



The Kelkar Education Trust's
Vinayak Ganesh Vaze College of Arts, Science & Commerce
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Mithaghar Road, Mulund East, Mumbai-400081, India
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Syllabus for M. Sc. Part-II Programme:
Zoology (Specialization: Oceanography)

Syllabus as per Choice Based Credit System (NEP-2020)

(June 2024 Onwards)

Submitted by

Department of Zoology

Vinayak Ganesh Vaze College of Arts, Science and Commerce

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The Kelkar Education Trust's
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❖ Syllabus as per Choice Based Credit System (NEP 2020)

Syllabus for Approval

Zoology (Specialization: Oceanography)

Sr. No.	Heading	Particulars
1	Title of Programme	M.Sc. Zoology :Semester III and IV
2	Eligibility for Admission	The B.Sc. degree examination of this university with Zoology 6 units or degree of anyother university recognized as equivalent thereto.
3	Passing marks	Minimum D Grade or equivalent minimum marks for passing at the Graduation level.
4	Ordinances/Regulations (if any)	---
5	No. of Years/Semesters	One year/Two semester
6	Level	P.G. part-II : Level- 6.5
7	Pattern	Semester
8	Status	Revised
9	To be implemented from Academic year	2024-2025

Date:.....

Signature:

BOS Chairperson: Dr. Vinod R. Ragade

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Post Graduate Program in Zoology (Specialization: Oceanography)

Year (2 Yr PG)	Level	Sem. (2 Yr)	Major		RM	OJT / FP	RP	Cum. Cr.	Degree	
			Mandatory*	Electives Anyone						
2	6.5	Sem-III	For Oceanography Specialization		--	--	04	22	PG Degree After 3-Yr UG Or PG Degree after 4-Yr UG	
			Credits 14 (4+4+4+2)							Credits 4 (2+2)
		Course 1 Credits 4 : Oceanography Course 2 Credits 4 : Aquaculture Methods and Practices Course 3 Credits 4 : Fish Processing Technology Course 4 Credits 2: Practical based on Oceanography, Aquaculture Methods and Practices and Fish Processing Technology		Course 1: Fin Fish and Shell Fish Biology Practical based on Fin Fish and Shell Fish Biology OR Course 2: Marine Biotechnology Practical based on Marine Biotechnology						
		Sem-IV	For Oceanography Specialization							
			Credits 12 (4+4+4)		Credits 4 (2+2)			22		
			Course 1 Credits 4: Capture Fisheries Course 2 Credits 4: Brackish and Marine Water Aquaculture Course 3 Credits 4: Industrial Fishery Course		Course 1: Dissertation Practical based on Dissertation OR Course 2: Marine Toxicology Practical based on Marine Toxicology		--	--	06	
Cum. Cr. for 1 Year PG Degree			26		8		-	-	10	44
Cum. Cr. for 2 Year PG Degree			54		16		4	4	10	88
2 Years - 4 Sem. PG Degree (80-88) credits after 3 Years UG Degree OR 1 Years - 2 Sem. PG Degree (40-44) credits after 4 Years UG Degree										

Proposed Draft Syllabus for M.Sc. Zoology Semester III and IV

(Specialization: Oceanography)

Choice Based Credit System (NEP 2020)

(To be implemented from the academic year, 2024-2025)

Semester – III

Paper I

Course Code: VGVPSMOC301

Credits: 4

OCEANOGRAPHY

Course Objectives

1. To familiarize learners to the background of Oceanography and the recent developments in the Oceanography.
2. To understand basic concepts and instrumentation in Oceanography.
3. To familiarize learners to the physical processes of Oceans and the Ocean-atmospheric interactions.
4. To familiarize learners to the chemical properties of the seawater and basics of Chemical Oceanography.

COURSE CONTENT

Unit No.	Content	Lectures
	Course Code: VGVPSMOC301 Paper I: OCEANOGRAPHY	
Unit 1	General Oceanography	15
	I. Oceanographic History, Oceanographic Expeditions: Challenger, Indian Ocean and Antarctic II. Oceanic climatology: ENSO, Impact of climate change on marine life III. Typical oceanographic research Vessel, its equipment and Oceanographic laboratories IV. * Satellite oceanography: Remote sensing satellites and their applications V. Ocean bottom features a. Continental shelf b. Continental slope c. Submarine canyons d. Submarine mountain ranges e. Sea mounds and Guyots f. Oceanic ridges and rises g. Oceanic trenches h. Abyssal floor VI. Oceanographic Instruments a. Grabs (Peterson and Van veen) for benthos collection b. Naturalist's dredge c. Trawl – Beam trawl, Otter trawl d. Plankton nets and Continuous plankton samplingsystem	

	<ul style="list-style-type: none"> e. Niskin Water Sampler f. CTD instrument / meter g. Stempel's pipette and dilution jar h. Underwater photography i. SCUBA apparatus j. Secchi disk. 	
	VII. Current Advances in Oceanography	
Unit 2	Physical Oceanography	15 H
	<p>I. *Sea water</p> <ul style="list-style-type: none"> i. Physical properties of Sea Water – Distribution of Temperature, Salinity, Density ii. Acoustical and Optical characteristics of Sea water <p>II. Waves and Tides</p> <ul style="list-style-type: none"> i. General aspects of Ocean waves, Waves Characteristics, Sea and swell, Deep and Shallow water waves, Storm surges and Tsunamis ii. Tides and tide generating forces, their causes, variation and types, Tidal currents <p>III. Ocean Circulation</p> <ul style="list-style-type: none"> i. Ekman spiral, Geostrophic current, Westward intensification with dynamic topography ii. Wind induced circulation, Thermohaline circulation and upwelling of water iii. *Types of currents, major currents of the world, Coriolis effect 	
Unit 3	Chemical Oceanography	15 H
	<ul style="list-style-type: none"> I. *Major and minor elements in seawater II. Chlorinity and Salinity: Definition and significance, practical salinity scale III. *Radioactive nuclides in the sea IV. Micronutrients and their role in marine environment (Phosphorus, Nitrogen, Silicon) V. *Dissolved gases (other than CO₂) in seawater – Basic concepts: solubility of gases in seawater and Oxygen Minimum Zone (OMZ) in Arabian Sea VI. Air – sea gas exchange, processes affecting their distribution VII. Dissolved gases (CO₂) in seawater <ul style="list-style-type: none"> a. Carbon dioxide equilibria in seawater b. pH, alkalinity and buffering capacity of oceans c. Components of CO₂ system in seawater d. Percentage composition of inorganic carbon e. Calcium carbonate precipitation and dissolution phenomena f. Lysocline and carbonate compensation depth VIII. Mineral resources from the sea <ul style="list-style-type: none"> a. Sea mud oozes and manganese nodules b. Oil, gas and sulphur deposits 	
Unit 4	Biological Oceanography	15 H
	<p>I. Division of marine environment</p> <ul style="list-style-type: none"> i. Intertidal organisms and their zonation ii. Marine biotic diversity - a) Plankton b) Nekton c) Benthos iii. Indices of species richness, measuring diversity, models explaining diversity gradient 	

	<p>iv. Benthic communities - a) Kelp forests b) Estuaries c) Formation and Growth of Coral Reefs d) Ecological Features of Mangrove Swamps</p> <p>II. Deep Sea Ecology</p> <p>i. Faunal composition, Species diversity, Food sources, Rates of Biological Processes, Whale Fall Ecosystem</p> <p>ii. Hydrothermal Vents and Cold seeps - a)Chemosynthetic production b) Vent Fauna c) Shallow Vents and Cold seeps d) Unique Environmental Features of Sulphide communities</p> <p>III. Human impact on marine Biota</p> <p>i. Fisheries impact</p> <p>ii. *Marine Pollutants – a) Petroleum Hydrocarbons b) Plastics c) Heavy Metals d) Sewage e) RadioactiveWaste f) Thermal Effluents g) Noise</p> <p>iii. *Impact on marine environments – a) Estuaries b) Mangrove Swamps c) Coral Reefs</p>	
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Semester III: Oceanography - Paper 1 Course Code: VGVPSMOC301	
(Internal Assessment Pattern)	
Marks: 40	
1. Class Test	15 marks
2 Presentation: (Based on Theory Unit 1,2,3 and 4)	15 marks
3 Class Participation and Overall conduct	10 Marks

Semester III: Oceanography- Paper 1 Course Code: VGVPSMOC301	
(Theory Paper Pattern)	
Duration: 2.5 hrs	Marks: 60
Q.1.A. Answer the following (Any one): Unit 1 A) OR A)	06 Marks
Q.1. B) Attempt any two of the following: Unit 1 a) b) c)	06 Marks
Q.2.A. Answer the following: (Any one) Unit 2 A) OR A)	06 Marks
Q.2. B) Attempt any two of the following: Unit 2 a) b) c)	06 Marks
Q.3.A. Answer the following: (Any one) Unit 3 A) OR A)	06 Marks

Q.3. B) Attempt any two of the following: Unit 3 a) b) c)	06 Marks
Q.4.A. Answer the following: (Any one) Unit 4 A) OR A)	06 Marks
Q.4. B) Attempt any two of the following: Unit 4 a) b) c)	06 Marks
Q.5. Write a note on (All questions are compulsory) a) Unit 1 b) Unit 2 c) Unit 3 d) Unit 4	12 Marks

Course Outcome: Oceanography (Paper 1)

Course Code: VGVPSMOC301

After the completion of the course, students will able to

CO1 The learner will be able to understand the history of Oceanography and its current status.

CO2 The learner will be aware of various oceanographic sampling techniques.

CO3 The learner will be able to understand the life under the sea and their interactions with marine environment.

CO4 The learner will be aware of the chemical properties of the sea water and their significance.

