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MARINE SCIENCE CREDIT & MARK

<u>CORE PAPERS</u>		<u>Credit Mark</u>	
SEMESTER – I	AECC-I	4	100
	CC-1 : INTRODUCTION OF OCEANOGRAPHY	4	75
	CC-1 : INTRODUCTION OF OCEANOGRAPHY (Practical)	2	25
	CC-2 : INTRODUCTION OF MARINE BIOLOGY	4	75
	CC-2 : INTRODUCTION OF MARINE BIOLOGY (Practical)	2	25
	GE-1A (Theory)	4	75
	GE-1A (Practical)	2	25
SEMESTER – II	AECC-II	4	100
	CC-3 : MARINE GEOLOGY	4	75
	CC-3 : MARINE GEOLOGY (Practical)	2	25
	CC-4 : BIOLOGICAL OCEANOGRAPHY	4	75
	CC-4 : BIOLOGICAL OCEANOGRAPHY (Practical)	2	25
	GE-2A (Theory)	4	75
	GE-2A (Practical)	2	25
SEMESTER – III	CC-5 : MARINE CHEMISTRY	4	75
	CC-5 : MARINE CHEMISTRY (Practical)	2	25
	CC-6 : PHYSICAL OCEANOGRAPHY	4	75
	CC-6 : PHYSICAL OCEANOGRAPHY (Practical)	2	25
	CC-7 : MARINE ECOLOGY AND ZOOGEOGRAPHY	4	75
	CC-7 : MARINE ECOLOGY AND ZOOGEOGRAPHY (Prac.)	2	25
	GE-1B (Theory)	4	75
	GE-1B (Practical)	2	25
	SEC-I	4	100
SEMESTER – IV	CC-8 : GEOLOGICAL OCEANOGRAPHY	4	75
	CC-8 : GEOLOGICAL OCEANOGRAPHY (Practical)	2	25
	CC-9 : PISCICULTURE	4	75
	CC-9 : PISCICULTURE (Practical)	2	25
	CC-10 : MARINE INVERTEBRATES AND THEIR BIOLOGY	4	75
	CC-10 : MARINE INVERTEBRATES AND THEIR BIOLOGY(P)	4	25
	GE-2B (Theory)	4	75
	GE-2B (Practical)	2	25
	SEC-II	4	100
SEMESTER – V	CC-11 : CHEMICAL OCEANOGRAPHY	4	75
	CC-11 : CHEMICAL OCEANOGRAPHY (Practical)	2	25
	CC-12 : ICHTHYOLOGY AND FISHERY BIOLOGY	4	75
	CC-12 : ICHTHYOLOGY AND FISHERY BIOLOGY (Practical)	2	25
	DSE-1 : PLANKTON AND PRODUCTIVITY	4	75
	DSE-1 : PLANKTON AND PRODUCTIVITY (Practical)	2	25
	DSE-2 : MARINE MINERAL RESOURCES	4	75
	DSE-2 : MARINE MINERAL RESOURCES (Practical)	2	25
SEMESTER – VI	CC-13 : METEOROLOGY	4	75
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	CC-14 : MARINE POLLUTION	4	75
	CC-14 : MARINE POLLUTION (Practical)	2	25
	DSE-3 MARINE BIOTECHNOLOGY	4	75
	DSE-3 MARINE BIOTECHNOLOGY (Practical)	2	25
	DSE-4 PROJECT PAPER	4	75
	DSE-4 PROJECT PAPER (Practical)	2	25

Mark Distribution

Core Course: $14 \times 100 = 1400$

DSE : $3 \times 100 = 300$

Project : = 100

GE-1 : $2 \times 100 = 200$

GE-2 : $2 \times 100 = 200$

Ability Enhancement(Compulsory): 2×100

Skill Enhancement Course: 2×100

Total Marks=2400, Total no. of papers=26

Subjects with Practical:

Theory-75 Marks, Practical-25 Marks

Mid Semester Theory-15 Marks, End Semester Theory-60 Marks

There is no Practical Exam. in Mid Semester.

CORE COURSE:MARINE SCIENCE

SEMESTER I - PAPER I – INTRODUCTION TO OCEANOGRAPHY

Maximum Marks: 75(15+60)

Unit I

Geologic history of the oceans - Early history of Oceanography and World exploration.

Seas - Oceans - Ocean floor - Continental shelf - Continental slope - Abyssal basin.

Unit II

Marine instrumentation – Echosounder - marine navigator (GPS) - underwater photography, etc.

Marine structures - vehicles - long term geologic history of oceans.

Unit III

Structure and motion of the ocean and its environments - properties, populations and energy budget.

Oceanic currents - Oceanic water masses and circulation - Ocean waves and Tsunamis.

Unit IV

Ocean resources and exploration - Early expeditions and recent expeditions - Bioresources of the sea - Food production from the sea - Energy production from the sea.

Mineral resources of the sea surface - Manganese and Phosphatic nodules - sub surface mineral resources of the ocean - Petroleum resources.

PRACTICAL

Maximum Marks: 25

Principal and mechanism of different oceanographic instruments-

1. Nansen reversing water bottle
2. Shallow water sampler
3. Reversing thermometers
4. Hydro photometer
5. Secchi Disc
6. Laboratory Record
7. Viva

BOOKS RECOMMENDED

1. Oceanography, Contemporary readings in Ocean Sciences by Gordon Pine.
2. Principles of Physical Oceanography by Allen, J.R.L published., Allen and Unwin
3. Introduction to Physical Oceanography by Knauss, J.A., Prentice-Hall
4. Introduction to Oceanography by Weighpt
5. Physical Geology by Arthur Holmes

CORE COURSE:MARINE SCIENCE

SEMESTER I - PAPER II – INTRODUCTION TO MARINE BIOLOGY

Maximum Marks: 75(15+60)

Unit I

Sea as a biological environment –Major divisions of marine environment, light, temperature and salinity.

