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|  |
| M.Sc.,  MARINE SCIENCE (COASTAL ZONE MANAGEMENT) |
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| **SYLLABUS**  **FROM THE ACADEMIC YEAR**  **2023 - 2024** |
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| **TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005** |
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**contents**

1. PO and PSO Description
2. PG – Template
3. Methods of Evaluation & Methods of Assessment
4. Semester Index.
5. Subjects – Core, Elective, Nonmajor, Skill Enhanced, Ability Enhanced, Extension Activity, Environment, Professional Competency
6. Course Lesson Box
7. Course Objectives
8. Units
9. Learning Outcome
10. Refence and Text Books
11. Web Sources
12. PO & PSO Mapping tables

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| **TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION** | |
| **Programme** | **M.Sc., Marine Science (Coastal Zone Management)** |
| **Programme Code** |  |
| **Duration** | **PG - Two Years** |
| **Programme Outcomes (Pos)** | **PO1: Problem Solving Skill**  Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.  **PO2: Decision Making Skill**  Foster analytical and critical thinking abilities for data-based decision-making.  **PO3: Ethical Value**  Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.  **PO4: Communication Skill**  Ability to develop communication, managerial and interpersonal skills.  **PO5: Individual and Team Leadership Skill**  Capability to lead themselves and the team to achieve organizational goals.  **PO6: Employability Skill**  Inculcate contemporary business practices to enhance employability skills in the competitive environment.  **PO7: Entrepreneurial Skill**  Equip with skills and competencies to become an entrepreneur.  **PO8: Contribution to Society**  Succeed in career endeavors and contribute significantly to society.  **PO 9 Multicultural competence**  Possess knowledge of the values and beliefs of multiple cultures and  a global perspective.  **PO 10: Moral and ethical awareness/reasoning**  Ability to embrace moral/ethical values in conducting one’s life. |
| **Programme Specific Outcomes**  **(PSOs)** | **PSO1 – Placement**  To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.  **PSO 2 - Entrepreneur**  To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.  **PSO3 – Research and Development**  Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.  **PSO4 – Contribution to Business World**  To produce employable, ethical and innovative professionals to sustain in the dynamic business world.  **PSO 5 – Contribution to the Society**  To contribute to the development of the society by collaborating with stakeholders for mutual benefit. |

**Template for P.G., Programmes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester–I** | **Credit** | **Hours** | **Semester-II** | **Credit** | **Hours** | **Semester-III** | **Credit** | **Hours** | **Semester–IV** | **Credit** | **Hours** |
| 1.1. Core-I | 5 | 7 | 2.1. Core-IV | 5 | 6 | 3.1. Core-VII | 5 | 6 | 4.1. Core-XI | 5 | 6 |
| 1.2 Core-II | 5 | 7 | 2.2 Core-V | 5 | 6 | 3.2 Core-VII | 5 | 6 | 4.2 Core-XII | 5 | 6 |
| 1.3 Core – III | 4 | 6 | 2.3 Core – VI | 4 | 6 | 3.3 Core – IX | 5 | 6 | 4.3 Project with viva voce | 7 | 10 |
| 1.4 Discipline Centric  Elective -I | 3 | 5 | 2.4 Discipline Centric  Elective – III | 3 | 4 | 3.4 Core – X | 4 | 6 | 4.4Elective - VI (Industry / Entrepreneurship)  20% Theory  80% Practical | 3 | 4 |
| 1.5 Generic Elective-II: | 3 | 5 | 2.5 Generic Elective -IV: | 3 | 4 | 3.5 Discipline Centric Elective - V | 3 | 3 | 4.5 Skill Enhancement course / Professional Competency Skill | 2 | 4 |
|  |  |  | 2.6 NME I | 2 | 4 | 3.6 NME II | 2 | 3 | 4.6 Extension Activity | 1 |  |
|  |  |  |  |  |  | 3.7 Internship/ Industrial Activity | 2 | - |  |  |  |
|  | **20** | **30** |  | **22** | **30** |  | **26** | **30** |  | **23** | **30** |
| **Total Credit Points -91** | | | | | | | | | | | |

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System**

**for all Post – Graduate Courses including Lab Hours**

**First Year – Semester – I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – I | 5 | 7 |
| Core – II | 5 | 7 |
| Core – III | 4 | 6 |
| Elective – I | 3 | 5 |
| Elective – II | 3 | 5 |
|  |  | **20** | **30** |

**Semester-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – IV | 5 | 6 |
| Core – V | 5 | 6 |
| Core – VI | 4 | 6 |
| Elective – III | 3 | 4 |
| Elective – IV | 3 | 4 |
| Skill Enhancement Course [SEC] - I | 2 | 4 |
|  |  | **22** | **30** |

**Second Year – Semester – III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – VII | 5 | 6 |
| Core – VIII | 5 | 6 |
| Core – IX | 5 | 6 |
| Core (Industry Module) – X | 4 | 6 |
| Elective – V | 3 | 3 |
| Skill Enhancement Course - II | 2 | 3 |
|  | Internship / Industrial Activity [Credits] | 2 | - |
|  |  | **26** | **30** |

**Semester-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – XI | 5 | 6 |
| Core – XII | 5 | 6 |
| Project with VIVA VOCE | 7 | 10 |
| Elective – VI (Industry Entrepreneurship) | 3 | 4 |
| Skill Enhancement Course – III / Professional Competency Skill | 2 | 4 |
| Extension Activity | 1 | - |
|  |  | **23** | **30** |