References

1. Dietrich, G., Kalle, K., Krauß, W., & Siedler, G. (1980). General Oceanography. Wiley.
2. Schlee, S. (1975). A history of oceanography: the edge of an unfamiliar world. Hale.
3. Gross, M. G. (1977). Oceanography: a view of the earth. Prentice-Hall publisher.
4. Siddhartha, K. (2001). Oceanography: A Brief Introduction. Kisalaya Publications.
5. Basu, S. K. (Ed.). (2003). Hand Book of Oceanography (Vol. 1). Global Vision Pub House.
6. Pinet, P. R. (2019). Invitation to oceanography. Jones & Bartlett Learning
7. Lalli, C., & Parsons, T. R. (1997). Biological oceanography: an introduction. Elsevier
8. Sverdrup, H. U., Johnson, M. W., & Fleming, R. H. (1942). The Oceans: Their physics, Chemistry, and general biology (Vol. 7). New York: Prentice-Hall.
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10. Thurman, H. V., & Burton, E. A. (1997). Introductory oceanography. New York: PrenticeHall
11. Qasim, S. Z. (1998). Glimpses of the Indian Ocean. Universities Press.
12. Pirie, R. G. (1973). Oceanography: contemporary readings in ocean sciences. Oxford University Press Inc.
13. Newell, G. E., & Newell, R. C. (1963). Marine plankton: a practical guide (No. 592 NEW).
14. Michael, P. (1984). Ecological methods for field and laboratory investigations. TataMcGraw-Hill
15. Tait, R.V. and DeSanto (1972). Elements of Marine Ecology: An Introductory Course Springer Veelag.
16. David Ross (1977) Introduction to Oceanography. Prentice-Hall
17. Schlieper, C. (1972). Research methods in marine biology.
18. Tait R.V. (2013). Elements of Marine Ecology: An Introductory Course. Elsevier.

19. Chhapgar, B. F. (1991). Seashore life of India (Vol. 3). Oxford University Press.
20. Pillai N. Krishna (1986). Introduction to Planktology. Himalaya Publication house Bombay.
21. Fincham A. A. (1984). Basic marine biology. Cambridge University Press.
22. Raymont J. E. G. (1980). Plankton & Productivity in the Oceans: Volume 1:
23. Phytoplankton 2nd Edition. Pergamon.
24. Levinton, J. S., & Levinton, J. S. (1995). Marine biology: function, biodiversity, ecology (Vol. 420). New York: Oxford University Press.
25. Riley J.P. and R, Chester R. (2016). Chemical Oceanography, 2nd edition. Academic Press.

Semester – III

Paper II

Course Code: VGVPSMOC302

Credits: 4

AQUACULTURE METHODS AND PRACTICES

Course Objectives

- a) To impart essential knowledge and skills regarding advanced technologies of different aquaculture production systems.
2. To gain knowledge regarding setting of fresh water aquarium, behavioural pattern, feeding habits, live food organisms and supplementary diet for ornamental fishes.
3. To aware the learners for identification of sexual dimorphism in Major carps and their maturity and spawning.
4. To aware the learners about the life history and hatchery of Giant Fresh Water Prawn.

COURSE CONTENT

Unit No.	Content	Lectures
	Course Code: VGVPSMOC302 Paper II: AQUACULTURE METHODS AND PRACTICES	
Unit 1	Principles of Aquaculture	15 H
	<p>b) Basics of Aquaculture – Definition and Scope</p> <p>II. Systems of Aquaculture:</p> <ol style="list-style-type: none"> a. Pond culture b. Pen culture c. Cage culture d. Rope culture e. Running water culture f. Zero water exchange system g. Re –circulatory aquaculture system (RAS) h. Biofloc <p>III.*Physical, chemical and biological factors affecting productivity of ponds</p> <p>IV. Criteria for selection of candidate species for Aquaculture Major fin fish candidate species for fresh water aquaculture such as a) Indian major carps – Rohu, Catla, Mrigal b) Exotic carps – Grass carp, Common carp, Silver carp c) Catfishes – Basa, Magur</p> <p>V.*Monoculture, polyculture, composite culture and integrated culture systems</p>	

	VI. Rearing Practices and its feasibility/economics a. Traditional b. Extensive c. Semi intensive d. Intensive methods e. Sustainable Aquaculture	
Unit 2	Aquarium Fishes and Management	15 H
	I. Identification, breeding and maintenance of important ornamental fishes a. Angel b. Danio c. Discus d. Flower horn e. Gourami f. Siamese fighter g. Sword tail h. Gold fish i. Koi II. *Setting and design of freshwater aquarium, aeration devices, aeration accessories, various types of filters III. *Aquatic plants and other structures for beautification and utility a. Amazon sword b. Cork screw c. Ludwigia d. Aqua rose e. Cobamba f. Pistia g. Formulated feed, its composition and its production	
Unit 3	Brooder and Sexual dimorphism in Major carps	15 H
	II. Induced breeding i. *History of induced breeding of fishes ii. Methods of pituitary extract preparation iii. Dosage determination and injection to the brood fishes iv. Spawning and hatching v. *Use of different synthetic hormones and analogues for induced spawning. vi. Induced breeding in Indian Carps – Catla, Labeo, Mrigal vii. *Induced breeding in Exotic Carps – Common Carp, Silver Carp, Grass Carps III. Hatchery design and operation i. Criteria for site selection of hatchery ii. Design and function of incubators iii. Essential components of hatchery, Role of hatchery iv. Management of hatchery v. Traditional double-walled hapa, Floating hapa vi. *Types of hatchery a) Vertical hatchery – Glass jar hatchery, Plastic Bucket hatchery b) Chinese hatchery b) Circular hatchery – CIEF D 80 Model and CIEF 81 Model	

	<p>vii. Mahaseer and Trout hatchery</p> <p>IV. Nursery Pond Management</p> <p>i. Pre-stocking pond management ii. Stocking pond management iii. Post stocking management</p> <p>V. Packaging and Transport</p> <p>a. Quality of container used in packaging and transporting the fish seed b. Transport containers for fish and fingerlings c. Packing and transportation of fish seed d. *Use of anaesthetics and disinfectants in fish breeding and transport</p>	
Unit 4	Giant freshwater prawn – <i>Macrobranchium rosenbergii</i>	15 H
	<p>I. Identification, sexual dimorphism, selection of brooder</p> <p>II. *Breeding and hatchery management</p> <p>III. Life cycle</p> <p>IV. Nutrition and Feeding</p> <p>V. *Rearing of Fresh water Giant Prawn</p> <p>VI. Diseases and its Control measures</p>	

Semester III: Aquaculture Methods and Practices- Paper 2 Course Code: VGVPSMOC302	
(Internal Assessment Pattern)	
Marks: 40	
1. Class Test	15 marks
2 Presentation: (Based on Theory Unit 1,2,3 and 4)	15 marks
3 Class Participation and Overall conduct	10 Marks

Semester III: Aquaculture Methods and Practices - Paper 2 Course Code: VGVPSMOC302	
(Theory Paper Pattern)	
Duration: 2.5 hrs	Marks: 60
Q.1.A. Answer the following (Any one): Unit 1 A) OR A)	06 Marks
Q.1. B) Attempt any two of the following: Unit 1 a) b) c)	06 Marks
Q.2.A. Answer the following: (Any one) Unit 2 A) OR A)	06 Marks

Q.2. B) Attempt any two of the following: Unit 2 a) b) c)	06 Marks
Q.3.A. Answer the following: (Any one) Unit 3 A) OR A)	06 Marks
Q.3. B) Attempt any two of the following: Unit 3 a) b) c)	06 Marks
Q.4.A. Answer the following: (Any one) Unit 4 A) OR A)	06 Marks
Q.4. B) Attempt any two of the following: Unit 4 a) b) c)	06 Marks
Q.5. Write a note on (All questions are compulsory) a) Unit 1 b) Unit 2 c) Unit 3 d) Unit 4	12 Marks

Course Outcome - Aquaculture Methods and Practices (Paper 2)

Course Code: VGVPSMOC302

After the completion of the course, students will able to

CO1 The learner will acquire knowledge regarding advanced technologies in aquaculture.

CO2 The learner will gain knowledge about the setting of commercial aquarium.

CO3 The learner will acquire knowledge regarding sexual dimorphism in Major carps and their maturity and spawning

CO4 The learners will familiarize the breeding, hatchery and rearing of the prawn.

References

1. Pillay, T.V.R. & M.A. Dill. Advances in Aquaculture. Fishing News (Books) Ltd. England 1979.
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Semester – III
Paper III
Course Code: VGVPSMOC303
Credits: 4
FISH PROCESSING TECHNOLOGY

Course Objectives
1. To impart knowledge and skill of handling of fish in hygienic conditions at various levels as well as personnel hygiene.
2. To get acquainted with different methods and materials required in traditional fish processing.
3. To give in depth knowledge of recent methods in fish processing.
4. To give in depth knowledge of recent methods in quality control and their norms

COURSE CONTENT		
Unit No.	Content	Lectures
	Course Code: VGVPSMOC303 Paper III: FISH PROCESSING TECHNOLOGY	
Unit 1	Hygienic Handling of fish	15 H
	I. *Methods of handling of fish II. Hygienic conditions required on board, landing centres and processing industry III. *Methods of transportation (conventional and recent) of fish to processing industry IV. Organoleptic tests V. Temperature modelling and relationships in fish transportation VI. *Typical layout for freezing industry, ice factory andcanning industry VII. Site Selection: <ol style="list-style-type: none"> a. Location b. Site Level c. Communications d. Site size VIII. Building specifications: <ol style="list-style-type: none"> a. General introduction b. Doors and windows c. Lighting d. Ventilation e. Drains f. Power supply g. Water supply h. Factory yards 	
Unit 2	Traditional fish processing	15 H
	I. *Indigenous methods of preservation II. Simple Vapour Compression System (Refrigerator): <ol style="list-style-type: none"> i. Ideal refrigerant 	