Classification of marine environment. Factors influencing the distribution of marine organisms.

Unit II

Phytoplankton and zooplankton - methods of collection, estimation of standing crop, wet and dry weight estimations, plankton volume, settling and displacement methods.

Adaptations of plankton through structural (weight, increase of surface area, flotation) and physiological mechanisms (specific gravity, water content, fat content, mono and divalent ions, gas defensive vacuoles).

Unit III

Organic production - primary and secondary productions, methods of estimation of primary production, factors affecting primary production, regional differences production (in primary and secondary),

Red tide phenomenon - its causes and effects. Phytoplankton and zooplankton interrelations.

Unit IV

Sea weeds - occurrence and distribution in India, economic importance. Sea grasses - morphological and anatomical adaptations, ecological role.

Mangroves and salt marshes - distribution - adaptations (morphological, anatomical and physiological), ecological role, uses, need for conservation.

PRACTICAL

Maximum marks: 25

1. Methods of Phytoplankton collection
2. Methods of Zooplankton collection
3. Methods of estimation of standing crop

4. Methods of estimation of primary production
5. Morphological and ecological adaptations of sea grasses
6. Laboratory Record
7. Viva

BOOKS RECOMMENDED:

1. Plankton and Productivity in the Oceans by J.E.G. Rayment, Pergamon Press, 1973.
2. Phytoplankton by A.D. Boney, Edward, Arnold, London, 1975.
3. Marine Botany: An Introduction, Holt Reinhart and Winston Inc., New York, 1966.
4. The Oceans - their Physics, Chemistry and General Biology by H.U. Svedrup, MW.Johnson and R.H. Fleming, Prentice-Hall Inc., New Jersey, 1959.
5. Marine Botany by J.D Clinton, John Wiley & Sons Inc., 1988

CORE COURSE: MARINE SCIENCE

SEMESTER II - PAPER III – MARINE GEOLOGY

Maximum Marks: 75(15+60)

Unit I

Introduction to Marine Geology-achievements made in marine geological studies.

Methods of exploring ocean floor such as Echo sounding, Sonagraph or Sonoprse, Under water photography, Gravity and magnetic measurement, Bathymetry and Navigation

Unit II

Geomorphology of the Ocean Floor: Continental shelf, slope rise, abyssal plain, sea mounts and guyots, submarine canyons, mid oceanic ridges and Trenches.

Salient features of Indian Ocean floor-bathymetric charts.

Unit III

Definition, classification and formation of coast and beach- rocky and sandy beaches, bays, inlets and fjords-, beach ridges and cheniers , beach profile and beach morphology

Beach sediment , alongshore and cross- shore sediment transport. Factors controlling geomorphology of beaches

Unit IV

Plate Tectonics- Origin of the earth, internal structure of the earth- the crust, core and mantle, crustal plates in motion, plate boundaries and sea floor spreading

Earthquakes: Definition- Effects- Causes, Volcanoes: Distribution -- Causes -- Effects of volcanic eruptions

PRACTICAL

Maximum Marks: 25

1. Principal and mechanism of marine geological instruments- Hand Auger, Petersen grab, Phleger corer , Lafond Dietz snapper
2. Identification of ocean land forms
3. Identification of volcanoes
4. Seismic zones of India
5. Laboratory Record

6. Viva

BOOKS RECOMMENDED

1. F.P. Shepard. Submarine Geology, Happer and Row, New york,1972
2. J.P.Bird. Beach and Coast.
3. CAM King. Introduction to Submarine Geology.
4. CAM King. Beach and Beach process.
5. H.L. Levin, The Earth through time.
6. M.N. Hil, The Sea, Vol. II
7. J.H. Devis, Geographic Variation in Coastal Development.
8. Marine Geology by Kennet, J.P., Prentice Hall.
9. The sea floor by Seibold, E. and Berger, W.H., Springer-Verlag.
10. Submarine Geology, 1967: F.P. Shepard
11. Dynamic Earth: Plates, Plumes and Mantle Convection 2000: Geoffrey F. Davies
12. Marine Geology, 1982 –James P. Kennet. Prentice Hall INC Englewood, Cliffs, N.J. 07632.
13. Marine geology and oceanography of the Arabian Sea and coastal Pakisthan 1984
Haq. B.U. and Milliman, J.D., Van Norstrand Reinhold Co.
14. Earth resources. 1969 –Skinner, B.J., Prentice Hall
15. Earth Science, 1985 - Mamowitz and Spaulding

CORE COURSE:MARINE SCIENCE

SEMESTER II - PAPER IV – BIOLOGICAL OCEANOGRAPHY

Maximum Marks: 75(15+60)

Unit I

Classification of marine flora - Marine flora - Bacteria, Fungi, Diatoms, Flowering Plants - Chrysophyta, Cyanophyta, Chlorophyta, Pyrrophyta .

Factors affecting marine life. Light, Temperature and Salinity as an ecological factors in marine Environment.

Unit II

Benthic Phycoflora: Blue green algae - Cyanophyta, Green algae (Chlorophyta) - Brown-algae (Phaeophyta) and Red algae (Rhodophyta).

History and study of Sea weeds - Ecology and Geographic distribution of marine flora - Marine environment, zonation, stratification, geographic distributions.

Unit III

Mangrove associations: Distribution of mangrove plants - Nutrient cycling, ecological significance of mangroves, mangrove interactions.

Zoogeographical distribution of flora & fauna in Indian west pacific region.

Unit IV

Calcareous algae and Fossils: Diversity of calcareous marine algae.

Chlorophyta, Phaeophyta, Rhodophyta - Fossil algae.

