equipment and tools for handling, filleting, and packaging fish products safely and efficiently and implement quality control measures to ensure compliance with regulatory standards and consumer expectations.
- Analyze the impact of processing methods on the nutritional value, texture, flavor, and shelf life of fish products and evaluate the efficiency and cost-effectiveness of different processing technologies in a commercial setting
- Design fish processing workflows optimized for maximum efficiency and product quality and develop new fish product formulations or processing techniques to meet market demands or address specific challenges

Unit	Topic	Lectures
I	**Traditional and Modern fish processing -1** 1.1 Indigenous methods of preservation 1.2 Simple Vapour Compression System (Refrigerator): 1.2.1 Ideal refrigerant,	15

	1.2.2 Types of refrigerants 1.3 Types of freezers, freezing of fin fishes and shell fishes 1.4 Accessory industry for canning, canning of fin fishes, shell fishes and cephalopods 1.5 Additives in fish processing 1.6 Major equipment used in fish processing industry and its maintenance	
II	**Traditional and Modern fish processing -2** 2.1 Surimi technology and surimi based analogue products (only technology aspect) 2.2 Thermal processing of fishery products ,Non-thermal processing of fishery products High pressure processing Vacuum cooling 2.3 Irradiation	15

Textbooks

Industrial Fishery by Dr. Ayub Mheboob Shaikh, Lulu Publication, Raleigh, NC 27607, USA.

Printed by Laxmi Book Publication, Solapur.

2. Fish handling & processing by Aitikin A. Published by Ministry of agriculture, fisheries & food,

Torry Research Station, Edinburgh, H.M.S.O., 1982; National govt. publ; 2nd ed.

3. Fish as food by Borgstorm G; Academic press, New York and London; 1965; eBook ISBN

9780323146869.

4. Advances in fish science & technology by Connell J. J; 1980; Fishing news books ltd, Farnham, Surrey, England.

5. Assessment of fish quality by Neha Charan; 2014; Randon publ.

6. Introduction to Fishery By-products by Windsor M. & Barlow; 1981; Fishing News (Books).

7. Post-harvest technology of fish and fish products by Balachandran K.K; 2001; Daya Publ;

Delhi; India.

(https://trove.nla.gov.au/work/33236887?q&versionId=40720970).

8. Advances in Fish Processing Technology by Sen D.P; 2005; Allied Publ.

(https://books.google.co.in/books/about/Advances_in_Fish_Processing_Technology.html?id=j1cRBAAAQBAJ&redir_esc=y)

9. Processing Aquatic Food Products by Wheaton F.W. & Lawson T.B; 1985; John Wiley & Sons.

(http://atlanticventures.net/processing-aquatic-food-products-by-f-w-wheaton- and-t-b-lawsonhardcover/)

10.

https://books.google.co.in/books?id=wptXJ7gmMo0C&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

11. https://books.google.co.in/books?id=-ioIGmVPvZwC&dq=Books%20on%20Hygienic%20handling%20and%20transportation%20of%20fish%20catch&source=gbs_similarbooks

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%20radio%20frequency%20technology%20in%20fishery%20 biology&f=false
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21. http://www.fao.org/3/X5624E/x5624e08.htm#5.1%20definition%20of%20q.a.

Course Code	Sem IV Elective Practical	Credits	Lectures /Week
K24PSZOOEP431	**Practical based on Fish Processing Technology**	2	2

Course Outcomes

After the completion of this course learner will be able to

- Identify various types of fish processing equipment and their functions.
- Explain the principles behind common fish processing methods and interpret quality attributes of fish products and understand factors affecting product quality during processing.
- Utilize equipment and tools for handling, filleting, and packaging fish products safely and efficiently and implement quality control measures to ensure compliance with regulatory standards and consumer expectations.
- Analyze the impact of processing methods on the nutritional value, texture, flavor, and shelf life of fish products and evaluate the efficiency and cost-effectiveness of different processing technologies in a commercial setting
- Design fish processing workflows optimized for maximum efficiency and product quality and develop new fish product formulations or processing techniques to meet market demands or address specific challenges.

Unit	Topic	Lectures
	Fish Processing Technology 1. Organoleptic tests freshness of fish and fishery products. 2. Dressing (Beheading, Peeling and Deveining) and grading of shrimps. 3. Fish dressing and filleting. 4. Estimation of moisture content in fish and shrimp muscle. 5. Sketching of layout of ice factory, cold storage, freezing and canning industry. 6. Identification of various equipment (Photographs) a) Thermal processing b) Pulsed light technology c) Infra-red (IR) and Radio frequency (RF) processing d) Ohmic or Joule heating e) High pressure processing f) Vacuum cooling g) Irradiation 7. Preparation of proposal for fish processing industry. 8. Visit to fish processing industry, fish landing centres, cold storages and ice plants.	