**Total 91 Credits for PG Courses**

|  |  |  |  |
| --- | --- | --- | --- |
| **METHODS OF EVALUATION** | | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | | **25 Marks** |
| Assignments / Snap Test / Quiz | |
| Seminars | |
| Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | | **75 Marks** |
| **Total** | | | **100 Marks** |
| **METHODS OF ASSESSMENT** | | | |
| **Remembering (K1)** | | * Thelowestlevelofquestionsrequirestudentstorecallinformationfromthecoursecontent * Knowledgequestionsusuallyrequirestudentstoidentifyinformationinthetextbook. | |
| **Understanding (K2)** | | * Understandingoffactsandideasbycomprehendingorganizing,comparing,translating,interpolatingandinterpretingintheirownwords. * Thequestionsgobeyondsimplerecallandrequirestudentstocombinedatatogether | |
| **Application (K3)** | | * Studentshavetosolveproblemsbyusing/applyingaconceptlearnedintheclassroom. * Studentsmust usetheir knowledgetodetermineaexactresponse. | |
| **Analyze (K4)** | | * Analyzingthequestionisonethatasksthestudentstobreakdownsomethingintoitscomponentparts. * Analyzingrequiresstudentstoidentifyreasonscausesormotivesandreachconclusionsorgeneralizations. | |
| **Evaluate (K5)** | | * Evaluationrequiresanindividualtomakejudgmentonsomething. * Questionstobeaskedtojudgethevalueofanidea,acharacter,aworkofart,orasolutiontoaproblem. * Studentsareengagedindecision-makingandproblem–solving. * Evaluationquestionsdonothavesinglerightanswers. | |
| **Create (K6)** | | * Thequestionsofthiscategorychallengestudentstogetengagedincreativeandoriginalthinking. * Developingoriginalideasandproblemsolvingskills | |

**PROGRAMME OUTCOMES (PO) - PROGRAMME SPECIFIC OUTCOMES (PSO) MAPPING**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **PROGRAMME SPECIFIC OUTCOMES (PSO)** | | | | | |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **PSO1** | **3** | **3** | **3** | **3** | **3** |
| **PSO2** | **3** | **3** | **3** | **3** | **3** |
| **PSO3** | **3** | **3** | **3** | **3** | **3** |
| **PSO4** | **3** | **3** | **3** | **3** | **3** |
| **PSO5** | **3** | **3** | **3** | **3** | **3** |

**Level of Correlation between PO’s and PSO’s**

*(Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix)*

Assign the value

**1 – Low**

**2 – Medium**

**3 – High**

**0 – No Correlation**

**M.Sc., Marine Science (Coastal Zone Management)**

***SEMESTE-I***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Course*** | ***Name of the Course*** | ***Credit*** | ***Teaching Hours*** | ***CIA*** | | ***UE*** | | ***Max*** | |
| **Max** | | **Max** | | **100** | |
| Core-I | Physical Oceanography | 5 | 7 | 25 | | 75 | | 100 | |
| Core-II | Chemical Oceanography | 5 | 7 | 25 | | 75 | | 100 | |
| Core – III | Biological Oceanography | 4 | 6 | 25 | | 75 | | 100 | |
| Discipline Centric  Elective -I | Geological Oceanography / Marine Pollution | 3 | 5 | 25 | | 75 | | 100 | |
| Generic Elective-II: | Physical and Geological Oceanography Practical | 3 | 5 | 25 | | 75 | | 100 | |
|  | Subtotals | **20** | **30** | |  | | 600 | |

**SEMESTER-II**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Core-IV | Marine Biodiversity and Conservation | 5 | 6 | 25 | 75 | 100 |
| Core-V | Fisheries Science and Statistics | 5 | 6 | 25 | 75 | 100 |
| Core – VI | Climate Change and Paleo- Oceanography | 4 | 6 | 25 | 75 | 100 |
| Discipline Centric  Elective – III | Marine Biotechnology | 3 | 4 | 25 | 75 | 100 |
| Generic Elective -IV: | Chemical Oceanography Practical | 3 | 4 | 25 | 75 | 100 |
| NME I | Non Major Elective 1  (Basics in Oceanography) | 2 | 4 | 25 | 75 | 100 |
| Subtotals |  | **22** | **30** |  |  | 600 |

**SEMESTER-III**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Core-VII | Integrated Coastal Zone Management | 5 | 6 | 25 | 75 | 100 |
| Core-VIII | Deep sea Exploration | 5 | 6 | 25 | 75 | 100 |
| Core – IX | Marine Geophysics | 5 | 6 | 25 | 75 | 100 |
| Core – X | Aquaculture | 4 | 6 | 25 | 75 | 100 |
| Discipline Centric  Elective - V | Biological Oceanography and Fishery Science Practical | 3 | 3 | 25 | 75 | 100 |
| NME II | Non Major Elective 2 (Marine Environment) | 2 | 3 | 25 | 75 | 100 |
| Internship/ Industrial Activity |  | 2 | 0 |  | 600 |  |
|  | Subtotals | **26** | **30** |  |  |  |

**SEMESTER-IV**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Last-Semester Project | 23 | 14 |  | 100 | 100 |
| **Grand Totals** | |  | **91** | | | **1900** |

# PHYSICALOCEANOGRAPHY

## Max.Marks(CIA=25+UE=75)=100;Credits=4)

**Objectives:**

1. Tounderstandthehistory,oceanstudiesandtypesofresearchvessels
2. Toknowtheinteractionofatmosphericoceaninteraction,physicalpropertiesofmarine environment

# UNIT—IHISTORYOFOCEANSTUDIES

Need for Ocean Studies – Definition of water bodies - Ocean as an important component of Hydrosphere – Historical account on Ocean Studies – Oceanographic exploration – International Oceanographic Organizations - Oceanographic institutions of India – Types of Vessels.