PRACTICAL

Maximum Marks: 25

1. Collection of Marine flora & fauna from Gopalpur coast.
2. Identification of method of preservation, Herbarium
3. Laboratory Record
4. Viva

BOOKS RECOMMENDED

1. Studies in Cryptogamic Botany - Vol III by M.R. Vijayaraghavan and Inderdeep Kaur, APFI Publishing Corporation, New Delhi, 1997.
2. Studies in Cryptogamic Botany - Vol II by M.R. Vijayaraghavan and Bela Bhatia, APH Publishing Corporation, New Delhi.
3. Cyanophyta by T.V. Desikachary, IARI, New Delhi, 1959.
4. Properties and products of Algae by J.E. Zajic, Plenum Press, New York, 1970.
5. Paleobotany by Arnold.

CORE COURSE:MARINE SCIENCE

SEMESTER III - PAPER V – MARINE CHEMISTRY

Maximum Marks: 75(15+60)

Unit I

Introduction to Marine chemistry: Historical development of Marine chemistry, different experiments conducted in the Indian Ocean like IIOE.

Major and Minor elements in sea water, conditions under which the major elements may not conservative.

Unit II

Elemental composition of sea water, constancy of relative ionic composition of sea water, radioactive nuclides: natural, artificial and cosmogenic.

Concept of Chlorinity and salinity: definition and significance , measurement of salinity , distribution of salinity in the ocean.

Unit III

Chemical processes in oceans- p^H , alkalinity and buffering capacity of sea water, dissolved oxygen in the ocean, dissolved gases(CO_2) in sea water.

Carbon dioxide Equilibria in sea water. Distribution of CO_2 in the atmosphere and sea.

Unit IV

Dissolves gases (other than CO_2) in sea water- Basic concepts: solubility of gases in sea water

Air -- sea exchange, processes affecting their distribution.

PRACTICAL

Maximum Marks: 25

1. Measurement of p^H of sea water by p^H meter
2. Determination of salinity of sea water by Harvey's method
3. Determination of dissolved oxygen by Winklers's method
4. Determination of Alkalinity of sea water
5. Laboratory Record
6. Viva

BOOKS RECOMMENDED

1. Martin, D.P : Marine Chemistry vol 1 & 2
2. Riley J.P & Chester,R : Introduction to Marine Chemistry
3. Riley,J.P & Skirrow,G: Chemical Oceanography
4. Wallace S.Broaker: Chemical Oceanography
5. Harvey: Marine chemistry
6. Chemical oceanography, 1982 –Broecker and Peng.
7. Marine geochemistry 1990 –Chester.
8. Chemical oceanography, 1992 – Millero and Saha, M.L.
9. Marine Chemistry, 1969 –Horne, R.A.
10. Chemical Oceanography, 1996 –F.J.Miller
11. Marine Chemistry (Vol.2), 1970 –Martin, D.F.

CORE COURSE:MARINE SCIENCE

SEMESTER III - PAPER VI – PHYSICAL OCEANOGRAPHY

Maximum Marks: 75(15+60)

Unit I

History of oceanography, dimensions of the oceans, salinity, density, specific volume & Adiabatic changes of sea water.

Physical Properties of sea water: Basic pure water characteristics, colligative, optical and acoustical properties of sea water.

Unit II

Distributions- Vertical and Horizontal distributions of temperature, salinity and density in the oceans.

Heat budget of the oceans: Heat budget equation, Bowen's ratio. Distribution of heat budget components in the oceans.

Unit III

Circulation: T-S diagram , Identification and significance of water masses.

Currents and Circulation in the Indian Ocean southwest and northeast monsoon.

Unit IV

Waves and their properties- wave generation by wind- deep and shallow water waves- effects of waves on sediments and structures- wave refraction and diffraction- impact on beaches, Classification as surface and long waves.

Tides and tidal currents in open and coastal oceans- Tide generating forces and Equilibrium tides- characteristics and distribution of tides and currents in estuaries. Tidal constituents and classification .Sea level fluctuation and changes.

PRACTICAL

Maximum Marks: 25

1. Ekman current meter
2. Bathy Thermograph
3. Vertical distribution of temperature and salinity
4. Conversion of temperature, salinity and sigma- t data for standard depths.

5. Laboratory Record
6. Viva

BOOKS RECOMMENDED

1. Principles of Physical Oceanography by Allen, J.R.L published, Allen and Unwin
2. Introduction to Physical Oceanography by Knauss, J.A., Prentice-Hall
3. The waters of the sea by P. Groen., Van Nostrand
4. Wind waves: Their generation and propagation on the Ocean Surface by Kinsman, B., Prentice-Hall.
5. Pickard G.L. Descriptive physical Oceanography, Pergammon Press Oxford, 1963.
6. Open University of U.K. Sea water: its composition, properties and behaviour. Pergammon Press.
7. Open University of U.K. Ocean circulation. Pergammon Press
8. W.Von Arx. An introduction to Physical Oceanography
9. Davis,A. Principles of Oceanography.
10. Joseph Weisberg & Howard Parish. Introductory Oceanography. Pergammon Press.
11. M. Tomczak. Regional Oceanography. Daya Publishing House, New Delhi
12. A.S.N.Murty & V.S.N.Murty. Physical Oceanography, A.P.H Publishing Co, NewDelhi,2010.
13. Open university of U.K: Waves, Tides & shallow water processes. Pergamon press
14. King, C. A., & King, C. A. M. (1972). Beaches and coasts.
15. King, C. A.,& King, C. A. M. (1975).Introduction to physical and biological oceanography (pp. p- 372). London: Edward Arnold.
16. T.Shibayama: Coastal processes, World Scientific Publication
17. Pond, S., & Pickard, G. L. (2013).Introductory dynamical oceanography. Elsevier.
18. Pedlosky, J. (2013).Geophysical fluid dynamics. Springer Science & Business Media.