	<ul style="list-style-type: none"> ii. Types of refrigerants <p>III. Types of freezers, freezing of fin fishes and shellfishes</p> <p>IV. Accessory industry for canning, canning of fin fishes, shell fishes and cephalopods</p> <p>V. *Additives in fish processing</p> <p>VI. *Major equipment used in fish processing industry and its maintenance</p>	
Unit 3	Modern fish processing	15 H
	<p>I. *Surimi technology and surimi based analogue products (only technology aspect)</p> <p>II. *Thermal processing of fishery products</p> <ul style="list-style-type: none"> a. Thermal processing b. Pulsed light technology c. Infra-red (IR) and Radio frequency (RF) processing technology and its applications d. Ohmic or Joule heating <p>III. Non-thermal processing of fishery products</p> <ul style="list-style-type: none"> a. High pressure processing b. Vacuum cooling c. Irradiation 	
Unit 4	Quality assurance norms and methods	15 H
	<p>I. Introduction to Quality Assurance</p> <p>II. Microbiological testing:</p> <ul style="list-style-type: none"> i. Standard norms ii. Biogenic amines iii. Rapid detection kits <p>III. *Hazard Analysis Critical Control Point (HACCP)</p> <p>IV. Check list for ensuring sea food safety</p> <p>*Changes that occur during freezing and frozen storage, and Protective treatments:</p> <ul style="list-style-type: none"> i. Changes: <ul style="list-style-type: none"> a) Microbiological b) Physical and chemical changes c) Protein denaturation d) Fat oxidation e) Dehydration f) Drip ii. Protective treatments: <ul style="list-style-type: none"> a) Polyphosphate b) Glazing c) Antioxidants d) Packaging <p>VI. *ISO-9000 series certification of the International Standard Organization</p> <p>VII. National and International food laws, integrated food law (FSSAI, CODEX GMP)</p>	

	VIII. Harbour management	
	IX. *Fish Toxins – Intrinsic and extrinsic factors for toxicity of fish	

Semester III: Fish Processing Technology- Paper 3 Course Code: VGVPSMOC303	
(Internal Assessment Pattern)	
Marks: 40	
1. Class Test	15 marks
2 Presentation: (Based on Theory Unit 1,2,3 and 4)	15 marks
3 Class Participation and Overall conduct	10 Marks

Semester III: Fish Processing Technology- Paper 3 Course Code: VGVPSMOC303	
(Theory Paper Pattern)	
Duration: 2.5 hrs	Marks: 60
Q.1.A. Answer the following (Any one): Unit 1 A) OR A)	06 Marks
Q.1. B) Attempt any two of the following: Unit 1 a) b) c)	06 Marks
Q.2.A. Answer the following: (Any one) Unit 2 A) OR A)	06 Marks
Q.2. B) Attempt any two of the following: Unit 2 a) b) c)	06 Marks
Q.3.A. Answer the following: (Any one) Unit 3 A) OR A)	06 Marks
Q.3. B) Attempt any two of the following: Unit 3 a) b) c)	06 Marks
Q.4.A. Answer the following: (Any one) Unit 4 A) OR A)	06 Marks
Q.4. B) Attempt any two of the following: Unit 4 a) b) c)	06 Marks

<p>Q.5. Write a note on (All questions are compulsory)</p> <p>a) Unit 1 b) Unit 2 c) Unit 3 d) Unit 4</p>	12 Marks
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<p>Course outcome- Fish Processing Technology (Paper III)</p> <p>Course Code: VGVPSMOC303</p>
<p>After the completion of the course, students will able to</p>
<p>CO1 The learner will be able to handle the fish hygienically after sorting the fresh fish.</p>
<p>CO2 The learner will understand packaging materials, compression system, refrigerants, freezers, freezing, canning of fish with additional knowledge of additives and instrumentation used in fish processing industry.</p>
<p>CO3 The learner will gain insight of recent methods in fish processing industry.</p>
<p>CO4 The learner will gain insight of recent methods in quality control and their norms.</p>

<p>References</p>
<ol style="list-style-type: none"> 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 ISBN9780323146869. 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. Advances in Fish Processing Technology by Sen D.P; 2005; Allied Publ. 8. Processing Aquatic Food Products by Wheaton F.W. & Lawson T.B; 1985; John Wiley & Sons.

Proposed Draft Syllabus for M.Sc. Zoology (Specialization Oceanography)

Semester III

Choice Based Credit System (NEP 2020)

(To be implemented from the academic year, 2023-2024)

ELECTIVE COURSE

Paper IV: Electives-1

Course Code: VGVPSELOC301

Credits: 2

FIN FISH AND SHELL FISH BIOLOGY

Course Objectives

1. To familiarize the learners about importance of morphological characters of fin fish and shell fish for taxonomy.
2. The learners will familiarize the basic of fish anatomy
3. The learners will familiarize about locomotion and light producing organs.
4. To aware the learners about importance of mud crab.

COURSE CONTENT

Unit No.	Content	Lectures
	Course Code: VGVPSELOC301 Electives 1: FIN FISH AND SHELL FISH BIOLOGY	
Unit 1	Morphology of fin fish and shell fish	15 H
	I. Fin fish morphology: skin, colour, eyes, mouth structure, jaws and teeth, fins, fin rays, spine, scales, operculum, gills and gill rakers, claspers	
	II. Shell fish morphology: eyes, hectocotylus arm, foot, shells, tentacles, pleopods, uropods, cephalothoracic appendages, antennae, antennules, spines	
	III. *Morphometric measurement, Significance of morphometric measurement	
	IV. *Taxonomic importance of morphological characters	

	V. Culture of finfish and shellfish - pearl oyster, edible oyster, Cobia.	
Unit 2	Basic fish anatomy	15 H
	<p>I. *Digestive system of a teleost and its associated glands</p> <p>II. Respiratory system</p> <p>a. Gill - Structure and Types, Mechanism of respiration b. Air bladder – Structure and Types, functions c. Accessory Respiratory Organs d. Respiratory pigment</p> <p>III. Nervous system of Teleost</p> <p>IV. Sense organs and Endocrine organs in fishes</p> <p>V. Weberian ossicle – Structure and functions</p> <p>VI. Heart and aortic arches of a teleost</p> <p>VII. *Excretion and Osmoregulation:</p> <p>a. Structure and function of the excretory organs b. Major excretory products of fishes, Patterns of nitrogen excretion c. Osmotic and ionic regulation – Acid-base balance</p>	
Unit 3	Locomotion and Light producing organs in fishes	15 H
	<p>I. Locomotion</p> <p>a. Types of locomotion b. Special mode of locomotion c. Locomotion due to the movement of appendages</p> <p>II. Migration in fishes</p> <p>a. General account of migration b. *Types of migration c. Advantages of migration d. Factors influencing migration e. Symbiosis</p> <p>III. Light producing organs</p> <p>a. Location b. *Nature of light producing organs c. Structure of light producing organs d. *Significance of luminescence in fishes</p>	
Unit 4	Mud Crab	15 H
	<p>I. Distribution, Habit and Habitat</p> <p>II. External characters</p> <p>III. Life history</p> <p>IV. Migration and movement</p> <p>V. *Heart and circulatory system</p>	

	VI. Respiratory system	
	VII. *Economic importance	

Semester III: Fin Fish and Shell Fish Biology- Electives 1	
Course Code: VGVPSSELOC301	(Internal Assessment Pattern)
Marks: 40	
1. Class Test	15 marks
2 Presentation: (Based on Theory Unit 1,2,3 and 4)	15 marks
3 Class Participation and Overall conduct	10 Marks

Semester III: Fin Fish and Shell Fish Biology - Electives 1	
Course Code: VGVPSSELOC301	(Theory Paper Pattern)
Duration: 2.5 hrs	Marks: 60
Q.1.A. Answer the following (Any one): Unit 1 A) OR A)	06 Marks
Q.1. B) Attempt any two of the following: Unit 1 a) b) c)	06 Marks
Q.2.A. Answer the following: (Any one) Unit 2 A) OR A)	06 Marks
Q.2. B) Attempt any two of the following: Unit 2 a) b) c)	06 Marks
Q.3.A. Answer the following: (Any one) Unit 3 A) OR A)	06 Marks
Q.3. B) Attempt any two of the following: Unit 3 a) b) c)	06 Marks
Q.4.A. Answer the following: (Any one) Unit 4 A) OR A)	06 Marks
Q.4. B) Attempt any two of the following: Unit 4 a) b) c)	06 Marks
Q.5. Write a note on (All questions are compulsory) a) Unit 1 b) Unit 2 c) Unit 3 d) Unit 4	12 Marks

Course outcome- Fin Fish and Shell Fish Biology - Electives 1**Course Code: VGVPSELOC301**

After the completion of the course, students will able to

CO1 The learners will gain the knowledge of morphological characters and will enable to use in the taxonomy of fin fish and shell fish.**CO2** The learners will aware about basic of fish anatomy.**CO3** The learners will gain the knowledge of types of locomotion, significance of luminescent and advantages of migration of fishes.**CO4** The learners will get the knowledge about biology and importance of the mud crab.**References**

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3. Moyle Peterb, Fishes: An Introduction to Ichthyology. Prentice Hall, 1974.
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12. Kuriyan, C.V. and V.O Sebastian 1993. Prawns and prawn fisheries of India (4th edn.) Hindustan Publ. Corp., Delhi pp 267.
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15. Misra, K.S. An Aid to the Identification of the Common Commercial Fishes of India and Pakistan. Narendra Publ. House., India, 320 pp.
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17. Marine crabs of Bombay state by B.F. Chhapgar; Taraporewala Marine Biological Station, Bombay
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Semester – III
Paper IV: Electives-2
Course Code: VGVSELOC302
Credits: 2
Marine Biotechnology

Course Objectives
1. To study about the bioactive compounds from marine organisms with novel applications.
2. To emphasize on the pharmaceutical applications and study the efficacy of marine by-products.
3. To develop sustainable aquaculture practices and analyze the marine-derived food products
4. To create awareness regarding environmental monitoring, conservation of marine ecosystem and recent advances in instrumentation and career opportunities in Marine Biotechnology
5. To study about the ecologically important microbes and impact of marine microbes on the ecosystem.

COURSE CONTENT		
Unit No.	Content	Lectures
	Course Code: VGVSELOC302 Electives-2: MARINE BIOTECHNOLOGY	
Unit 1	Marine Bio-resources and Aquaculture	15 H
	<ul style="list-style-type: none"> a. Types and divisions of marine habitats – Basic concepts about coastal-wetlands, estuaries, mangroves, seagrass, coral reefs and deep sea ecosystems b. Aquaculture and Fishery c. Bioactive substances from marine organisms - alkaloids, terpenoids and steroids. Nucleosides, peptides, depsipeptides, polyketides & macrolides. d. Integrated multi-trophic aquaculture (IMTA), Aquaponics e. Ecofriendly aquaculture practices; probiotics in aquaculture. f. Application of Biotechnology in Aquaculture 	
Unit 2	Microbial technology	15 H
	<ul style="list-style-type: none"> a. Marine metagenomics – principle, protocol and applications. b. Thermal fish processing c. Satellite Imagery d. RADAR and SONAR e. Hybridoma technology – production of monoclonal antibodies and their applications. f. Bioassays for screening biomolecules - Design of assays - Brine shrimp lethality assay, Cytotoxicity assay, Antimicrobial assays, Anticancer assays g. Fluorescence in situ hybridization (FISH) h. Protein biomarkers for paralytic shellfish toxins. 	