# UNIT—IIOCEANDESCRIPTION

Dimensions of the Ocean: Depth, Area and Volume – measuring the depth of the Ocean Dimen- sions - Principles of Echosounder – Seafloor features – mid ocean ridges – trenches – Island arcs and basins – Submarine Canyons – Bengal fan – continental shelf and slope – sea mounts – World Oceans - satellitealtimetry.

# UNIT—IIIATMOSPHERE–OCEANINTERACTION

Atmospheric boundary layer – Beaufort wind scale and state of sea – Scatterometer – windsat – Special Sensor Microwave/ Imager (SSM/I) – Anemometer – Weather buoys – windstress.

# UNIT—IVPHYSICALPROPERTIES

Oceanic Heat budget (Fluxes, insolation, infrared, and latent heat) – Temperature – Salinity - Density – Pressure – light – Eckman Spiral – Langmuir circulation – Geostrophic currents – Oceanic circulations - Vorticity – Deep circulation.

# UNIT—VOCEANICPROCESSES

Tropical Ocean stratification – E1Nino – ENSO – Global ocean models – coastal models– Ocean waves – Coastal Processes and Tides – Tsunamis – Storm surges.

## UNIT-VIADVANCESINPHYSICALOCEANOGRAPHY(NotforExamination)

Updating current developments in ocean sciences – Monitoring current Oceanographic changes- Learning new techniques to study global warming, Updating current status of AMOC cycle

## Reference:

Baretta-Bekker, 1998.Encyclopaedia of Marine Science.Springer, 357pp. Brown,E.,andothers,2004.Oceancirculation.TheOpenUniversity,286pp.

Brown,E.,andothers,2006.Waves,tidesandshallowwaterprocesses.TheOpenUniversity, 227pp.

Diwan,A.PandArora,D.K.,1995.OceanographicEnvironment,AnmolPublication,NewDelhi. Garrisson, T., 1998.Oceanography.Media edition,553pp.

Gross,G.,1993.Oceanography:Aviewoftheearth,PrenticeHallInc,New

Hayes,S.1998.Oceanography–Anillustratedguide,JohnWilley&Sons,NewYork.

Ikeda,M.andF.W.Dobson,2005.Oceanographicapplicationsofremotesensing.CRC Press, 492pp.

Marshall,J.andR.A.Plumb,2008.Atmosphere,oceanandclimatedynamics.NIO.Collected reprints.Vol.1 to27+.

Philander,S.G.,2004.OuraffairwithElNINO.Princeton,275pp.

Pickard,G.L,1975.DescriptivePhysicalOceanography, PergamonPress,London. Pinet,P.R.,1999.InvitationtoOceanography,JonesandBarlettPublishers,555pp.

Reddy, M.P.M., 2001.Descriptive Physical Oceanography.Oxford& IBM, 40pp. Rose,D.A.,1977.IntroductiontoOceanography,PrenticeHallInc,NewJersey.

Sverdrup,H.U.,M.W.JohnsonandRichardH,Fleming,1942.TheOceans,TheirPhysics, Chem- istry and General Biology, Asia Publishing House, New Delhi.

**Courseoutcome**

* UnderstandingthedevelopmentofOcean science
* Studyingaboutthephysicalandgeomorphologicaldimensionofoceans
* LearningofAtmosphere-OceanInteraction
* UnderstandingthePhysicalpropertiesoftheocean
* Studyingaboutthevariousoceanic process
* RecentdevelopmentsofOceanscience
* Learningocean bottom profilingbyusinginstrumentation
* Fieldvisitandonboardexperienceonphysicalprocessof ocean

# CHEMICALOCEANOGRAPHY

**Max.Marks(CIA=25+UE=75)=100;Credits=4)**

**Objective:**

* 1. Tounderstandthechemistryand itscompositionofmarinewater
  2. Tolearnabouttheimportantchemical elementsandnutrientcycleinmarineenvironment

# UNIT—IINTRODUCTION

General introduction of marine chemistry, chemical properties of sea water, composition of sea- water, oxidation-reduction potential of seawater constancy, concept of chlorinity and salinity, method of measurement.

# UNIT—IICHEMICALELEMENTS

Major and minor elements of seawater, abundance and residence time, anoxic basin. Interaction of major and minor elements with marine organisms. Trace elements concept, types of distribu- tion, inputs and cycling of trace elements in coastalwaters.

# UNIT—IIGASEOUSRELATION

Dissolved gases, basic concepts, solubility in seawater, carbon dioxide-origin-importance and distribution-CO2-CO3 systems.Dissolved oxygen-origin and factors governing the distribution – BOD and COD. Air and sea gas exchange, non reactive, minor reactive and noble gases - origin, distribution and importance.

# UNIT—IVNUTRIENTSCYCLE

Organic matter, types, sources, seasonal variation, ecological processes and significance.Nutri- ents origin, Fertility of the sea, nitrogen, phosphorus, determination, seasonal variation. Nitro- gen - Phosphorus ratio, Silicon: origin, distribution cycle and their significance.

# UNIT—VBIOGEOCHEMICALINTERACTIONS

BiochemicalinteractionofOceanandatmosphere-phytoplankton.Biogeochemicalcycles

- DMS and climate, El Nino and ENSO, climate change in recent century, role of Oceaninclimate change and carbonate system, global warming, green house effect, heat budget and sea levelrise.