CORE COURSE: MARINE SCIENCE

SEMESTER III - PAPER V11 – MARINE ECOLOGY AND ZOOGEOGRAPHY

Maximum Marks: 75(15+60)

Unit I

Marine environment - ecological factors - light, temperature, salinity, pressure, pelagic environment, planktonic and nektonic adaptations, benthic environment - intertidal, interstitial and adaptation

Other coastal environments - coral reefs, estuaries, mangroves, sea grass beds, forests, polar seas and hydrothermal vent - Marine zoogeography.

Unit II

Marine ecosystem concept - ecosystem structure and function, food chain, food-web, ecological pyramid, energy flow.

Population ecology - group attributes, population growth, population density variation, carrying capacity, dispersal, prey-predator relationship, density dependent and independent factors.

Unit III

Community ecology - structure and composition, diversity and stability, concept of niche, succession.

Community wise adaptation - fouling and boring community, animal association in the sea

Unit IV

Marine biodiversity - definition and importance, biodiversity assessment techniques - Marine resources, Fisheries - Pelagic - Benthic and non biological.

Threats to marine biodiversity, overexploitation, physical alteration, pollution, alien species

PRACTICAL

Maximum Marks: 25

1. Method of collection of benthos & their distribution.
2. Methods to study coral reefs and sea grass beds
3. Laboratory Record
4. Viva

BOOKS RECOMMENDED:

1. Marine Biology - An Ecological Approach (Fourth Edition) by J.W. Nybakken, Addison Wesley Edu. Pub. inc., 1997.
2. An introduction to Marine Ecology (Third edition) by R.S.K. Barnes and R.N. Hughes, Blackwell Science, 1999
3. Basic Ecology by E.P. Odum, Saunders College Publications, Philadelphia, 1987.
4. Marine Ecology by J.S. Levinton, Prentice-Hall Inc., New Jersey.
5. Environmental Science - A study of interrelationships (Sixth Edition) WCB/McGraw Hill, 1995.

CORE COURSE:MARINE SCIENCE

SEMESTER IV - PAPER VIII – GEOLOGICAL OCEANOGRAPHY

Maximum Marks: 75(15+60)

Unit I

Defination and classification of estuaries, formation of coastal lagoon and Deltas.

Sedimentation and circulation in different kind of estuaries

Spits , bars, Barriers, coastal barriers and barrier islands, tidal flats, Bars and troughs Source, classification and distribution of marine sediment .Rate of sedimentation and age determination

Unit II

Geological Time Scale: Introduction, the standard geological time scale. Age of the earth and its determination.

Life through Time: The nature of the fossil record, Fossil formation and classification.

Organic evalution,fossil and Stratigraphy

Unit III

Marine sediment: Source, classification and distribution , Rate of sedimentation and age determination

Study of marine minerals, polymetallic manganese nodules and their distribution and mineralogy. Beach Placers with special reference to Indian coast.

Unit IV

Definition- Rocks-, their general classification into igneous, sedimentary and metamorphic-

Forms and structures of igneous rocks- Textures- Classification of igneous rocks,

Classification of sedimentary rocks- Textures and structures of sedimentary rocks

Definition- agents and kinds of metamorphism- Zones, and grades and facies of metamorphism- Textures and Structures of metamorphic rocks.

PRACTICAL

Maximum Marks: 25

1. Megascopic Identification of Igneous and Metamorphic rocks.
2. Microscopic Identification of Igneous and Metamorphic rocks.

3. Estimation of Calcium carbonate in marine sediments.
4. Heavy mineral separation by gravity method.
5. Laboratory Record.
6. Viva.

BOOKS RECOMMENDED

1. Sheppard, F.P, 1967: Submarine Geology
2. Lauff, G.H: Estuaries
3. P.D.Komar: Shore Processes and sedimentation
4. Ippen, A.T: estuary and coastline hydrodynamics
5. Bird, E.C: Coasts –An introduction to systematic geomorphology
6. Petrography and Petrology by F.F. Grout, McGraw Hill, New York, 1932
7. Theoretical Petrology by T.F.W. Barth, John Wiley and Sons, New York, 1952
8. The Evolution of Igneous rocks by N.L. Bowen, Princeton University Press, Princeton, 1956.
9. The Origin of Metamorphic and Metasomatic Rocks by H.Ramberg, University of Chicago Press, Chicago, 1958
10. Igneous and Metamorphic Petrology by F.J. Turner and J. Verhoogen. McGraw Hill, New York, 1960.
11. Petrology of Igneous rocks by Hatch and Wells, Thomas Murphy, 1961.
12. Petrology by W.T. Haug, McGraw Hill Book Co, 1962.
13. Metamorphic Petrology By F.J. Turner and J. Verhoogen, McGraw Hill, New York, 1968.
14. The Sedimentary Rocks By F.H. Hatch and R.H Rastal, London, 1971.
15. Petrology of Igneous and Metamorphic Rocks by Donald W. Hyndman, McGraw Hill Book, 1972.

CORE COURSE: MARINE SCIENCE

SEMESTER IV - PAPER 1X – PISCICULTURE

Maximum Marks: 75(15+60)

Unit I

Fundamentals of Aquaculture, scope and importance of coastal aquaculture.

Intensive culture of Indian major carps, design and construction of fish farm, induced breeding.

Unit II

Methods of collection, packing and transport of fish seed. Common aquatic weeds in fish farm and their methods of control. Construction of aqua farms. Design and construction of a shrimp hatchery, selection of site for brackish water fish farm.

Culture of tiger, white and brown shrimps- Traditional, Extensive, semi-intensive and intensive system at culture. Monoculture and polyculture of shrimps. Cages, pen and Raft culture.

Unit III

Culture of important Marine and Brackish water species. Culture of Mullet, Milk fish, crabs, oysters, mussels and sea weeds.