Unit 3	Marine Bioprospecting	15
	<ul style="list-style-type: none"> a. Algal Biotechnology – Pharmaceutical application, antimicrobial compounds. Bio-prospecting of algal resources for value added compounds/products, Production of nanoparticles b. Photobioreactors - algae as food and feed, Bioethics, IPR and patenting issues c. Biomaterials from the marine environment – chitin, chitosan, oils and fats, surfactants, biopolymers and novel enzymes from marine organisms d. Enzymes of industrial and diagnostic importance. e. Entrepreneurship and career advances 	
Unit 4	Marine Microbiology	15 H
	<ul style="list-style-type: none"> a. Morphology and fine structure of bacteria, archaea and fungi b. Methods of isolation and preservation of cultures. c. Influence of physical and chemical factors on the distribution of marine microorganisms. d. Host microbe interactions in the marine environment e. Fermentation and bioconversion by microbial organisms. f. Industrially important marine microorganisms g. Microbiological techniques in marine food industry 	

Semester III: Marine Biotechnology- Electives-2	
Course Code: VGVPSSELOC302	(Internal Assessment Pattern)
Marks: 40	
1. Class Test	15 marks
2 Presentation: (Based on Theory Unit 1,2,3 and 4)	15 marks
3 Class Participation and Overall conduct	10 Marks

Semester III: Marine Biotechnology- Electives 2	
Course Code: VGVPSSELOC302	(Theory Paper Pattern)
Duration: 2.5 hrs	Marks: 60
Q.1.A. Answer the following (Any one): Unit 1 A) OR A)	06 Marks
Q.1. B) Attempt any two of the following: Unit 1 a) b) c)	06 Marks
Q.2.A. Answer the following: (Any one) Unit 2 A) OR A)	06 Marks
Q.2. B) Attempt any two of the following: Unit 2 a) b) c)	06 Marks

Q.3.A. Answer the following: (Any one) Unit 3 A) OR A)	06 Marks
Q.3. B) Attempt any two of the following: Unit 3 a) b) c)	06 Marks
Q.4.A. Answer the following: (Any one) Unit 4 A) OR A)	06 Marks
Q.4. B) Attempt any two of the following: Unit 4 a) b) c)	06 Marks
Q.5. Write a note on (All questions are compulsory) a) Unit 1 b) Unit 2 c) Unit 3 d) Unit 4	12 Marks

Course outcome- Marine Biotechnology - Electives 2 Course Code: VGVPSSELOC302
After the completion of the course, students will able to
CO1 The learners will be able to analyze the bioactive compounds from marine organisms and basics of aquaculture.
CO2 The learners will understand the effective marine by-products and its applications.
CO3 The learners will gain the knowledge of techniques gain insights of career opportunities in Marine Biotechnology.
CO4 The learners will be able to gain knowledge about the role of microbes in the environment.

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<ol style="list-style-type: none"> Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten. (2010). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 4th Edition. ASM Press Connel, D.W. (2000). Bioaccumulation of Xenobiotic Compounds. Boca Raton, FL: CRC Press. Carol, D (Ed.). (1976). Marine Microbiology. Stroudsburg: Dowden, Hutchinson & Ross. Freshney, R.I. (2010). A Manual of Basic Techniques - Culture of animal cells. John Wiley & Sons. James, A & Lilian, Evison. (1979). Biological Indicators of Water Quality in Environmental Science and Technology Texts and Monographs. New York: John Wiley and Sons. John, H. Paul. (2001). Method in Microbiology: (Vol.13) Marine Microbiology, Academic Press. Kennish, M.J., 1994. Practical handbook on estuarine and marine pollution. Elsevier Pillai, T.V.R. (1993). Aquaculture- Principles and Practices, John Wiley & Sons. Scheper T. (Ed.). 2005. Marine Biotechnology (Vol. I), Springer (Germany)

10. Vemberg, F.J & Vemberg, W.B. (1978). Pollution and Physiology of Marine Organisms. New York: Academic Press
11. Yousef, E.Ahmed.(2003). Food Microbiology: A Laboratory Manual. John Wiley and Sons.
12. [Assurance of seafood quality \(fao.org\)](http://www.fao.org)

Semester – III
Practicals - Mandatory
Course Code: VGVPSMOCP301
Credits: 2

Practical based on Oceanography, Fresh Water Aquaculture and Fish Processing Technology

SR. NO.	LIST OF EXPERIMENTS	
1.	Physical and Chemical Oceanography: Determination of physico-chemical parameters: a) Salinity (Argentometric method) b) Silicates	
2.	Estimation of primary productivity by light and dark bottle	
3.	Quantitative estimation of plankton settling method, wet-weight method, weight displacement method, counting method	
4.	Estimation of Turbidity, pH, Hardness of pond water.	
5.	Extraction of Chitin from Prawn shell wastes	
6.	Estimation of moisture content in fish and shrimp muscle.	
7.	Biometric studies of fish / prawn a) Study of relationship between total length and standard length / head length / body depth length / body weight. Calculate correlation (standard length and total length, head length and total length, body depth and total length). Calculate the index values for various relationships	
8.	a) Niskin water sampler b) CTD meter c) Bathythermometer d) Ekman's Current Meter e) Secchi disc f) Stemple pipette and counting slide	f) Plankton nets: i. Standard net ii. Hensen net iii. Clarke Bumpus net
	g) Nekton sampling device: i. Beam trawl ii. Otter trawl	h) Benthic sampling devices: i. Naturalist dredge ii. Scallop dredge iii. Petersen grab iv. Van veen grab Ekman grab and corers
9.	Identification of important Ornamental fishes: Angel, Danio, Discus, Flower horn, Gourami, Siamese fighter, Sword tail, Koi	
10.	Identification of Zooplankton permanent slides: <i>Noctiluca</i> , <i>Obelia medusa</i> , <i>Physalia</i> , <i>Zoea</i> , <i>Copepods</i> , <i>Megalopa</i> , <i>Bipinnaria</i> , <i>Nauplius</i> , <i>Pteropods</i> , <i>Sagitta</i>	

11.	Identification of intertidal organisms: a) Rocky shore: Chiton, Balanus, Corals (Acropora, Meandrina) b) Sandy shore: Solen, Umbonium, Fiddler crab, Balanoglossus c) Muddy shore: Lingula, Arenicola, Mud skipper
12.	Identification of various equipment of Fish Processing (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
13.	Report on Visit to Institutes involved in Marine Biology or Oceanography Research/ Visit to fish processing Industry/ Fish landing Centres

Practical based on Oceanography, Aquaculture Methods and Practices and Fish Processing Technology	
Course Code: VGVPSMOCP301	(Practical Paper Pattern)
Duration: 5 hours	Marks: 50
Major Question: Q.1 Estimate the Salinity and Silicates of the given water sample. <p style="text-align: center;">OR</p> Q.1 Estimate the primary productivity using light and dark bottle method of the given water sample. <p style="text-align: center;">OR</p> Q.1 Estimation of Turbidity and pH / Hardness of the given pond water sample. <p style="text-align: center;">OR</p> Q.1 Extraction of Chitin from Prawn shell wastes	15 marks
Minor Question: Q.2 Quantitative estimation of plankton using settling method / wet weight method / weight displacement method / counting method. <p style="text-align: center;">OR</p> Q.2 Q. 2 From the data provided present an account of biometric parameters of the given fish. i) Study of relationship between total length and standard length / head length / body depth / body weight. Calculate its correlation <p style="text-align: center;">OR</p> Q.2 Estimation of moisture content in fish and shrimp muscle.	08 marks
Q.3 Identification a) Oceanographic instrument b) Intertidal organism c) Zooplankton d) Equipment of Fish Processing	12 marks
Q.4. Report on Visit to Institutes involved in Marine Biology or Oceanography Research/ Visit to fish processing Industry/ Fish landing Centres	05 marks
Q.4. Viva voce based on Theory.	05 marks
Q.5 Journal.	05 Marks

Semester – III
Practicals – Electives-1
Course Code: VGVPSSELOCP301
Credits: 2

Practical based on Fin fish and Shell fish Biology

Sr. No.	List of Experiments
1	Identification - <i>Matuta sp.</i> , <i>Scylla serrata</i> , <i>Neptunus sanguinolentus</i> , <i>Neptunus pelagicus</i> , <i>Charybdis sp.</i> , <i>Sepia sp.</i> , <i>Loligo sp.</i>
2	Dissections a) Nervous system of a suitable bony fish b) Aortic arches of a suitable bony fish c) Digestive system of a suitable bony fish d) Weberian ossicles from a suitable bony fish e) Heart and circulatory system of mud crab
3	Mountings: Fins, Gills and rakers, clasper, hectocotylus arm, rostrum, chelate leg, pleopod, uropod, antenna, antennule, walking leg, air bladder
4	Types of fins and scales
5	Permanent slides - Larval stages of crab
6	To identify and locate the shoals of fishes from the data/photographs captured by remote sensing devices/techniques/GPS (Demonstration only)
7	Determination of ammonia from the tank water
8	Effect of salinity on ammonia excretion by aquatic animals.
9	Identification of Air Breathing Fishes: <i>Anabas testudineus</i> , <i>Clarius batrachus</i> , <i>Boleophthalmus spp</i>
10	Visit to local fish market to identify commercially important shell fishes and prepare a report.