## UNIT-VI ADVANCED BIOGEOCHEMICAL TECHNIQUES (Not for

**Examination)**

Multitude of advanced analytical tools used in marine sample analysis– Marine Data Analysis involve multivariate evaluation techniques in Marine Chemical research and Marine Chemical Modelling. Explain physical marine chemistry. Isotope geochemistry, Sediment chemistry and Diagenesis, Air sea exchange and control of carbondioxide and Estuarinegeochemistry,chemistryoftheArticocean,MajorriverflowinArcticocean-

ChemistryofparticulatematterfromthesouthIndianandAntarcticoceans,Chemical tracers.

## Reference:

BiggG.R..,2003.TheOceansandClimate,CambridgeUniversityPress,273pp.

FashamM.J.R.,2003.OceanBiogeochemistry:Theroleoftheoceancarboncyclein global change.

James,R.,2005.MarineBiogeochemicalcycles,2/e.OpenUniversity,MiltonKeynes,130pp. Riley,J.P.andChester,R.,1971.IntroductiontoMarineChemistry,AcademicPress,465pp.

Schulz,H.D.,2000.Marinegeochemistry.Springer-Verlog.

SverdrupK.A.,andVirginiaArmbrust,2008.IntroductiontotheWorld’sOceans-Science, 508

**CourseOutcome:**

1. Samplingtechniquesofmarine sources.
2. PreservationandstorageofMarinesamples
3. Understandingaboutthevariouschemical methods
4. Chemicalanalysisofseawater
5. Analysisofnutrientsinseawater
6. Evaluationofchlorinityand salinityofseawater
7. MeasurementoftraceelementsbyusingAAS
8. Demonstrationofspectrophotometer

# BIOLOGICALOCEANOGRAPHY

## Max.Marks(CIA=25+UE=75)=100;Credits=4)

**Objectives:** The goal of biological oceanography is to understand the recent development ofbiological oceanography. Plankton and their role in ocean food web. Distribution, ecological an economic importance of marine flora and fauna. To understand the classification and zonation of marine environment and organisms.

# UNIT-IINTRODUCTIONTOBIOLOGICALOCEANOGRAPHY

Historicaldevelopmentofbiologicaloceanography,classificationofmarineenvironmentandmarine organisms, properties affecting life in the sea.

# UNIT-II:PLANKTONANDORGANICPRODUCTION

Plankton-ecological and economic importance, classification, methods of collection, primary and secondary production-methods of estimation of primary production, estimation of standing crop and biomass-numerical methods, plankton volume, adaptation of plankton, factors controlling primary production,redtidephenomenon-itscausesand effects. Foodchainandfoodwebs-themicrobialloop. **UNIT-III: BENTHIC FLORAL COMPONENTS**

Seaweeds-classification, occurrence, economic importance, seagrass and saltmarshes-distribution, theirroleincoastalecosystems,mangroves-distribution,ecologicalfeatures,importanceandusesofmangroves. **UNIT-IV: NEKTON AND FISHERIES OCEANOGRAPHY**

Nektonic crustaceans, cephalopods, marine reptiles, seabirds, marine mammals-cetaceans, sirenians, pinnipedes,importanceofmarinemammals,marinefishes-classification,migrationandschooling,major food species, mariculture, global fishery resources.

# UNIT-V:BENTHICFAUNALCOMMUNITY

Zonations-rocky shores, sandy shores, estuaries and kelp forest, marine sponges-their types and importance,Cnidarians-classification,coralreefs-structure,distributionandlimitingfactors,marine mollusks-classification, echinoderms-their types and importance, deep sea ecology-Brachiopoda, phoronida and pogonophora.

## UNIT-VI:ADVANCESINBIOLOGICALOCEANOGRAPHY(NotforExamination)

BiologicalresourceassessmentandmanagementusingremotesensingandGIS.Innovativetechnologies

i.e. algal biofuels, natural products from marine organisms, marine organisms behaviors and their interactionswiththeenvironment.Products,processes,services,technologies,ornewideasthatarereadily available to markets, governments and society.

## References:

Carol M. Lalli and Timothy R. Parsons., 1997. Biological Oceanography-An Introduction,Elsevier pub., 314 pp.

PeterCastroandMichaelE.Huber.,2003.MarineBiology,McGrawHill.Pub.,468pp.

JamesW.Nybakken.,2001.MarineBiology-Anecologicalapproach, BenjaminCummings.,516pp.

**Courseoutcome:**

1. HistoryandrecentdevelopmentsofBiologicalOceanography
2. PlanktonandOrganicproductioninocean
3. OccurrenceandimportanceofBenthicfloral components
4. Distributionandvaluesofmarinenektonic organisms
5. Statusandapplicationsoffisheriesoceanography
6. Zonationsofvariouscoastalandoceanichabitat
7. Distributionandimportanceofoceanicbenthicfaunalcommunity
8. Deepseaecologyandrecentissuesinoceanlife

# GEOLOGICALOCEANOGRAPHY

## Max.Marks(CIA=25+UE=75)=100;Credits=4)

**Objectives:**

* 1. Toknowtheoceanbasinsanditsfracturesystems,orginanditscompostion
  2. Tounderstandthemarinesedimentsandmineral depositsandplatetectonics

# UNIT—IOCEANBASINS

Shape of ocean floor – Ocean floor features - Continental margins: shelf and slope -Origin of ocean basins –– Oceanic ridges – East Pacific Rise – Mid Atlantic Ridge - Rift valleys – South African Rift valleys - Trenches – Marianas trench – Fracture systems – Oceanic crust: origin and composition

# UNIT—IICOASTALOCEAN

Beaches – Beach sands - Beach zones – Longshore drift – Barrier Islands – Tidal types of Coasts - Classification of coasts – Wave action and Shoreline development – coastal features – Marine terraces - Vulnerability of coasts to natural marine disasters

# UNIT—IIICONCEPTSOFPLATETECTONICS

Outline of plate tectonics – Plate boundaries – Geologic processes at plate boundaries – Seafloor spreading – Geomagnetic and other evidences for seafloor spreading – Subduction zones – Is- land arc systems.