Textbooks

1.Industrial Fishery by Dr. Ayub Mheboob Shaikh, Lulu Publication, Raleigh, NC 27607, USA.
Printed by Laxmi Book Publication, Solapur.

2. Fish handling & processing by Aitikin A. Published by Ministry of agriculture, fisheries & food,
Torry Research Station, Edinburgh, H.M.S.O., 1982; National govt. publ; 2nd ed.
3. Fish as food by Borgstorm G; Academic press, New York and London; 1965; eBook ISBN
9780323146869.
4. Advances in fish science & technology by Connell J. J; 1980; Fishing news books ltd, Farnham, Surrey, England.
5. Assessment of fish quality by Neha Charan; 2014; Randon publ.
6. Introduction to Fishery By-products by Windsor M. & Barlow; 1981; Fishing News (Books).
7. Post-harvest technology of fish and fish products by Balachandran K.K; 2001; Daya Publ;
Delhi; India.
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8. Advances in Fish Processing Technology by Sen D.P; 2005; Allied Publ.
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9. Processing Aquatic Food Products by Wheaton F.W. & Lawson T.B; 1985; John Wiley & Sons.
(http://atlanticventures.net/processing-aquatic-food-products-by-f-w-wheaton- and-t-b-lawsonhardcover/)
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https://books.google.co.in/books?id=wptXJ7gmMo0C&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
11. https://books.google.co.in/books?id=-ioIGmVPvZwC&dq=Books%20on%20Hygienic%20handling%20and%20transportation%20of%20fish%20catch&source=gbs_similarbooks
12.
https://books.google.co.in/books?id=UPjSBwAAQBAJ&printsec=frontcover&dq=Books+on+Temperature+modelling+and+relationships+in+fish+transportation.&hl=en&sa=X&ved=0ahUKEwiLxIydo5XnAhVs7HMBHVuQC_UQ6wEILDAA#v=onepage&q=Books%20on%
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Fqs9Ej5IV1YBEb29p34#v=onepage&q=Temperature%20modelling%2
0and%20relationships%20in%20fish%20transportation.&f=false
14.
https://books.google.co.in/books?id=W9XFDwAAQBAJ&pg=PA90&dq=Books+on+layout+of+cold+storage&hl=en&sa=X&ved=0ahUKEwim2YEpZXnAhVM7XMBHadjALEQ6wEILDAA#
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https://books.google.co.in/books?id=C4IHywAACAAJ&dq=Books+on+layout+of+canning+indus
try&hl=en&sa=X&ved=0ahUKEwj5neylppXnAhUJILcAHbY1Ad8Q6wEILDAA
16.
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ng&hl=en&sa=X&ved=0ahUKEwii2cmzp5XnAhUK7nMBHeqqDaMQ6wEIaDA H
17.
https://books.google.co.in/books?id=VqFUjwEACAAJ&dq=Books+on+pulsed+light+tech nology
&hl=en&sa=X&ved=0ahUKEwjf3bX6p5XnAhW0juYKHYwUAu8Q6wEILDAA
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https://books.google.co.in/books?id=ejwvWAFGCREC&printsec=frontcover&dq=Books+ on+irra
diation&hl=en&sa=X&ved=0ahUKEwi2kLa5qJXnAhWM6XMBHRMwDvoQ6
wEIRDAD#v=onepage&q=Books%20on%20irradiation&f=false
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https://books.google.co.in/books?id=O7OtDwAAQBAJ&printsec=frontcover&dq=Books+ on+infr
a+red+and+radio+frequency+technology+in+fishery+biology&hl=en&sa=X&ved=0ahUKE wjelr
CiqZXnAhXJ63MBHd6ABzcQ6wEILjAA#v=onepage&q=Books%20on%20infra%20red%2 0and
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20. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4190208/
21. http://www.fao.org/3/X5624E/x5624e08.htm#5.1%20definition%20of%20q.a.

Evaluation Scheme for First Year (PG) under NEP (22 credits)

I. Internal Evaluation for Theory Courses – 40 Marks

1) Continuous Internal Assessment(CIA) Assignment –

Project – 40 marks

II. External Examination for Theory Courses – 60 Marks

Duration: 2 Hours

Theory question paper pattern:

Evaluation Scheme for Second Year (PG) under NEP (22 credits)

I. Internal Evaluation for Theory Courses – 40 Marks

1) Continuous Internal Assessment(CIA) Assignment –

Project – 40 marks

II. External Examination for Theory Courses – 60 Marks

Duration: 2 Hours

Theory question paper pattern:

Question	Based on	Marks
Q.1	Unit I	15
Q.2	Unit II	15
Q.3	Unit III	15
Q.4	Unit IV	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.
- RM carries 100 Marks

III. Practical Examination

- Each core subject carries 20+30 Marks
- Internal Practical-20 Marks and external 30 Marks
- Duration: 2 hours for Internal Practical and 3 Hours for external
- Minimum 80% practical from each core subjects are required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam

NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examination