



Hindi Vidya Prachar Samiti's
Ramniranjan Jhunjhunwala College
of Arts, Science & Commerce
(Empowered Autonomous College)

Affiliated to
UNIVERSITY OF MUMBAI

SYLLABUS FOR M.Sc-II.
SEMESTER : III & IV
PROGRAM : M.SC. ZOOLOGY
PROGRAM CODE : RJSPGZOO
NATIONAL EDUCATION POLICY (NEP 2020)
LEVEL 6.0
(CBCS 2024-2025)

SEMESTER- III

OPEN ELECTIVE -II OCEANOGRAPHY AND FISHERY SCIENCE

M.Sc - II Zoology Syllabus Semester III & IV

SEMESTER-III (THEORY)		L	Cr
Paper-I : Physical Oceanography, Biological Oceanography, Oceanographic Instruments, Fish And Fisheries Science Paper Code: RJSPGZOOE302		60	4
UNIT I: Physical Oceanography I		15	
1	1.1Physical properties of sea water- Molecular properties of water 1.2Sound in the sea Light in the sea Colour of sea water- 1.3Pressure-Temperature-Salinity and Conductivity- 1.4Density of sea water,Effects of temperature and salinity on density-Potential ,Specific volume and specific volume anomaly		
UNIT II: Biological Oceanography.		15	
2	2.1 Sea as a biological environment. 2.2 Division of marine environment. a) Marine biotic diversity: Marine bacteria, Plankton, Nekton, Benthos b)Intertidal organisms and their zonation. 2.3Adaptations of Marine life with respect Light, Temperature, Salinity. 2.4 Currents: Role in nutrition, transportation and propogation.		
UNIT III: Oceanographic Instruments		15	
	3.1Sea Water sampling system: Reversing Nansen bottles, Reversing thermometer, Secchi disc, Stempel's pipette and dilution jar, plankton nets and continuous plankton net. Trawl. 3.2 Sediment sampling system: Grab (Peterson and Van veen) for benthos collection, naturalist's dredge (Ekman Sanders deep sea anchor dredge) 3.3 Underwater photography, remote sensing and satellite imaging, SCUBA apparatus. Case Study: Oceanographic Expeditions: Challenger, Indian Ocean and Antarctic ,Law of sea.		
Unit IV: Fish And Fisheries Science		15	
4	Fish processing and marketing strategies. 3.1. Introduction to fishery science- Francis Day and FAO. 3.2. Major commercial fisheries: a) Elasmobranchs (shark and ray) b)Teleosts: Sciaenoids, Indian salmon, Seer fish, Mackerel, Sardine, Sole fish, Harpodon, Ribbon fish fisheries. c) Crustacean fisheries: Prawns , Lobster and Crab d) Molluscan fisheries. Case Study: Dipping trend of sardine fishery in India.		

M.Sc-II	Semester III Theory
RJSPGZOOE101 Paper-I Physical Oceanography, Biological Oceanography, Oceanographic Instruments, Fish And Fisheries Science	LEARNING OBJECTIVES : 1. To demonstrate a scientific understanding of the physical and biological oceanography. 2. To enable the learner to understand the basics of oceanographic instruments. 3. To understand fish resources. COURSE OUTCOMES : 1. A comprehensive understanding of the multi-disciplinary nature of ocean sciences including physical, biological oceanography. 2. Knowledge of habitats in the ocean, marine organisms and predator-prey relations between them. 3. Knowledge of surface and deep ocean circulation and their driving mechanisms.

**OPEN ELECTIVE: OCEANOGRAPHY AND FISHERY SCIENCE
PRACTICALS FOR SEMESTER III**

1. To measure the conductivity of the given water sample.
2. To estimate the salinity /density of the given water sample by refractometer.

3. Identification of intertidal organisms:
 - a) Rocky shore- Patella, Chiton, Fissurella, Mytilus species, *Perna viridis*, Cardium, Balanus, Gorgonids, Littorina and Corals.
 - b) Sandy shore: Solen, Umbo, Oliva, Pea crab, Fiddler crab, Molluscan shells, Star fish and Balanoglossus.
 - c) Muddy shore: Lingula, Chaetopterus, Arenicola, Tubiculus worm and Mud skipper.