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# UNIT—IVMARINESEDIMENTSANDMINERALDEPOSITS

Terrigenous - Biogenic -Authigenic - Volcanogenic - Cosmogenous – Turbidites – Hemipelagic: shallow sediments – Sulphide chimneys – Pelagic sediments: Oozes and clays - Phosporites - Placer minerals: origin of marine placers – species and distribution - Ferromanganese oxide minerals: origin of nodules and crusts and distribution – Hydrothermal minerals:

# UNIT—VPALAEOOCEANOGRAPHY

Panthalassa – Tethys Sea – Approaches to palaeooceanographic reconstructions – various proxy indicators for palaeooceanographic interpretation - Joint Global Ocean Flux Study (JGOFS) and its applications in palaeooceanography – Ocean Drilling programme and its major accomplish- ments in palaeooceanography – Eustary - Palaeooceanographic scenario in and around Ariya-lur, Tamil Nadu.

## UNIT–VIADVANCESINGEOLOGICALOCEANOGRAPHY(NotforExamination)

Gas hydrates exploration, technique in Indian sub continentworld current scenario, carbon budget and Climate change issues. Future studies on Global Warming and Sea level rise.Sustainable development on Geological oceanography.

**References:** Abrantes,F.andMix,A.C.,1999.Reconstructingoceanhistory.Springer,4 43pp. Charles, A., 2005.GeologicalOceanography.

Cronan,D.S.,2000.HandbookofMarineMineralDeposits.CRCpress,406pp.

Einsele,G.,2000.Sedimentarybasins:evolution,faciesandsedimentbudget.Springer,792p

p.Eisma,D.,Intertidaldeposits,CRCPress,525pp.

King,C.A.M.,1959.BeachesandCoasts,EdwardArnold,London.

King,C.A.M.,1975.IntroductiontoMarineGeologyandGeomorphology.Edward Arnold, Lon- don.

Radhakrishnan,V.,1997.GeneralGeology,V.V.P.Publishers,Tuticorin,2 28pp.. Seabold,E.andBerger,W.H.,1982.TheSeaFloor,SpringerVerlag.

Shepard,F.P.,1977.Geologicaloceanography:evolutionofcoasts,continentalmargins& the deep

-seafloor.Crane,Russak,214pp.

Shepard, F.P., 1978. Geological Oceanography, Heinmann, London. TheOcean,1969.AScientificAmericanbook,W.H.Freemanandcompany,SanFrancisc o.Wefer, G. and other, 2003.Ocean Margin Systems.Springer,495pp.

**Courseoutcome**

1. Detailstudyaboutsubmarinefuturesofworldocean
2. Studyingaboutthecoastalgeomorphologicalfeaturesandcoastalocean process
3. Understandingtheplatetectonic theory
4. studyingabouttheseafloor,sediments nature
5. understandingaboutpast oceanographic processes
6. Studyingaboutthesesimologicalstudyinworldocean
7. Knowingaboutvariousseafloorsediment process
8. Explorationofocean floorlivingand non-livingresources

**Objectives:**

# MARINEPOLLUTION

## Max. Marks=100; Credits=4

1. Togaintheknowledgeontypes,sourcesandimpactofpollutiononmarineresources
2. Tolearnthetypesofmarinepollutionmonitoringmethods,Oceanmanagementandmarine pollution abatement programs**.**

# UNIT—IINTRODUCTION

Marine pollution – GESAMP definition and its role – major marine pollutants and types – classification – nature, sources and transportation pathways. Conservative and non-conservative pollutants.

# UNIT—IIMAJORMARINEPOLLUTANTS

Types, sources and ecological effects on marine environment – Sewage, heavy metal, pesticide, oil, nuclear, thermal, plastic and micro-plastic pollution. Ecological impact of pollutants on marine organisms. Effect of mining and dredging operation on marine environment.

# UNIT—IIIMARINEPOLLUTIONMONITORING

Marine pollution monitoring –Physical, chemical and biological methods. Biological indicators and accumulators. Conservation and management of the living resources in the high sea. Coastal issues – climate change and sea level rise.

# UNIT—IVOCEANMANAGEMENT

National and international agencies for Ocean management – IMO, IUCN, FAO, UNEP, MoEF&CC and MOES. Principles of remote sensing and GIS for Ocean management, Coastal and ocean resource management - endangered coastal biota, marine biosphere reserves and marine parks.

# UNIT—VPOLLUTIONABATEMENTPROGRAMS

Pollutionabatementprograms indevelopedcountries –casestudies.Assessingpollutiondamage. Law pertaining to marine pollution. State of some seas – Biodegradation and bioremediation.

## UNITVI:RECENTPROBLEMSINMARINEENVIRONMENT(notforexamination)

Microplastics – Micro plastics in marine environment – Sources – Bioaccumulation - Impacts on marine organisms – Marine food web –Microplastic toxicity and its effects on organisms and ecosystems.

**Courseoutcome**

1. DefinitionofMarinepollutions,classificationofmarinepollution
2. Variousmarinepollutantsanditsecologicalimpacts
3. Methodsformarinepollutionmonitoring
4. NationalandInternationalagencyforoceanmanagement
5. Assessmentofpollutiondamageandstateofsomeseas
6. Lawpreteraningtomarinepollution
7. Impactofmininganddredgingofmarine environment
8. Bioaccumulation,BiomagnificationandBiotransformation

## Employability:

Students get employability skills in EIA and water quality monitoring companies and Oceanographic institutes.