Feeding habits, growth, reproductive capacity and life history of fresh water prawn.

Unit IV

Rearing and culture of ornamental fishes. Economic criteria and market value.

Turtle resources of India with special reference to Odisha coast. Effect of pollution on Aquaculture. Fish diseases in culture fishes.

PRACTICAL

Maximum Marks: 25

1. Identification of Indian major carps & their seeds.
2. Collection & Identification Aquatic weeds
3. Collection of shrimps & Identification of shrimps seeds.
4. Laboratory Record
5. Viva

BOOKS RECOMMENDED

1. Bardach, J.E.J.A Ryther and N.D.M.C. Larney 1972: Aquaculture, Farming and Husbandry of fresh and Marine Organics Wiley Interscience, New York.
2. Milne, P.H. 1972, Fish and shell fish farming in coastal waters. Fishing News (Books) Limited, London.
3. Inversion, E.s. 1976, Farming on the edge of the sea. Fishing News (Books) Limited, London.
4. Pillay, T.R. ed. 1982, Coastal aquaculture in Indo-Pacific region, Fishing News (Books) Limited London.
5. Nayak. L. 2001, Recent trends in aquaculture, Berhampur University.
6. Dey, V.K. Ornamental fishes, hand book on Aquafarming, Presented by MPEDA, Kochi.
7. Bal. D.V. and D.V.Rao, 1984. Marine Fisheries Tata, Mc.Graw. Hill Publishing Co.Ltd., New Delhi.
8. Chapman V.J. 1980: Sea weeds and their uses, Chapmans Hall, London.
9. Jhingran V.G. 1972, Fish and fisheries of India, Hindustan Publishing corporation Ltd. New Delhi.
10. Kurien C.V. and Subastian, V.O. 1982, Prawn and Prawn fisheries of India, Hindustan Publishing Corporation (India), Delhi.
11. Meske, C. 1985, Fish aquaculture-technology and experiments, Pergamon Press Ltd. London.
12. Guasim, S.Z. 1998, Glimpses at the Indian Ocean, University Press (India) Hyderabad.

CORE COURSE: MARINE SCIENCE

SEMESTER IV - PAPER X – MARINE INVERTEBRATES AND THEIR BIOLOGY

Maximum Marks: 75(15+60)

Unit-1

Classification: Life History and foraminefora & Radiolaria, relationship of Protozoa and sponges.

Polymorphism- Life history. Theories on Coral reefs- Distribution.

Unit-II

Classification – Morphology Reproduction and adaptive radiation.

Functional Morphology – Development and Evolution of the of Entoprocta.

Unit III

Chaetognath – Classification, Distribution, Morphology and Anatomy. Embryology and evolution.

Brachiopoda- Classification . Morphology- Crustacean appendages, Larval forms and evolution - Paleontology.

Unit IV

Mollusca: Classification- General characters and phylogenetic relationships- Adaptive radiation.

Echinodermata: Water vascular system, larva- their comparative morphology and evolution.

PRACTICAL

Maximum Marks: 25

1. Study of museum Specimens and prepared slides: Protozoa, Noctiluca, Ceratium, Elephidium, Radiolarian ooze, Porifera, Sycon, Spongiella, Chalina, Euspongia, Hylonema, Coelenterata corallium
2. Study of permanent slides of Crustacean larva
3. Study of larval forms of Echinodermata
4. Laboratory Record
5. Viva

BOOKS RECOMMENDED

1. Hyman, L. 1967. The Invertebrate Zoology, Vol.I to VI. Mc. Graw Hill Book. Co. Ltd. New York.
2. Kaestner, A. 1967. Invertebrate Zoology Vols.I to III, Wiley Interscience Publishers, New York.
3. Barnes, R.D. 1974, Invertebrate Zoology. Toppan Company Ltd. Tokyo, Japan.
4. Young, C. M. The Living Seashore.
5. Hedgepetch, J.W. A tretlse on Marine Ecology and Paleoecology (Vol-I & II).

CORE COURSE:MARINE SCIENCE

SEMESTER V - PAPER XI – CHEMICAL OCEANOGRAPHY

Maximum Marks: 75(15+60)

Unit I

Major and minor constituents of sea water. Factors affecting the distribution of trace elements in the sea and their significance. Residence times of elements in the sea water.

Trace metals and their interaction with biological system. Determination of trace metals- Principal and different components of Atomic absorption spectrophotometer.

Unit II

Nutrient Cycle in the Ocean: Nitrogen and Phosphorous cycles in the oceans.

CNP ratio. Distribution of Nitrogen and Phosphorous in the oceans.

Unit III

Origin, nature and ecological Effects of Dissolved Organic Matter in the Sea. Fate of dissolved organic mater and distribution of Dissolved Organic Carbon in the sea

Nature and Origen of Particulate Matter in the sea. Ecological Significance and Fate of Prticulate Organic Matter and distribution of Particulate Organic Carbon in the sea.

Unit IV

Marine Corrosion: Causes of corrosion and its prevention, protection and biofouling .

Desalination: Desalination and recovery of essential chemicals from the sea. Different desalination techniques –solar still, diffusion, humidification, distillation, freezing electro-dialysis, ion exchange and hydration processes.

PRACTICAL

Maximum Marks: 25

1. Estimation of Ca & Mg
2. Estimation of Nitrate
3. Estimation of Nitrite
4. Estimation of Phosphate
5. Spectrophotometer
6. Laboratory Record

7. Viva

BOOKS RECOMMENDED

1. Riley J.P & Chester,R : Introduction to Marine Chemistry
2. Riley,J.P & Skirrow,G: Chemical Oceanography
3. Wallace S.Broaker: Chemical Oceanography
4. Chemical oceanography, 1982 –Broecker and Peng.
5. Chemical oceanography, 1992 – Millero andSaha, M.L.
6. Marine Chemistry, 1969 --Horne, R.A.
7. Chemical Oceanography, 1996 –F.J.Miller
8. Marine Chemistry (Vol.2), 1970 –Martin, D.F.