4. 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.

5. Identification and classification of Marine fishes
 - List of Marine fishes
 - Elasmobranchs
 - Teleosts

6. Crustacean fishery
 - (*Penaeus monodon*, *P. indicus*, *M. monoceros*, *P. stylifera*, *Solenocera indica*,
 - *Nematopaleomon*, *Acetes indicus*).

7. Molluscan fishery
 - (*Meretrix*, *Perna viridis*, *Katylisia* sps., *Crassostrea* sps., *Xancus pyrum*, *Solen kemp*,
 - Cuttle fish and gastropods).

SEMESTER- IV

OPEN ELECTIVE -II OCEANOGRAPHY AND FISHERY SCIENCE

M.Sc - II Zoology Syllabus Semester III & IV

SEMESTER-IV (THEORY)		L	Cr
Paper-I: Physical Oceanography II, Marine Ecology and Bio-deterioration, Marine Geology, Fish processing and marketing strategies COURSE CODE: RJSPGZOOE402		60	4
UNIT I: Physical Oceanography II		15	
	1.1 Vertical circulation: wind induced circulation, Thermohaline circulation and upwelling of water. 1.2 Waves: Characteristics of waves, deep water and shallow water waves, transitional waves, wind generated waves, internal waves and Tsunami 1.3 Tides: Tides generating forces, equilibrium theory of tides, dynamic theory of tides, tides as a source of power. 1.4 Currents: Types of currents, major currents of the world, Coriolis effect and El Nino effect.		
UNIT II: Marine Ecology and Bio-deterioration.		15	
	2.1. Marine algae and plankton in relation to fisheries. Indicator species, Ecology of harmful algal blooms – causative species, bloom formation, decomposition and its impact on ecosystem function 2.2 Introduced species and marine bio-invasion: – concept, alien species and effect on local ecosystem function. 2.3 Fouling and Boring organisms: – larvae and their adherence to substratum, mechanism, implications and control Case Study: Mussels as an Invasive species.		
UNIT III : Marine Geology		15	
3	3.1 Sea bed minerals with emphasis on Indian ocean – Polymetallic nodules, phosphorites, carbonates, placer deposits and petroleum resources, gas hydrates. 3.2 Fossilization process – Types of microfossils and classification 3.3 Role of microfossils in paleo – oceanography, paleoclimate, marine archaeology, petroleum exploration and monitoring marine pollution & mitigation.		
Unit IV : Fish processing and marketing strategies		15	
4	4.1 Biochemical composition of fish, fish spoilage and need for preservation. 4.2 Techniques in fish preservation- Traditional and modern 4.3 Design of fish processing plant: Site selection, design and preparation of layout of processing plants - freezing plant, cold storage, canning plant, dryers etc, water supply, equipment and effluent treatment. 4.4 Concept of HACCP and MPEDA for quality assurance of seafood products. 4.5 Marketing strategies Case studies: Success story of Gadre Marines, India		

M.Sc - II Zoology Syllabus Semester III & IV

M.Sc-II	Semester IV Theory
RJSPGZOOE401 Paper- I Physical Oceanography II, Marine Ecology and Bio-deterioration, Marine Geology, Fish processing and marketing strategies	Learning Objectives: To enable the learner to explain the configuration of the ocean bottom. To gain the knowledge on basics of marine ecology. To discuss sustainable development of natural resources To understand fish resources and management policies Course Outcome: 1. A comprehensive understanding of the multi-disciplinary nature of ocean sciences physical and geological oceanography. 1. Understanding of mechanisms generating ocean bathymetry and sedimentation. 2. Knowledge of marine resources and marketing skills.

**OPEN ELECTIVE: OCEANOGRAPHY AND FISHERY SCIENCE
PRACTICALS FOR SEMESTER IV**

Practical

1. Collection of marine algae and preparation of herbaria (at least five different forms).
2. Identification of fouling and boring organisms
(*Limnoria* sps., *Lepas*, *Balanus*, *Caprella*, *Teredo*, *Littorina*, *Crassostrea*, *Pellaria/Sertularia*).
3. Estimation of Protein given fish/Prawn sample
4. Estimation of Lipid from given fish/Prawn sample
5. Making of Prawn Pickle.