## Reference:

Carl J. Sindermann, 2005. Coastal pollution: Effects on living resources and humans (Marine Science Series). 271 pp.

Churchill,R.RandA.V.Lowe,1983.TheLawoftheSea,3ded.(Manchester:Manchester University Press) 494 pp

Clark,R.B.2001.Marinepollution,Fifthedition.OxfordUniversitypress,NewYorkInc.,231pp.

# PHYSICALANDGEOLOGICALOCEANOGRAPHYPRACTICAL

## Max.Marks(CIA=40+UE=60)=100;Credits=6)

GENERAL: Sketching, describing demonstration of marine research instruments and equip- ments:– Snorkel, SCUBA, moorings, floats and drifters, ADCP, CTDs, Reversing thermometer, current meters, echo sounders, wave measurers, tide gauges, Secchi disk, polarizingpetrologicalmicroscope,Boomerangsedimentsamplers,boxandpistoncorers, Patterson grab, sidescan so- nar, marine magnetometer, ocean bottom seismometer and Tsunami Warning Systems.

PHYSICALOCEANOGRAPHY:ProblemsrelatedtoPhysicaloceanography. GEOLOGICAL OCEANOGRAPHY: Problems related to Geological oceanography

|  |  |  |
| --- | --- | --- |
| Evaluation | | Marks |
| ContinuousInternalAssessment | | 40 |
| Observation | 5 |  |
| RecordNoteBook | 10 |  |
| Testpractical | 25 |  |
| UniversityPracticalExamination | | 60 |
| PracticalsTotal | | 100 |

# MARINEBIODIVERSITYANDCONSERVATION

## Max. Marks=100; Credits=4)

**Objectives**:Theobjectivesofthis courseareinclude:Tohelp studentsdevelopanunderstandingofthe major issues in marinebiodiversityresearch. To show students how biodiversityis measured and what are the major patterns of diversity. To develop an understanding of the terms structural and functional biodiversity and the relationship between the two. To know the values of marine biodiversity and threats of marine biodiversity and To discuss and debate issue concerning conservation of marine biodiversity.

## Unit-I:Introductiontomarinebiodiversity

Understanding the marine biodiversity and conservation, origin of conservation biology, divisions of biodiversity, keystone species, ecosystem functioning, world’s marine biological diversity, marine hot spots-cold seeps, hydrothermal hotspots, marine biosphere reserves and their importance in India and abroad.

## Unit-II:Patternsandvaluingbiodiversity

Species diversity, species richness, species evenness, factors affecting species diversity, values of biodiversity-ecological economic values, ethical values, socio-economic values and conservation feasibility values.

## Unit-III:Threatstomarinebiodiversity

Biodiversity in special ecosystems with reference to mangroves and coral reefs. Species extinction, vulnerability to extinction, habitat destruction-coral reefs and mangroves, habitat degradation, habitat fragmentation, Over exploitation,alienspecies,diseases, globalclimate change-coral bleaching, ocean acidification.

## Unit-IV:Conservationstrategies

Importance of conservation, IUCN and their importance, various conservation strategies- germplasm banks, cryopreservation, marine protected areas, breeding and culture of food and endangered species, sea ranching, mesh size regulation, TED, fishing holidays, conservation and development at national and international level.

## Unit-V:Conservationpoliciesandlegislations

Various legislations and regulations in conservation of marine biodiversity-the role of MoEn& F in conservation, NGO’s involvement in conservation, various case studies related to coastal marine conservation science and policy with reference to Indian maritime states.

**Unit-VI: Recent Advances in Marine Biodiversity & Conservation (Not for Examination)**Climateimpactsonglobalhotspotsofmarinebiodiversity,therelationshipbetweenmarine biodiversityconservation and povertyalleviation in the strategies of rural development. Application of Remote Sensing and GIS in assessing marine biodiversity.

## References:

Richard B. Primack., 2002. Essentials of conservation biology – 3rd edition, Sinauer Assoc. Inc. Pub., USA, 698 pp.

Singh,J.S.,S.P.SinghandS.R.Gupta.,2006.Ecology,EnvironmentandResource conservation.,Anamaya Pub., New Delhi, 688 pp.

**Courseoutcome**

1. Understandingthemarinebiodiversityandconservation
2. Patternsandvaluesofmarinebiodiversity
3. Threatstomarine biodiversity
4. Marineconservationstrategies
5. Marineconservationpoliciesand Legislations
6. Marinebiospherereservesandimportance
7. Marineecosystemfunctioning
8. Biodiversityinspecial ecosystems

# FISHERIESSCIENCEANDSTATISTICS

## Max.Marks(CIA=25+UE=75)=100;Credits=4)

**Objectives:**

* 1. Tolearnbasicichthyotaxonomicskillsandknowthefisheriesresourcesincoastalandopen ocean.
  2. TogetknowledgeonfisheriesforecastingsysteminIndiaandvariouspreservationandprocessing techniques.