CORE COURSE: MARINE SCIENCE

SEMESTER V - PAPER XII – ICHTHYOLOGY AND FISHERY BIOLOGY

Maximum Marks: 75(15+60)

Unit I

Habit and habitat of fishes: General morphology and outline classification of fishes: major fisheries of the world and their characteristics.

Basic anatomy of fishes. Detail structure and function of gills, types of air breathing organs in fishes.

Unit II

Structure and function of swim bladder. Food and feeding habit of pelagic and demersal fishes.

Reproductive system in fishes and reproductive mechanism. Fish migration and factors affecting migration. Age determination in fishes. Types of pelagic and demersal fish eggs. Electrical organs in fishes and their function.

Unit III

Major marine fisheries in India: Methods of resource assessment: Survey of fish eggs and fish larva with reference to fish population features.

General attributes of fish population growth. Principles of tagging in fish population studies and their significance.

Unit IV

Oceanography in relation to fisheries. The major marine fishery resources of Indian seas.

Sardine, Mackerel, Pomfrets, Tuna and Hilsha fishery resources. The fisheries of Chilika lake.

PRACTICAL

Maximum Marks: 25

1. Collection of Fishes & their identification. Museum specimens.
2. Dissection of fishes
3. Measurement of fecundity in fishes
4. Laboratory Record

5. Viva

BOOKS RECOMMENDED

1. K.F, Lagler T.E. Bardach and R.R. Miller, 1962. Ichthyology. John Wiley and Sons and Inc. New York.
2. Carl, E. Bond, 1979. Biology of fish, W.B. Saunders Company. Philadelphia.
3. King, M. 1995. Fisheries biology Assessment and Management. Fishery News Books.
4. Jones, E.R.H. 1980. Fish Migration Edward Arnold Ltd, London.
5. Nikolski, G.V. 1969. Theory of fish population dynamics as the biological background for rational exploitation and management of fishery resources. Otto Roeltz Science publishers. Berlin.
6. Saint and Shury: Commercial fishery methods.
7. D.V. Bal and K.V. Rao, 1984: Marine Fisheries.
8. Jhingran, J., V: Fish and Fisheries of India

CORE COURSE:MARINE SCIENCE

SEMESTER VI - PAPER XIII – METEOROLOGY

Maximum Marks: 75(15+60)

Unit I

Introduction- Revolution and Rotation of the earth around the sun and associated seasons. Origin, Composition and Structure of the atmosphere. Vertical distribution of temperature and associated layers.

Electromagnetic spectrum and solar radiation, Radiation balance of the earth- atmosphere system. Greenhouse effect. Relative, absolute and specific humidity, Mixing ratio, Dew point temperature, Dry and wet bulb temperature.

Unit II

Classification and distribution of Fog and Clouds. Types of Precipitation, Precipitation process and its distribution. Different forms of precipitation. Theories of formation of precipitation-Bergeron Findeisen and Accretion processes.

Introduction to Air masses and their classification, fronts and frontogenesis.

Unit III

Definition of monsoon, areas of occurrence, Concepts of origin of monsoon-Thermal concept, Aerological concept and Flohn's concept. Synoptic features associated with monsoon. The Indian monsoon.

Definition of tropical cyclones, areas of formation, structure and conditions favourable for tropical cyclone genesis, classification and concept.

Unit IV

Koppen and Thornthwaite's schemes of climatic classification, Water balance.

General circulation of the atmosphere, ozone hole and global warming. El Nino and La Nina, their mechanisms- global change- storms and hurricanes- methods and measurements.

PRACTICAL

Maximum Marks: 25

1. Measurements of air temperature
2. Measurement of pressure,

3. Measurement of surface and upper wind speed & direction
4. Measurement of humidity
5. Measurement of and rain fall.
6. Laboratory Record
7. Viva

BOOKS RECOMMENDED

1. Fairs Rhode Bridge. Encyclopodia of Atmospheric Sciences.
2. S.Peterson, 1941. Introduction to Meteorology. Mcgraw-Hill BookCompany, Inc.
3. Duxbury, A. C. (2013). The Earth and Its Ocean.
4. J.S. Fein and P.L. Stephens, Monsoons, Wiley Interscience
5. World Meteorological Organisation,. International Cloud AtlasWallace, J. M., & Hobbs, P. V., 2006. Atmospheric science: an introductory survey(Vol. 92) Academic press.
6. G.G.Tarakanov, Tropical Meteorology, MIR Publishers
7. G.P.Srivastava, Surface meteorological instruments and measurement practices, Atlantic Publisher, New Delhi
8. Hess, S. L. 1979.Introduction to theoretical meteorology. RE Krieger Publishing Company.
9. Trewartha, G. T., & Horn, L. H.,1954. An introduction to climate(Vol. 1961). New York: McGraw-Hill.
10. Critchfield, H. J. H. J.,1966. General climatology.
11. J.S.Fein & P.L.Stephens: Monsoons, Wiley Interscience
12. P.K.Das: Monsoons, NBT Publication
13. Charney, J. G., & Shukla, J. (1981). Predictability of monsoons. Monsoon dynamics

CORE COURSE: MARINE SCIENCE

SEMESTER VI- PAPER XIV –MARINE POLLUTION

Maximum Marks: 75(15+60)

Unit I

Ocean pollution: kinds and quantities of pollutants entering to oceans - ocean dumping , classification of pollution- fate of pollutants - toxic effects and nuclear waste disposal.

Oil spills - disposal of oil platforms and other structures at sea - accomplishments and case studies towards reducing pollutant/contaminant inputs to the ocean.