Practical based on Fin fish and Shell fish Biology- Electives 1	
Course Code: VGVPSSELOCP301 (Practical Paper Pattern)	
Duration: 5 hours	Marks: 50
Major Experiment Q.1 Dissect any given Teleost fish so as to expose its Digestive system / Nervous system / Aortic arches. <p style="text-align: center;">OR</p> Q.1 Dissect any given Teleost fish so as to expose its Weberian ossicles. <p style="text-align: center;">OR</p> Q.1 Dissect Crab so as to expose its circulatory system.	12 marks
Minor Experiment: Q.2 Determine ammonia from the given tank water <p style="text-align: center;">OR</p> Q.2 Effect of salinity on ammonia excretion by aquatic animals.	07 marks
Q.3 Make a temporary preparation of (stain if necessary) a) Fins / Gills and rakers / Clasper / Walking leg b) Hectocotylus arm / Rostrum / Chelate leg c) Pleopod / Uropod / Antenna / Antennule d) Scales / Air bladder	12 marks

Q.4 Identify and describe. 09 a) Schooling /One Mollusc b) Shoaling / Larval stages of Crab c) Crab species/ Air breathing fish	09 marks
Q.5 Viva Voce based on theory	05 Marks
Q.6 Journal	05 Marks

Semester – III
Practicals – Electives-2
Course Code: VGVPSSELOCP302
Credits: 2
Based on Marine Biotechnology

Sr.No.	List of Experiments
1.	Isolation of Novel industrial enzymes
2.	Study of Biosensors
3.	Extraction of Bioactive compounds from animals
4.	Study of Sting ray-new chemical compounds
5.	Aggregation and dispersion of Chromatophores
6.	Study of Ballast water and effect on Indigenous species
7.	Detection of heavy metals and effect of oil rig on the marine ecosystem
8.	Study of Ocean acidification in bivalves
9.	Extraction of Marine by-products
10.	Isolation of gut flora
11.	Biochemical tests – Kovac’s oxidase test, catalase test, marine oxidation fermentation tests.
12.	Instrumentation: a) Bioreactor b) UV Spectrophotometer c) Recombinant DNA Technology d) Tissue Culture e) Transgenic (Genetically Modified Organisms)
13.	Report of Herbarium/ Shell collection

Practical based on Marine Biotechnology- Electives 2	
Course Code: VGVPSSELOCP302 (Practical Paper Pattern)	
Duration: 5 hours	Marks: 50
Major Experiment Q.1 Detection of heavy metals and effect of oil rig on the marine ecosystem <p style="text-align: center;">OR</p> Q.1 Biochemical tests – Kovac’s oxidase test, catalase test, marine oxidation fermentation tests. <p style="text-align: center;">OR</p> Q.1 Isolation of Novel industrial enzymes <p style="text-align: center;">OR</p> Q.1 Study of Ballast water and effect on Indigenous species	12 marks

Q.2 Extraction of Bioactive compounds from animals OR Q.2 Aggregation and dispersion of Chromatophores OR Q.2 Extraction of Marine by-products	08 marks
Q.3. Study of Sting ray-new chemical compounds OR Q.3 Study of Ocean acidification in bivalves OR Q.3 Study of Biosensors	06 marks
Q.3 Identification: a) Instrumentation b) Techniques in Marine Biotechnology c) Transgenic (Genetically Modified Organisms)	09 marks
Q.4 Report of Herbarium/ Shell collection	05 marks
Q.5 Viva Voce based on theory	05 Marks
Q.6 Journal	05 Marks

Semester – III

RESEARCH PROJECT (RP) Course Code: VGVPSRPOC301 Credits: 4

Semester IV: Research Project Proposal (RP) (Assessment Pattern)	
Duration:	Marks: 100
CONTENT	MARKS
Title	02 marks
Introduction	05 marks
Rationale/ Research Perspectives	10 marks
Aims and Objectives	10 marks
Materials and Methods	05 marks
Expected Outcomes/ Results	05 marks
References	03 marks
	40 Marks
SUBMISSION OF RESEARCH PROJECT	60 MARKS

Proposed Draft Syllabus for M.Sc. Zoology Semester III and IV

(Specialization: Oceanography)

Choice Based Credit System (NEP 2020)

(To be implemented from the academic year, 2024-2025)

Semester – IV

Paper I

Course Code: VGVPSMOC401

Credits: 4

CAPTURE FISHERIES

Course Objectives

1. To create awareness about the rich diversity of commercially important aquatic resource organisms of inland fisheries and their economic potential.
2. To create awareness about the rich diversity of commercially important aquatic resource of estuaries and other economic potential.
3. To create awareness about food and feeding, reproduction and crafts and gears used in fisheries
4. To impart knowledge about conservation and sustainable consumption / harvesting of these depleted natural resources.

COURSE CONTENT		
Unit No.	Content	Lectures
	Course Code: VGVPSMOC401 Paper I: CAPTURE FISHERIES	
Unit 1	Inland Fishery resources of India	15 H
	I. Riverine fisheries <ol style="list-style-type: none">i. West coast riverine systemii. East coast riverine systemiii. North Eastern riverine system II. Lacustrine fisheries <ol style="list-style-type: none">i. Originii. Ecologyiii. *Productivity of lakes III. Tropical fisheries <ol style="list-style-type: none">i. Carpsii. Cat fishes IV. Temperate fisheries <ol style="list-style-type: none">i. Troutii. Mahaseer V. Fishery Resources of Maharashtra <ol style="list-style-type: none">i. *East coast river systemii. North Eastern river system	

Unit 2	Estuarine fishery resources of India	15 H
	<p>I. *Ecology of Estuaries</p> <p>II. Principle Fisheries of Brackish water, Fisheries of Chilka, Pulicat and Kolleru lake</p> <p>III. *Hooghly Matlah Estuary</p> <p>IV. Hilsa fishery, Mullet fishery, Khajuri fishery</p> <p>V. Osmotic and ionic regulation in estuarine animals.</p>	
Unit 3	Commercially important fisheries in India	15 H
	<p>I. Coastal fisheries</p> <p>i. *Shark – <i>Scoliodon sorrakowah</i></p> <p>ii. Ray – <i>Himantura uarnak (Trygon uarnak)</i></p> <p>iii. Sardine – <i>Sardinella longiceps</i></p> <p>iv. Mackerel – <i>Rastrelliger kanagurta</i></p> <p>v. Bombay duck – <i>Harpodon nehereus</i></p> <p>vi. *Pomfret – <i>Pampus cinereus (Stromateus cinerius), Pampus chinensis (Stromateus sinensis), Parastromateus niger</i></p> <p>vii. Thread fin – <i>Eleutheronema tetradactylum (Polynemus tetradactylus), Galeoides decadactylus (Polynemus polydactylus)</i></p> <p>viii. Pink Perch – <i>Nemipterus japonicus (Synagris japonicus)</i></p> <p>ix. Ribbon fish – <i>Lepturacanthus savala (Trichiurus savala)</i></p> <p>II. *Deep Sea fisheries</p> <p>i. Yellow fin Tuna - <i>Thunnus albacares</i></p> <p>ii. Skipjack Tuna - <i>Katsuwonus pelamis</i></p> <p>III. Commercial Shell fish fisheries</p> <p>i. Crustacean</p> <p>a) Shrimp – <i>Litopenaeus vannamei</i></p> <p>b) Crab – <i>Scylla serrata</i></p> <p>c) Prawn – <i>Penaeus monodon</i></p> <p>d) Lobster – <i>Panulirus sp.</i></p> <p>ii. Mollusca</p> <p>a) Clam – <i>Katelsia opima</i></p> <p>b) Mussels – <i>Perna viridis (Mytilus viridis)</i></p> <p>c) Oyster – <i>Crassostrea ingens</i></p> <p>d) Cephalopod – <i>Sepia pharaonic</i></p>	
Unit 4	Population Dynamics and Conservation	15 H
	<p>I. Structure and estimation of population</p> <p>II. *Factors affecting fish population</p> <p>III. *Problems of overfishing</p> <p>IV. Concept of MSY (Maximum Sustainable Yield), MEY (Maximum Economic Yield) and recruitment</p> <p>V. Conservation of capture fisheries resource</p> <p>VI. Abundance in population and fishery</p>	

	VII. *Fishery catches and fluctuation, Optimum Yield, Age Composition, Population Growth, Population Models	
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Semester IV: Capture Fisheries (Paper 1)	
Course Code: VGVPSMOC401	(Internal Assessment Pattern)
Marks: 40	
1. Class Test	15 marks
2 Presentation: (Based on Theory Unit 1,2,3 and 4)	15 marks
3 Class Participation and Overall conduct	10 Marks

Semester IV: Capture Fisheries (Paper 1)	
Course Code: VGVPSMOC401	(Theory Paper Pattern)
Duration: 2.5 hrs	Marks: 60
Q.1.A. Answer the following (Any one): Unit 1 A) OR A)	06 Marks
Q.1. B) Attempt any two of the following: Unit 1 a) b) c)	06 Marks
Q.2.A. Answer the following: (Any one) Unit 2 A) OR A)	06 Marks
Q.2. B) Attempt any two of the following: Unit 2 a) b) c)	06 Marks
Q.3.A. Answer the following: (Any one) Unit 3 A) OR A)	06 Marks
Q.3. B) Attempt any two of the following: Unit 3 a) b) c)	06 Marks
Q.4.A. Answer the following: (Any one) Unit 4 A) OR A)	06 Marks
Q.4. B) Attempt any two of the following: Unit 4 a) b) c)	06 Marks
Q.5. Write a note on (All questions are compulsory) a) Unit 1 b) Unit 2 c) Unit 3 d) Unit 4	12 Marks

Course outcome- Paper I**Course Code: VGVPSMOC401**

After the completion of the course, students will able to

CO1 Learners will get a bird eye view on dimension and magnitude of inland fisheries potential of India.**CO2** Learners will get knowledge about the specific estuarine resource of India.**CO3** Learners will get knowledge about the crafts and gears, food and feeding used in fisheries of India.**CO4** Learners will appreciate and adapt the principles of sustainability for conservation and long-term sustenance of the capture fisheries.**References**

1. V.G. Jhingran, Fish and fisheries, Hindustan Publishing Corporation (India) Revised and enlarged 2nd edition.
2. David Ross, Introduction to Oceanography.
3. D.V. Bal and K.V. Rao, Marine fisheries of India, T-M-H.
4. Harold Thurman, Introductory oceanography, Prentice Hall. London.
5. Richard A. Davis, Jr. Oceanography an Introduction to the Marine Environment- Wm.C. Brown Publishers.
6. Fishes by M Chandy, National Book Trust India.
7. The Fishes of India by Francis Day, Volume I Text, Today and Tomorrows Book Agency, New Delhi.
8. Fundamentals of Ichthyology by S.P. Biswas, Narendra Publishing House, Delhi, India.