## UnitI

**Introduction to ichthyology** : Systematics, Taxonomy and Classification; Importance of taxonomy, International Code of Zoological Nomenclature, Morphology, morphometric, meristic, osteology and soft anatomical characters, Describing and naming of a new species; Cataloguing

## Unit-II

**Marine fisheries resources of India**:Catch trends – pelagic, demersal, midwater, deep sea and oceanic fishery.Trawl, gill net, lines, seine, bag net fishery. Collections of data for estimation of fish catch in marine systems

## UnitIII

**Fisheries forecasts** –Fisheries forecastingsystem in India and other countries –Applicationof remote sensing and GIS for monitoring fish fauna; Global Positioning System (GPS).Potential fishing zones. **Unit IV**

**Fish preservation and processing**: Preservation methods – Chilling, Freezing and Irradiation. Processing methods – salting, drying, smoking and canning. Quality control and quality assurance. Marine fisheries management and conservation

## UnitV

**Statistics:** Fisheries data collection and analysis. Sampling methods. Stock assessment techniques. Basic statistical tools and software for fisheries data analysis.

## UnitVI

**Fisheriesextension**:Sustainablemanagementoffisheriesresources.Catchperuniteffort.Species level identification of major commercial fishes. Fisheries Research Institutes in India

**Employability:**Student will get opportunityin statefisheries departments, aquacultureindustries,fish processing and preservation sector.

## References

Moyle,P.B.andJ.R.,Cech.,1996.Fishes–AnIntroductiontoIchthyology.PrenticeHallInc.N. Jersey, 594p

Biradar,R.S.(2002).CoursemanualonFisheriesStatistics,2ndEdition,CIFE,Mumbai

Fischer,W.andBiachi,G.,1984.FAO-identificationsheetsforfisherypurposes.VolI-VIpages variable.

Jayaraman,K.C.,2002. Fundamentalsof fishtaxonomy. Publ.

Patel,A.N.andSurendraSingh.1992.Remotesensing–PrinciplesandApplications.Scientific publishers, Jodhpur. 161 p

## Outcomeofthecourse

1. Studentunderstandstheimportanceofichthyotaxonomy,morphometricandmeresticfeatures
2. Variousgearsandcraftsusedforfishingwillbeknown
3. Understandtheimportanceofcollectionofdata forestimationoffishcatch
4. Studentsenabletounderstandtheimportanceandvaluesoffisheriesforecasting
5. Understandsthefisheriesmanagementandconservationmethods
6. Differenttypesoffishprocessingandpreservationmethodswillbeknown
7. Studentsunderstandthebasicstatisticaltoolsforanalysisoffisheriesdata

# CLIMATECHANGEANDPALEO-OCEANOGRAPHY

# UNIT—ICLIMATOLOGY

Climatology- Definition, Weather, Climate, Monsoon, Indian climate, Natural climate change, Green house gasses, Climate variability**,** Anthropogenic influence on climate change, Understanding Ocean and Climate Processes.

# UNIT–IIPALEOCEANOGRAPHY

Paleoceanography, Approaches to palaeoceanographic reconstructions – various proxy indicators for palaeoceanographic interpretation - Different type of dating, Ocean Drilling programme and its major accomplishments in palaeoceanography, Late Quaternary climate change, Role of past global changes organization (PAGES)

# UNIT—IIICLIMATECHANGE

World Oceans, Nutrient Uptake and Gas Exchange, Carbon budget, Global warming, Global climate change

# UNIT—IVIMPACTOFCLIMATECHANGE

Sea Level change, Impact on the coast, Changes in Meridional overturning circulation, Changes in polar region, Marine organisms and Seawater Chemistry.

# UNIT—VMANAGEMENTSTRATEGY

IPCC report, Management strategy for climate change induced issues - Socioeconomic & cultural, Health, Natural disaster, etc., Government and Non-governmental organization and its role.

# UNIT—VICURRETSTAUTUSOFCLIMATE

Current status of Atmospheric green house gas level,Global weather, climate and extreme events observation. Mechanism and climate trend analysis and discussion.

## References

King,C.A.M.,1975.IntroductiontoMarineGeologyandGeomorphology.EdwardArnold,London The Ocean and Climate. Grant R. Bigg

ClimatologybyD.S.Lal

<http://www.insaindia.org/pdf/Paleoclimate-Final_18-12-09-web.pdf>

Sverdrup,Duxbury,Duxbury,AnintroductiontotheworldOcean. Paul R. Pinet.Invitation to Oceanography.

Wefer,G.andother,2003.OceanMarginSystems.Springer,495pp. Charles, A., 2005. Geological Oceanography.

King,C.A.M.,1959.BeachesandCoasts,EdwardArnold,London.

# MARINEBIOTECHNOLOGY

## Max.Marks(CIA=25+UE=75)=100;Credits=4

**Objectives:**

* 1. Tounderstandthebioactivecompoundsfrommarinesources
  2. Tolearntheisolationofbioactivecompoundsfrommarinebacteria

**UNIT—IMARINEBIOACTIVECOMPOUNDS**

Bioactive natural products – anti-bacterial, anti-fungal, anti-viral, anti-inflammatory, anti- tumour, anti- parasitic and antihelminthic from macroalgae, marine bacteria, dinoflagellates, coelentrates (corals), bryozoans, sponges and tunicates. Extraction, isolation, purification and characterization of bioactive compounds from marine organisms.

**UNIT—IIMARINEPHARMACOLOGY**

Needand potentialitiesofmarinedrugs,importanceandsources,carbohydrates andderivatives,aliphatic acids and derivatives.Antibiotic compounds from marine organisms - Toxins, chemis- try and pharmacology structure, molecular mechanisms, types and functional properties.Phar- macological evaluation of drugs – routes of drug administration – absorption, distribution, me- tabolism andexcretion ofdrug.

**UNIT III: ENZYME TECHNOLOGY:** Introduction to Enzymes- Terminologies,Nomenclature & Classification of enzymes. Protein, Non-protein enzymes. Ribozymes, Metallo enzymes, DNA- Ezymes .Enzyme- Lock and key Hypothesis, Kinetics Model. Regulations of enzyme. Industrial applications. Drug discovery-properties of enzymes.