UNIT II

Plastics in the marine environment - Nature of plastic materials - Potential plastic pollutants - Distribution and impact of plastics - Trace metals as pollutants.

Factors influencing the toxicity of trace metals to marine organisms - Important contaminant metals in marine systems - Mercury, Cadmium, etc.

Unit III

Pollution by sewage and nutrients - discharges by rivers and estuaries - piped outfalls to the sea - sewage and micro-organisms.

Disposal of persistent organic compounds - Effects of persistent organic compounds on marine organisms.

Unit IV

Time scale of global changes in the ecosystem and climate - impact of circulation in atmosphere and ocean on climate, rainfall and agriculture.

Pollution and its effects on fisheries. Heavy metal pollution and its control measures.

PRACTICAL

Maximum Marks: 25

1. Estimation of TDS
2. Estimation of DO
3. Estimation of BOD
4. Estimation of COD
5. Estimation of Total organic carbon in the waters of Gopalpur coast

6. Laboratory Record
7. Viva

BOOKS RECOMMENDED

1. Marine Pollution by Sebastian A. Gerlach, Springer Verlag
2. Marine Pollution by Johnson, R., Academic Press.
3. Chemical Oceanography, Volumes 1 to 9, Academic Press
4. Estuarine Chemistry by Burton and Liss, Academic Press

DISPLANERY SPECIFIC ELECTIVE (DSE)

SEMESTER V –PAPER- I - PLANKTON AND PRODUCTIVITY

Maximum Marks: 75(15+60)

Unit I

Definition of Phytoplankton and taxonomic classification.

Methods of estimation of standing stock and biomass-Plankton volume-settling and displacement method.

Unit II

Phytoplankton patchiness and factors affecting phytoplankton distribution in the sea.

Phytoplankton blooms-Red Tide phenomena and causes and consequences of phytoplankton blooms. Phytoplankton succession in estuaries and coastal waters.

Unit III

Primary Productivity: Concepts; Methods of estimation of Marine Primary Productivity; Factors affecting primary productivity.

Regional difference in primary production in oceans. Primary Productivity in the Bay of Bengal and the Arabian Sea.

Unit IV

Zooplankton: Definition and taxonomic classification; Horizontal and Vertical distribution of Zooplankton

Factors affecting the Zooplankton distribution

PRACTICAL

Maximum Marks: 25

1. Field collection and Identification of Phytoplankton
2. Field collection and Identification of Zooplankton
3. Identification of locally available microalgae and sea grass
4. Laboratory Record
5. Viva

BOOKS RECOMMENDED

1. Raymont, J.E. G, 1973. Plankton and Productivity in the Ocean (Vol.-Pergamon Press, London.
2. Raymont, J.E.G. 1973. Zooplankton (Vol-II) Pergamon Press, London.
3. Wimpunny,R.S. 1966. Plankton of the Sea. Feber and Feber Limited, London.
4. Davis, C.C. 1955, The marine and fresh water Plankton, Michigan State University Press, U.S.A.
5. Spoel S.Vender and Heyman, R.P. 1983. Comperative atlas of Zooplankton biological patterns in the oceans, Springer, Verlag, Berlin.
6. Parsons, J.R. M. Takahasi and hargrave 9Iled), 1977, Biological oceanographic Processes. Pergaman Press, Oxford.
7. Bougis: Marine Plankton Ecology.
8. Newell and Newell: Marine Plankton - A Practical Handbook.

DISPLANERY SPECIFIC ELECTIVE (DSE)

SEMESTER V – DSE- PAPER-11-MARINE MINERAL RESOURCES

Maximum Marks: 75(15+60)

Unit I

Introduction to marine mineral resources - Marginal marine deposits - Evaporites and placer deposits

Surface deposits in continental shelf - Subsurface deposits in continental shelf- Dee sea deposits.

Unit II

Beach placer deposits - Heavy mineral sands in beach dunes - rutile - ilmenite - zircon and monazite - Source of the heavy minerals

Offshore placers - Origin and economic value of Manganese and phosphate nodules - various methods of dredging of marine surface mineral.

Unit III

Evaporite deposits from oceanic waters - Natural salt pans - Calcium sulphate deposits.-

Common salt deposits - Potash deposits - Borate and bromine deposits

Unit IV

Deep sea deposits - Sediment hosted Lead - Zinc deposits (stratiform ore deposits)

Marine Volcanic associated ore deposits - Mineral deposits in the principal plate tectonic regimes of the oceans

PRACTICAL

Maximum Marks: 25

1. Megascopic Identification of evaporates and minerals of placer deposits
2. Microscopic Identification of evaporates and minerals of placer deposits
3. In an out line map of India. Show the petroleum deposits
4. Laboratory record
5. Viva

BOOKS RECOMMENDED

1. Oceanography, Contemporary readings in Ocean Sciences by Gorden Pirie,
2. Introduction to Oceanography by Weighpt
3. Marine Geology by Kennet, J.P., Prentice Hall.
4. The Sea floor by Seibold, E. and Berger, W.H., Springer-Verlag.
5. Suvinder Singh (Oceanography)

DISPLANERY SPECIFIC ELECTIVE (DSE)

SEMESTER VI –DSE- PAPER-1-MARINE BIOTECHNOLOGY

Maximum Marks: 75(15+60)

Unit I

Marine natural products - Marine organisms: an alternative source of potentiality valuable natural products –

Pharmaceuticals from marine organisms: anti - cancer, diagnostic and therapeutic, bioadhesives and thermostable enzymes.

Unit II

Marine Microbiology - Microbial biofilms; Marine polysaccharaides - biomedical and biotechnological applications

Molecular pathogenicity of aquacultural pathogens; Biochemistry, gene regulation and molecular biology of marine hyperthermophils.