REFERENCE BOOKS

1. Svedrup et al., The Oceans.
2. Boersma, A., & Haq, B. U. (Eds.). (1978). Introduction to marine micropaleontology. Elsevier. 2.Cam, K. (1972). Beaches and coasts.Edward Arnold, London.
3. R.V. Tait, Marine zoology, Oxford press.
4. Skinner, B. J. (1969). Earth resources. Englewood Cliffs, N.J.: PrenticeHall.
5. David Ross, Introduction to Oceanography.
6. Teleki, P. G., Dobson, M. R., Moore, J. R., & von Stackelberg, U. (Eds.). (2012). Marine minerals: advances in research and resource assessment (Vol. 194). Springer Science & Business Media.
7. Carl Schliper, Research method in marine biology.
8. Thurman, H. V., & Trujillo, A. P. (2004). Introductory oceanography. Upper Saddle River, N.J: Pearson Prentice Hall.
9. B.F. Chapgar, Sea Shore life of India, SIDGWICK and JACKSON, London
10. D.V. Bal and K.V. Rao, Marine fisheries of India, T-M-H.
11. Russel and Young, The Seas 1995.
12. Nair N.B. and Thampi D.H., Atextbook of marine ecology, T-M-H.
13. Harold Thurman, Introductory oceanography, Prentice Hall. London.
14. Dyer, K. R. (1986). Coastal and estuarine sediment dynamics. Chichester: Wiley.
15. Qasim S.Z., Glimpses of Indian Ocean, Sangum Bodes Ltd. London. Navya Printers,
16. Gross, M. G. (1972). Oceanography: a view of the earth. Englewood Cliffs, N.J: Prentice-Hall. 5.Haq, B. U., & Milliman, J. D. (1985). Marine geology and oceanography of Arabian Sea and coastal Pakistan.
17. Michael King, Fisheries Biology assessment and management, Fishing News Publishers,
18. R. Gordob Pirje, Oceanography.
19. Haq, Bilal U. & Milliman, John D. (1984). Marine geology and oceanography of Arabian Sea and coastal Pakistan. New York : Van Nostrand Reinhold/Scientific and Academic Editions 7.Kennett, J. P. (1982). Marine geology. Prentice Hall INC Englewood, Cliffs, N. J. 07632
20. Newell and Newell, Marine Plankton.
21. Jhingran, Fish and fisheries
22. Komar, P. D. (1976). Beach processes and sedimentation. Englewood Cliffs, N.J: Prentice-Hall.
23. P. Michal, Ecological methods for field and laboratory investigations.
24. Petrushevskaya, M. G., Funnel, B. M., & Riedel, W. R. (1971). Micropaleontology of the Oceans. Hyderabad.

QUESTION PAPER PATTERN FOR THEORY AND PRACTICAL

Semester III/Semester IV(Elective) THEORY EXAMINATION

Maximum Marks: 60

Duration: 2 Hours

Instructions:

- i. All questions are compulsory.
- ii. All questions carry equal marks.
- iii. Draw neat and labelled diagrams wherever necessary.

1. Answer any one questions from the following (Based on Unit I)

- i. 7.5
- ii. 7.5

2. Answer any one questions from the following (Based on Unit II)

- i. 7.5
- ii. 7.5

3. Answer any one questions from the following (Based on Unit III)

- i. 7.5
- ii. 7.5

4. Answer any one questions from the following (Based on Unit IV)

- i. 7.5
- ii. 7.5

Total Marks: 50

M.Sc. ZOOLOGY Semester IV

PRACTICAL EXAMINATION RJSPGZOOEP402

Total Marks: 50

Q1. MAJOR EXPERIMENT

Estimation of Protein given fish/Prawn sample 12M

OR

Estimation of Lipid from given fish/Prawn sample

Q2. Identification of fouling and boring organisms (any three) 09M

Q3. Collection of marine algae and preparation of herbaria (at least five different forms). 10M

Q4. Making of Prawn Pickle and report submission. 09M

Q5. Viva 5M

Q6. Journal 5M

- Candidates are required to present certified journal on the day of practical examination.