Semester – IV
Paper II
Course Code: VGVPSMOC402
Credits: 4

BRACKISH AND MARINE WATER AQUACULTURE

Course Objectives
1. To familiarize the learners about breeding, raising and harvesting of shellfish and aquatic plants.
2. To familiarize the learners about breeding, raising and harvesting of fin fish.
3. To reduce operating costs and maximize the farmer's income.
4. To undertake surveillance of existing and emerging fish and shellfish diseases

COURSE CONTENT		
Unit No.	Content	Lectures
	Course Code: VGVPSMOC402 Paper II: BRACKISH AND MARINE WATER AQUACULTURE	
Unit 1	Shell fish culture	15 H
	<p>I. Crab culture</p> <ul style="list-style-type: none"> i. Introduction, History and Present status of crab culture ii. Cultivable species of crabs in India iii. Pond design iv. Principles of crab hatchery, brood stock, larval and post-larval management v. *Techniques of Crabs culture, cage culture and pen culture vi. Crabs fattening vii. *Prospect, problems and development of crab culture in India <p>II. Brackish water Prawn – <i>Penaeus monodon</i> Culture</p> <ul style="list-style-type: none"> i. Breeding techniques ii. Hatchery & Nursery Management iii. *Rearing practices – Extensive, Semi-intensive, Intensive & Sustainable <p>III. Pearl oyster culture</p> <ul style="list-style-type: none"> i. Techniques of pearl oyster culture (Fresh water and Marine water) for artificial production of pearls ii. *Pearl culture techniques <ul style="list-style-type: none"> a) Rafts b) Long lines c) Pearls oyster baskets d) Under water platforms e) Mother oyster culture / Collection of oysters f) Rearing of oysters g) Environmental parameters h) Pearl Oyster surgery 	

	<ul style="list-style-type: none"> iii. Selection of Oyster iv. Graft tissue preparation v. Nucleus insertion vi. Conditioning for surgery vii. Post-operative culture, harvesting of pearl, clearing of pearl viii. Present status, Economic importance of pearls ix. Prospects and problems of pearl industry in India <p>IV. Live feed culture</p> <ul style="list-style-type: none"> i. Candidate species of phytoplankton and zooplanktonas food organisms ii. Tropic potentials- proximate composition of live feed iii. Culture requirements of important live food organisms iv. *Culture of Green algae, blue-green algae, spirulina, diatoms, infusoria, rotifers, cladocerons, tubifex, brineshrimp, chironomids. Culture of earthworms, bait fish and forage fish 	
Unit 2	Fin Fish culture	15 H
	<p>I. Lates calcarifer</p> <p>II. Mullet</p> <p>III. Milk fish</p> <p>IV. *Tilapia</p> <p>V. Recent Advances in the Fish farming System</p>	
Unit 3	Farm Engineering	15 H
	<p>I. Design, layout and construction of different aqua farms and aqua house</p> <p>II. *Construction and design of pond dyke and sluicagate</p> <p>III. Water supply and drainage system</p> <p>IV. Design and fabrication of automatic feeder, aerator and bio filter</p> <p>*Instruments (Kits) for measuring water quality</p>	
Unit 4	Fin Fish and Shell fish Pathology and Health Management	15
	<p>I. Fish Pathology: Causative agents, symptoms and control of some infectious diseases of fish</p> <ul style="list-style-type: none"> a. Diseases b. Fungal Diseases - Saprolegniasis, Branchiomycosis c. Bacterial Diseases - Fin and Tail rot, Ulcer diseases, Dropsy, Eye diseases, Ferunculosis, Bacterial Gill diseases, ERM, Edwardsiellosis, Vibriosis d. Protozoan Diseases - White spot diseases, Costiasis, Trichodinosis, Whirling disease e. *Metazoans - Dactylogyrus, Gyrodactylus, Hirodinosis, Lernaea, Argulus f. Viral diseases - IPN, IHN, VHs, CCVD, EUS 	

	<p>II. Shell Fish Pathology: Some common diseases of prawns – pathogens, symptoms and Control IHN, Baculovirus, Black gill disease, Brown spot disease</p> <p>III. Health Management</p> <ol style="list-style-type: none"> a. Principles of disease diagnosis b. *Epidemiological and clinical diagnosis c. Microbiological and post mortem examination of fin fishes in fresh water, brackish water and marine water environment d. *Environmental impact of disease management e. Aquaculture medicines and its importance in fisheries f. Rules and regulation for use of aquaculture medicine 	
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Semester IV: Brackish and Marine Water Aquaculture – (Paper 2)	
Course Code: VGVPSMOC402	(Internal Assessment Pattern)
Marks: 40	
1. Class Test	15 marks
2 Presentation: (Based on Theory Unit 1,2,3 and 4)	15 marks
3 Class Participation and Overall conduct	10 Marks

Semester IV: Brackish and Marine Water Aquaculture- Paper 2	
Course Code: VGVPSMOC402	(Theory Paper Pattern)
Duration: 2.5 hrs	Marks: 60
Q.1.A. Answer the following (Any one): Unit 1 A) OR A)	06 Marks
Q.1. B) Attempt any two of the following: Unit 1 a) b) c)	06 Marks
Q.2.A. Answer the following: (Any one) Unit 2 A) OR A)	06 Marks
Q.2. B) Attempt any two of the following: Unit 2 a) b) c)	06 Marks
Q.3.A. Answer the following: (Any one) Unit 3 A) OR A)	06 Marks
Q.3. B) Attempt any two of the following: Unit 3 a) b) c)	06 Marks
Q.4.A. Answer the following: (Any one) Unit 4 A) OR A)	06 Marks

Q.4. B) Attempt any two of the following: Unit 4 a) b) c)	06 Marks
Q.5. Write a note on (All questions are compulsory) a) Unit 1 b) Unit 2 c) Unit 3 d) Unit 4	12 Marks

Course outcome- Paper 2 Course Code: VGVPSMOC402
After the completion of the course, students will able to
CO1 The objective is an environmentally responsible source of food and commercial products, helps to create healthier habitats, and is used to rebuild stocks of threatened or endangered species.
CO2 The objective is an environmentally responsible source of food and commercial products, helps to create healthier habitats, and is used to rebuild stocks of threatened or endangered species.
CO3 The employment and economic advantages, as well as the possibility of sustaining species that might be over-fished if not for the controlled environments of fish farms.
CO4 The study of fish and shellfish diseases gives a wide knowledge, not only of the potential pathogens, but also of the environmental constraints and specialist adaptations, which govern the ectothermic, aqueous, existence of organisms.

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Semester – IV
Paper III
Course Code: VGVPSMOC403
Credits: 4
INDUSTRIAL FISHERY

Course Objectives

1. To familiarize the learners about the entrepreneur of value-added products from the fin fish and shell fish.
2. To provide information on various fish products and by-products, utilization of fishery wastes and their nutritional value.
3. To impart comprehensive overview of the scientific and technical aspects of food packaging.
4. To familiarize the students with the basic concepts of Entrepreneurship and marketing as applied to fishery industries.

COURSE CONTENT		
Unit No.	Content	Lectures
	Course Code: VGVPSMOC403 Paper I: INDUSTRIAL FISHERY	
Unit 1	Value added Products	15 H
	I. *Dry, salted and smoked products II. Fish / Prawn Pickle III. Fish Chakli and Wafers IV. Artificial products / Crab streaks V. RTE products VI. Fish Kebab VII. Fish cutlet VIII. Fish Amoti IX. Fish Rumani X. Fish fillets	
Unit 2	Fish, Shell fish and Seaweed Products and By-products	15 H
	I. By-products a. Fish meal b. *Fish oil c. Fish protein concentrate	

	<ul style="list-style-type: none"> d. Functional fish protein concentrates e. Isinglass f. Shark leather g. Fish glue h. *Fish gelatin i. *Pearl essence j. Shark fin soup <p>II. Fermented fish products</p> <ul style="list-style-type: none"> a. Fish-Shrimp sauces and pastes b. Philippine Bagoong c. Malaysian Budu d. Fish silage e. Fish Protein Hydrolysate <p>Products from marine invertebrate shell waste</p> <ul style="list-style-type: none"> a. Chitin b. Chitosan c. Glucosamine hydrochloride d. Astaxanthin e. *Calcium Supplements from shell <p>IV. Seaweed products</p> <ul style="list-style-type: none"> a. Alginates b. Agar agar c. Agarose d. Carageenan 	
Unit 3	Packaging Methods for Fish Products and By-products	15 H
	<p>I. Food packaging</p> <ul style="list-style-type: none"> i. *Purposes of food packaging ii. Technological aspects of packaging of fishery products iii. Packing of fresh and frozen fish for consumers iv. Packaging for transport, shipping and institutional supplies v. Packaging standards for domestic and international trade <p>II. Packaging materials</p> <ul style="list-style-type: none"> i. Basic films and laminates, their manufacture and identification ii. Resistance of packaging materials iii. *Development of protective packaging for fishery products <p>III. Modified atmosphere packaging</p> <ul style="list-style-type: none"> i. *Controlled packaging and aseptic packaging ii. Flexible packing, retort pouch processing of fish and fishery products principles and iii. techniques <p>IV. Labelling and printing of packaging materials.</p> <ul style="list-style-type: none"> i. Labeling requirements – national and international, legislation on labeling ii. Labeling for product traceability 	