Unit-III

Bioremediation - Marine pollution - Aerobic and anaerobic bioremediation in the marine environment

Marine microorganisms capable, of degrading and detoxinng chlorinated hydrocarbons and other pollutants.

Unit IV

Biofouling and Control technology - Biofouling organisms - Problems due to biofouling - Antifouling paints and its environmental pollution - Biotechnological approach to biofouling control.

Receptor molecules and chemical signals that control life in ocean - ploidy manipulation to enhance growth - reproduction and development of disease resistance in aquacultural species crustaceans, molluscans, fin fishes

PRACTICAL

Maximum Marks: 25

1. Preparation of culture medium for bacteria- Nutrient broth and agar medium
2. Method of enumeration of bacterial population in water
3. Isolation and Identification of bacteria

4. Methods of enumeration of mortality of bacteria
5. Staining of bacteria gran staining.
6. Laboratory record
7. Viva

BOOKS RECOMMENDED

1. Environmental Biotechnology, Principles and applications by Bruce E.Rittmann and Perry L. McCarthy., McGraw Hill.
2. Fish Biotechnology- M.M.Ranga and DO(ms), Q.J.Shammi, Agrobios. India.Jodhpur.
3. Applied fisheries. Q.J.Shammi and B.S.Bhatragar Agrobios (India)
4. Ferguson Wood, E.J. 1967 Microbiology of oceans and Estuaries. Elsevier publishing co. Austarelam.
5. Dawa, C.J. 1981, marine Botany, John Wiley & Sons Inc. U.S.A.p.p.628
6. Larry Mekame and Judy Kandel, 1996 Microbiology, essentials and applications, Mc. Graw.Hill Inc. New York, pp.943.
7. Hawker, L.E. and Linton a.H. 1971. Microorgaanisms: Function, form and Environment Edward Arnold Limited, London.
8. Doetesch, R.N. and T.M.Cook, 1973. Introduction to Bacteria and their Ecobiology, University park Press, Battm.. London.
9. Yahe Eawson, E., 1966, marine Botany: an Introduction Hole Reinhart and Wionston Inc. New York.
10. Johnson, T.W. and F.K. Sparrow, 1961, Fungi in oceans and estuaries J. Cramerco.
11. Mass, S.T. 1986, Biology of Marine fungi, Cambridge University Press, pp.382.
12. Dube, H.C. 1994, A text book of fungi bacteria and viruses, vikas publishing house, pp.240.
13. Tadasi Arai,M.D. 1976, Actinomycutes one boundary microorganisms, Toppen Co. Ltd.
14. Ronald M. Atlas, 1988, Microbiology Fundamentals and applications, Maxwell Macmillion. International Editions, pp.807

ENVIRONMENTAL STUDIES (AECC I)
SEMESTER – I
FOR UNDER GRADUATE ARTS, SCIENCE & COMMERCE
FULL MARKS: 100

TIME: 3 HOURS
TIME: 1 HOUR

END SEMESTER: 80
MID SEMESTER: 20

Unit – I

The Environment: The Atmosphere, Hydrosphere, Lithosphere, Biosphere, Ecology, Ecosystem, Biogeochemical Cycle (Carbon Cycle, Nitrogen Cycle), Environment Pollution: Air Pollution, Water Pollution, Soil Pollution, Radiation Pollution.

Unit – II

Population Ecology: Individuals, Species, Pollution, Community, Control Methods of Population, Urbanization and its effects on Society, Communicable Diseases and its Transmission, Non-Communicable Diseases.

Unit- III

Environmental Movements in India: Grass root Environmental movements in India, Role of women, Environmental Movements in Odisha, State Pollution Control Board, Central Pollution Control Board.

Unit –IV

Natural Resources: Conservation of Natural Resources, Management and Conservation of Wildlife, Soil Erosion and Conservation, Environmental Laws: Water Act, 1974, Air Act, 1981, The Wildlife (Protection) Act, 1972, Environment Protection, 1986, Natural Disasters and their Management.

Books Recommended

1. Dash MC and Mishra PC, Man and Environment, McMillan, London.
2. Mishra PC and Das MC, Environment and Society, McMillan, London.
3. Odeem EP, Fundamentals of Ecology, Natraj Publication.
4. Mishra DD, Fundamental Concept in Environmental Studies, S.Chand, New Delhi.
5. Asthana DK and Asthana Meera, A Testbook of Environmental Studies, S. Chand, New Delhi.
6. Bharuach Erach, Textbook for Environmental Studies, Universities Press India Pvt. Ltd., Hyderabad.

ABILITY ENHANCEMENT COMPULSORY COURSE (AECC II)
SEMESTER – II
FOR UNDER GRADUATE ARTS, SCIENCE & COMMERCE
FULL MARKS: 100

TIME: 3 HOURS
TIME: 1 HOUR

END SEMESTER: 80
MID SEMESTER: 20

SKILL ENHANCEMENT COMPULSORY COURSE-I
COMMUNICATIVE ENGLISH
(SPECIAL COURSE)
ENRICHING LINGUISTIC KNOWLEDGE & COMMUNICATION PROFICIENCY
SEMESTER – III
FOR UNDER GRADUATE ARTS, SCIENCE & COMMERCE
FULL MARKS: 100

TIME: 3 HOURS
TIME: 1 HOUR

END SEMESTER: 80
MID SEMESTER: 20

SKILL ENHANCEMENT COMPULSORY COURSE-II
QUANTITATIVE AND LOGICAL THINKING
(SPECIAL COURSE)
ENRICHING LINGUISTIC KNOWLEDGE & COMMUNICATION PROFICIENCY
SEMESTER – IV
FOR UNDER GRADUATE ARTS, SCIENCE & COMMERCE
FULL MARKS: 100

TIME: 3 HOURS
TIME: 1 HOUR

END SEMESTER: 80
MID SEMESTER: 20