	<ul style="list-style-type: none"> iii. *Type of labeling for organic foods, specific foods like organic foods, GM foods, iv. Irradiated foods, vegetarian and non-vegetarian foods. Label design specification – v. size, colour <p>V. *Biodegradable plastics, Edible packaging and Bio-composites</p> <p>VI. Environmental Concerns: Recycling and Disposal of Plastic waste</p> <p>VII. Paper and Paper-based materials, Corrugated Fiber Board box (CFB)</p>	
Unit 4	Entrepreneurship and Marketing	15 H
	<p>I. Role of Government and other organizations in promoting entrepreneurship Government schemes and incentives for Small and Medium enterprises (SMEs) Small Scale Industries (SSIs), START Ups, Women entrepreneurs</p> <p>II. Science and Technology in Entrepreneurship</p> <ul style="list-style-type: none"> a. Development (STED project of NSTEDB), b. *Agribusiness Incubation Centre (ICAR), c. National Fisheries Development Board (NFDB), d. *National Bank for Agriculture and Rural Development (NABARD), e. Entrepreneurship Development Institute of India (EDII), f. National Co-operative Development Corporation (NCDC), g. Small Industry Development Organization (SIDO), h. National Institute for Entrepreneurship and Small Business Development (NIESBUD), i. National Alliance Young Entrepreneur (NAYE), j. Self Employed Women Association (SEWA), k. Self Help Groups (SHGs) <p>II. Fish Market</p> <ul style="list-style-type: none"> a. Structure, Functions and Types b. Marketing channels & supply chains c. Consumer behavior d. Marketing research <p>III. Fish markets & marketing in India:</p> <ul style="list-style-type: none"> a. Problems of fish marketing in India b. Cold storage & other marketing infrastructure in India c. Marketing organization and improvement d. E-marketing e. Role of Government and Co-operatives in fish marketing, Export and import of fish & fishery products, Role of MPEDA 	

Semester IV: Industrial Fishery - (Paper 3)	
Course Code: VGVPSMOC403	(Internal Assessment Pattern)
Marks: 40	
1. Class Test	15 marks
2 Presentation: (Based on Theory Unit 1,2,3 and 4)	15 marks
3 Class Participation and Overall conduct	10 Marks

Semester IV: Industrial Fishery - (Paper 3)	
Course Code: VGVPSMOC403	(Theory Paper Pattern)
Duration: 2.5 hrs	Marks: 60
Q.1.A. Answer the following (Any one): Unit 1 A) OR A)	06 Marks
Q.1. B) Attempt any two of the following: Unit 1 a) b) c)	06 Marks
Q.2.A. Answer the following: (Any one) Unit 2 A) OR A)	06 Marks
Q.2. B) Attempt any two of the following: Unit 2 a) b) c)	06 Marks
Q.3.A. Answer the following: (Any one) Unit 3 A) OR A)	06 Marks
Q.3. B) Attempt any two of the following: Unit 3 a) b) c)	06 Marks
Q.4.A. Answer the following: (Any one) Unit 4 A) OR A)	06 Marks
Q.4. B) Attempt any two of the following: Unit 4 a) b) c)	06 Marks
Q.5. Write a note on (All questions are compulsory) a) Unit 1 b) Unit 2 c) Unit 3 d) Unit 4	12 Marks

Course outcome- Paper 3**Course Code: VGVPSMOC403**

After the completion of the course, students will be able to

CO1 The learners will get knowledge of value-added preparation and will start its own business.

CO2 The learner will develop the competence for making fish by products leading to self employment.

CO3 The learner will be equipped with the knowledge on packaging machinery, systems, testing and regulations of packaging, thus helping in job placement in fish processing / export unit.

CO4 The learner will understand and apply the entrepreneurship and marketing skills and become a successful entrepreneur.

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Proposed Draft Syllabus for M.Sc. Zoology (Specialization Oceanography)

Semester IV

Choice Based Credit System (NEP 2020)

(To be implemented from the academic year, 2023-2024)

ELECTIVE COURSE

Semester – IV

Paper IV: **Electives-1**

Course Code: VGVPSSELOC401

Credits: 2

DISSERTATION

Course Objectives
1. To learn how to implement a research design.
2. To understand fundamental principles of research methodology.
3. To aware the students for good practice in research data presentation.
4. To aware the students to explore the research problem and its interpretation

COURSE CONTENT		
	Content	Lectures
	Course Code: VGVPSELOC401 Elective Paper I: DISSERTATION	
	Submission of Research Proposal	15 H
	<p>Guidelines to the Project:</p> <p>1.The Project shall include:</p> <ul style="list-style-type: none"> i. Title of the Project ii. Aims, Objectives and Rationale iii. Materials and Methods iv. Observation and / Results v. Interpretation of Observation / Results and Discussions vi. Conclusion and / Recommendation vii. Relevance of Work / Justification of Work with Project title viii. Relevant References <p>2. The project must be type-written using computer and printed for binding.</p> <p>3. No minimum or maximum limit of the number of pages is defined since the volume of the proposal is dependent on the scope of the selected topic.</p> <p>4. Name of the mentor may be reflected on the first page of the project along with the student's names.</p> <p>5. The hard copy of proposal must be retained and submitted along with the dissertation in the examination for the reference of the external examiner/s.</p> <p>6. Student should prepare individual power point presentation (PPT) on the project and must present it in front of examiners at the time of examination.</p> <p>7. The project will be prepared individually by students</p>	

Semester IV: Dissertation Project Proposal		Paper IV
Course Code: VGVPSELOC401		(Internal Assessment Pattern)
Duration:	Marks: 40	
CONTENT	MARKS	
Title	02 marks	
Introduction	05 marks	
Rationale/ Research Perspectives	10 marks	
Aims and Objectives	10 marks	
Materials and Methods	05 marks	
Expected Outcomes/ Results	05 marks	
References	03 marks	

Semester IV: DISSERTATION (Elective 1)	
Course Code: VGVPSSELOC401	(Theory Paper Pattern)
EVALUATION OF PROJECT OF PAPER IV PROJECT	60 Marks
1. Title of the Project	01 marks
2. Aim, Objectives and Rationale	04 marks
3. Materials and Methods	05 marks
4. Observations and / Results	10 marks
5. Interpretation of Observations / Results and Discussion	10 marks
6. Conclusion and / Recommendation	10 marks
7. Relevant work / Justification of work with Project title	10 marks
8. Relevant References	05 marks
9. Certified Dissertation	05 marks

Course Outcome- Electives 1
After the completion of the course, students will able to
CO1 The students will be able to gain skills about designing a research work.
CO2 The students would learn the methodologies used in research and analyze the facts.
CO3 The students would acquire the skill of data presentation and its applications.
CO4 The students would explore to analyze the research problem in an innovative perspective with its validation.

Semester – IV
Paper IV: Electives- 2
Course Code: VGVPSSELOC402
Credits: 2
MARINE TOXICOLOGY

Course Objectives
1. To understand the basic principles of Toxicology, sources and identification of toxins and its mechanisms.
2. To study the impact of accumulation of toxins on the aquatic organisms.
3. To analyze the mechanism of toxicity in the marine ecosystem and applications of marine resources in Pharmacology and Cosmetology
4. To gain knowledge about the screening of toxins and techniques to minimize the environmental risks

COURSE CONTENT		
Unit No.	Content	Lectures
	Course Code: VGVPSELOC402 Electives: 2 MARINE TOXICOLOGY	
Unit 1	Introduction to Aquatic Toxicology	15 H
	<ul style="list-style-type: none"> a. Sources of aquatic pollution, Effluent from industries, waste water treatment. b. Toxicology- lethal and sub lethal effects of pollutants to marine organisms c. Toxicity caused by metal and non-metals, Phytotoxins- Toxic principles of various alkaloids and toxic plants d. Metabolism of toxic substances by aquatic organisms e. Environmental Impact Assessment – Scope and definition of EIA 	
Unit 2	Marine Pharmacology and cosmetology	15 H
	<ul style="list-style-type: none"> a. Marine microorganisms as a source of biomedical resources dinoflagellates as a source of bioactive molecules – b. Antibiotics used in aquaculture c. Marine derived drugs in preclinical and clinical trial- their source, mode of action and targeted diseases d. Cosmeceuticals Derived from Bioactive Substances e. Recent advances in Pharmacology and Scope of Pharmacology 	
Unit 3	Environmental Toxicity	15 H
	<ul style="list-style-type: none"> a. Ecotoxicology of heavy metals- Case studies of arsenic, mercury and cadmium b. Bioaccumulation, biomagnification, Algal bloom & Eutrophication: Causes, consequences and control mechanisms. c. Effects of xenobiotics and their biodegradation in marine life d. Bioremediation in the Marine Environment e. Algae as bio-indicator of pollution f. Toxicity of Petroleum Hydrocarbons; Ecological Impact of Oil Pollution 	
Unit 4	Screening of Toxins and Instrumentation	15 H
	<ul style="list-style-type: none"> a. High throughput screening strategies: In vitro biochemical and cell based assays; b. Anticancer activity screening assays: Brine shrimp lethality assay c. Determination of Paralytic Shellfish Toxins and Tetrodotoxin in Shellfish d. Toxicity testing methods e. Fluorescence Microscopy, Spectrophotometers, Enzyme Linked Immunosorbent Assay (ELISA) 	

Semester III: Marine Toxicology- (Electives-2)	
Course Code: VGVPSSELOC402	(Internal Assessment Pattern)
Marks: 40	
1. Presentation	20 marks
2 Assignment: (Based on Theory Unit 1,2,3 and 4)	10 marks
3 Class Participation and Overall conduct	10 Marks

Semester IV: Marine Toxicology		Electives 2	
Course Code: VGVPSSELOC402		(Theory Paper Pattern)	
Duration: 2.5 hrs		Marks: 60	
Q.1.A. Answer the following (Any one): Unit 1 A) OR A)		06 Marks	
Q.1. B) Attempt any two of the following: Unit 1 a) b) c)		06 Marks	
Q.2.A. Answer the following: (Any one) Unit 2 A) OR A)		06 Marks	
Q.2. B) Attempt any two of the following: Unit 2 a) b) c)		06 Marks	
Q.3.A. Answer the following: (Any one) Unit 3 A) OR A)		06 Marks	
Q.3. B) Attempt any two of the following: Unit 3 a) b) c)		06 Marks	
Q.4.A. Answer the following: (Any one) Unit 4 A) OR A)		06 Marks	
Q.4. B) Attempt any two of the following: Unit 4 a) b) c)		06 Marks	
Q.5. Write a note on (All questions are compulsory) a) Unit 1 b) Unit 2 c) Unit 3 d) Unit 4		12 Marks	

Course Outcome- Electives 2**Course Code: VGVPSSELOC402**

After the completion of the course, students will be able to

CO1 The students will gain knowledge about the identification and sources of toxins in the marine environment.

CO2 The students will be able to analyze the effective techniques to reduce the impact of toxins on the marine organisms.

CO3 The students would acquire knowledge about the applications of marine resources in medicines and cosmetics.

CO4 The students would be able to explore the techniques for the screening of the toxins in marine environment.

References

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Semester – IV**Practicals- Mandatory****Course Code: VGVPSMOCP401****Credits: 2****Based on Capture Fisheries, Brackish and Marine Water Aquaculture & Industrial Fishery**

Sr.No.	List of Experiments
1.	Study of Stages of Fish eggs and Plotting the frequency polygon by ova diameter measurement.
2.	Biometric studies of fish / prawn b) Study of relationship between total length and standard length / head length / body depth length / body weight. c) Calculate correlation (standard length and total length, head length and total

	length, body depth and total length). Calculate the index values for various relationships
3.	Extraction of Gelatin from Fish as a by-product.
4.	Extraction of Chitin from Prawn shell wastes.
5.	<p>Identification, Classification of Marine fishes w.r.t. Fishery Aspects on the following: List of Marine fishes:</p> <p>A. Elasmobranchs:</p> <ol style="list-style-type: none"> 1. Family Carcharidae: <i>Carcharias</i> <i>sps.</i>, <i>Zygaena malleus</i> 2. Family Rhinobatidae: <i>Rhynchobatus djiddensis</i> 3. Family Trygonidae: <i>Himantura uarnak</i> (<i>Trygon urnak</i>) <p>B. Teleost:</p> <ol style="list-style-type: none"> 1. Family Percidae: <i>Lutjanus johnii</i>, <i>Therapon</i> <i>sps.</i>, <i>Nemipterus japonicus</i> (<i>Synagris japonicus</i>) 2. Family Squamipinnes: <i>Scatophagus argus</i> 3. Family Polynemidae: <i>Eleutheronema tetradactylum</i> <i>Polynemus tetradactylus</i> 4. Family Sciaenidae: <i>Sciaena</i> <i>sps.</i> 5. Family Trichuridae: <i>Lepturacanthus savala</i> (<i>Trichiurus savala</i>) (<i>haumela</i>) 6. Family Carangidae: <i>Caranx rottleri</i> 7. Family Stromatidae: <i>Pampus argenteus</i>, <i>Pampus chinensis</i> <i>Stromateus sinensis</i> 8. Family Scombridae: <i>Rastrelliger kanagurta</i>, <i>Cybium guttatum</i> 9. Family Gobidae: <i>Boleophthalmus</i> <i>sps.</i> 10. Family Mugillidae: <i>Mugil</i> <i>sps.</i> 11. Family Pleuronectidae: <i>Psettodes erumei</i>, <i>Cynoglossus elongatus</i> 12. Family Scopelidae: <i>Saurida tumbil</i>, <i>Harpodon nehereus</i> 13. Family Sombrosocidae: <i>Strongylura strongylura</i> (<i>Belone stongylurus</i>), <i>Hemiramphus</i> <i>sps.</i> 14. Family Clupeidae: <i>Sardinella longiceps</i> (<i>Clupea longiceps</i>) 15. Family Chirocentridae: <i>Chirocentrus dorab</i> 16. Family Muraenesox: <i>Muraenesox</i> <i>sps.</i>
6.	<p>Study of crafts and gears used on the East and West coast of India.</p> <p>Fishing Crafts: Dinghy, Coracle, Masula, Dhoni boat, Plant built boat, Dugout Canoe, Trawler</p> <p>Fishing Gears: Hook and line, Gill net, Cast net, Drag net, Purse seine, Box trap</p>
7.	<p>Identification of Fin fish and shell fish diseases</p> <ol style="list-style-type: none"> a) Fungal Diseases – Saprolegniasis, Branchiomycosis b) Bacterial Diseases – Fin and Tail rot, Ulcer diseases, Dropsy, Eye diseases, Ferunculosis, Bacterial Gill diseases, ERM, Edwardsiellosis, Vibriosis c) Protozoan Diseases – White spot diseases, Costiasis, Trichodinosis, Whirling disease d) Metazoans – Dactylogyrus, Gyrodactylus, Hirodinosis, Lernaea, Argulus e) Viral diseases – IPN, IHN, VHs, CCVD, EUS.
8.	<p>Aquaculture medicines and its importance in fisheries: Geotox, aquanone, Bio-ox, sodium chloride, formalin, malachite green, methylene blue, potassium permanganate, hydrogen per oxide and glutaraldehyde phostoxin, dipterex, antimicrobials, copper sulphate, sumithion, melathion</p>

9.	<p>Identification of packaging materials:</p> <p>a) Simple & Lacquered Cans b) Polyolefin Films c) Waxed Duplex cartons d) Retort Pouches e) Corrugated Fibre Board box</p>
10.	Preparation of value added product / by-product: Prawn Pickle /Fish body oil / Fish meal
11.	<p>Visit to Intertidal Zones/ National Part/ Sanctuaries/Local fish markets</p> <p style="text-align: center;">OR</p> <p>Fish market survey to study (Any one):</p> <p>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</p>

Practical based on Capture Fisheries, Brackish and Marine Water Aquaculture & Industrial Fishery (Practical Paper Pattern)	
Duration: 5 hours	Marks: 50
<p>Major Question:</p> <p>Q.1 Extraction of Gelatin from Fish as a by-product</p> <p style="text-align: center;">OR</p> <p>Q.1 Extraction of Chitin from Prawn shell wastes</p>	12 marks
<p>Minor Question:</p> <p>Q.2 Measure ova diameter and plot a frequency polygon for the given fish.</p> <p style="text-align: center;">OR</p> <p>Q.3 From the data provided present an account of biometric parameters of the given fish.</p> <p>i) Study of relationship between total length and standard length /head length / body depth / body weight. ii) Calculate its correlation</p>	08 marks
<p>Q.3 Identification</p> <p>a) Elasmobranch b) Teleost</p>	08 marks
<p>Q.4 Identification</p> <p>a) Fin fish and shell fish diseases b) Aquaculture medicines and its importance in fisheries c) Identification of packaging materials:</p>	06 marks
Q.5 Report on Visit to Intertidal Zones/ National Part/ Sanctuaries/Local fish markets/ Fish market survey to study	06 marks
Q.6. Viva voce based on Theory.	05 marks
Q.7 Journal.	05 Marks

Semester – IV
Practicals- Electives 1
Course Code: VGVPSSELOCP401
Credits: 2

Practical based on Dissertation

- The Practical of Semester 4 Elective Paper-1 comprises the Research Project for which students will have to take up a particular topic based on which they will be doing research applying the ethics of research, methods and methodology, etc.
- They are expected to abide by rules of Scientific Research and if possible, derive a conclusion for the same. This will help the learners to build a strong foundation for pursuing research.
- Learners will acquaint themselves with the preparation of layout, structure and language of typical reports, illustrations and tables.
- Learners will gain the knowledge about how to write bibliography, referencing and footnotes in reports and thesis or in research articles. Further, learners will be oriented to presentation of data through effective communication with the help of advanced visual technology.
- In addition to that they will be aware about the application of results, environmental impacts, conservation of biodiversity, ethical issues and ethical committees.
- The practical should be organized in such a manner that learners can be trained to manage large data sets generated via multiple observations, arrange them in a proper format and present them in relevant graphs/charts by adopting a hands-on in silico approach.

Semester IV: Presentation of Dissertation- Electives 1	
Course Code: VGVPSSELOCP401	(Practical Paper Pattern)
Duration: 5 hrs	50 Marks
1. Content of Presentation	10 marks
2. Quality of Presentation	10 marks
3. Presentation Skill	10 marks
4. Quality of Work	10 marks
5. Viva based on Proposal / Question Answer Session	10 marks

Semester – IV
Practicals- Electives 2
Course Code: VGVPSSELOCP402
Credits: 2

Based on Marine Toxicology

The practical based on Marine Toxicology comprises of internship/Short term Research work at Research Institute Internship Program. In this project work, the students would gain knowledge about the concepts in Marine Toxicology and get hands-on-experience in the different arenas of Oceanography. The internship would also provide an insight towards

research orientation and methodology. The following are the topics which can be covered under the Internship Program:

1. Basics of Oceanography
2. Identification and counting of Zooplankton
3. Interpretation of satellite imageries and GIS data
4. Instrumentation used in Marine Sciences
5. Analysis of toxins
6. Isolation and extraction of Bioactive compounds
7. Extraction of sustainable marine by-products
8. Biodiversity study of marine protected areas
9. Extraction of Squalene
10. Morphometrics of Marine fishes

Semester IV: Presentation of Internship Report- Electives 2

Course Code: VGVPSSELOCP402 (Practical Paper Pattern)

Duration: 5 hrs	50 Marks
1. Content of Presentation	10 marks
2. Quality of Presentation	10 marks
3. Presentation Skill	10 marks
4. Quality of Work	10 marks
5. Viva based on Proposal / Question Answer Session	10 marks

Semester – IV

RESEARCH PROJECT (RP)

Course Code: VGVPSRPOC401

Credits: 6

- The Semester 4 Research Project (RP) comprises of the Research work, which can include Internship and Training work as a part of Research project, for which students will have to select a research problem and apply the ethics of research, methodology and its implications.
- The Research Project Report has to be submitted with Results of the study and Conclusion.
- Learners will also acquire the knowledge of a Research design according to the topic.
- Learners will be able to focus on the insights of data documentation, instrumentation and scientific writing
- The learners will be trained in research orientation with awareness pertaining to socio-economic and environmental problems with a multi-disciplinary approach.

EVALUATION OF RESEARCH PROJECT (RP)
1. Title of the Project
2. Purpose of the Research Work/ Rationale
3. Materials and Methods
4. Observations and / Results
5. Interpretation of Observations / Results and Discussion
6. Conclusion and / Recommendation
7. Relevant work / Justification of work with Project title & Research Design
8. Relevant References
9. Certified Research Project Report

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