**UNIT IV: MOLECULAR BIOLOGY:** Bio macromolelues – structure and function. DNA- as a geneticmaterial – Historicalevidence. Biotransformationprocedure-Transformation, Transduction & Transfection. Recombinant DNA- technology- Gene structure, promotor, operator.

**UNIT V: MOLECULARTOOLS:** PCR – principle and synthesis; its applications: Types of PCR- Multiplex PCR – uses a number of pairs of primers to allow analysis of a number of fragments in a single sample. Nested PCR –qPCR – Repetitive sequence-based PCR – Reverse transcriptase PCR – Single cell PCR.

# UNITVI:MARINEBIOFOULING:

Problemsbybiofouling-Antifouling

Befouling and Control technology -Biofouling organisms - paintsanditsenvironmentalpollution-Biotechnological

approachtobiofoulingcontrol.RecentApproaches tocontrolFoulingOrganisms.

## Reference

* FundamentalsofEnzymology:NicholasPrice&Lewis Stevens
* Enzymes:Biochemistry, BiotechnologyandClinicalChemistry-Trevor Palmer
* BiochemistrytextbookbyStryer,VoetandLehninger(RelevantChapters)
* EssentialsofMolucularBiology(2ndedition):ByFriefelder
* ProteinsbyGary Walsh
* Bergey'sManualofSystematicBacteriology-Vol1
* MarineBiology-LalliC.M.andT.R.Parsons.,1997.BiologicalOceanograpahy-An Introduction, Elsevier, 314 pp
* MarinePollution-Clark,R.B.2001.Marinepollution,Fifthedition.OxfordUniversitypress,New York Inc., 231pp

**Courseoutcome**

* 1. ImportanceofMarineproductsglobally
  2. Someofthemostpertinentapplicationsofaquaculture/marinebiotechnology
  3. Transgenic,DiseaseResistance,andConservationetc
  4. DNAfingerprintingtoknowpolymorphisminfish stocks
  5. Developingmarker-assistedselectiontechnologies
  6. Improvingtechnologiesforcryo-preservationofgametesandembryos
  7. IdentificationsSeaweedsandTheirProducts
  8. TherapeuticAgentsfromseveralmarinespecies

# CHEMICALOCEANOGRAPHYPRACTICAL

Max.Marks(CIA=40+UE=60)=100;Credits=6)

Sampling techniques – seawater sampling, preservation and storage. Sample preparation prior to analysis, soluble components of seawater, filtration, solvent extraction, coprecipitation, adsorp- tion techniques, chemical pretreatment of organics. Principles of analysis, wet chemical methods, titrimetry, spectrometry, photometry and electrometry. The determination of pH, electrical con- ductivity, dissolved oxygen, total dissolved solids, turbidity, total organic matter, dissolved and particulate organic matter.

Determination of major anions - Salinity, total alkalinity, chloride, bicarbonate, sulphate. Deter- mination of major cations – calcium, magnesium, sodium and potassium. Measurement of nutri- ents – nitrite, nitrate, ammonia, phosphate.Determination of trace elements, classical and ad- vanced analytical instrumentation, atomic absorption spectrophotometer.Analysis of iron, man- ganese, cadmium, nickel, cobalt, chromium, copper, lead, zinc. Cold vapour techniques – meas- urement of arsenic, mercury and selenium. Quality control tools, precision, accuracy, error in analysis, statistical methods, interpretation of datas.

**References:**

Crompton, T.R., 1997.. Analysis of seawater, Springer, UK, 510pp Manahan,S.E.,1998..FundamentalsofEnvironmentalChemistry,CRCPress,NewYork,1230

pp. Beer, T.,, 1996.. Environmental Oceanography –CRC Press, New York,367pp. APHA,1995.Standardmethodsforanalysisofwaterandwastewater,AmericanPublicHealthAs-

sociation,Springer,NewYork1600pp.

# NONMAJORELECTIVE–IBASICSINOCEANOGRAPHY

## MaxMarks(CIA=25+UE=75)=100;Credits=3

M. Sc. Marine Science students will choose one course from any of the courses with a minimum of 2 credits offered by other departments of the University. Courses are commonly tutored on Thursdays’ afternoons.

For courses offered by Department of Marine Science for students of other programmes of study see at the end of this book of syllabi.

# INTEGRATEDCOASTALZONEMANAGEMENT

## Max.Marks(CIA=25+UE=75)=100;Credits=4)

**Objectives**

1. To gain the knowledge on coastal zone and its importance, various coastal ecosystems and its vulnerability.
2. Tobeabletounderstand theOceanlaws – Lawofthesea

# UNIT—IINTRODUCTION

Definitions – Integration - Coastal zones and importance - Sea and Oceans - Coastal resources management programme - Integrated Coastal Zone Management - need, scope, potentials and constraints for ICZM.

# UNIT—IILANDSEAINTERACTIONS

Multiple uses of the coastal zones and conflicts.Human impacts on the coastal zones with special emphasis on artisanal fishing, coastal aquaculture and coastal tourism. Coastal vulnerability - mangroves, corals, sand dunes, sea-grasses, lagoons and enclosed seas, islands, coral reefs and other protected areas.

# UNIT—IIICOASTALECOSYSTEMMONITORING

Coastal and marine ecosystem monitoring –Estuaries, mangroves, lagoons, backwater, reef etc. Effect ofportactivitiesandcoastalpollutiononmangroves,coralsandbeaches.Coastalhazards,impactsand management.

# UNIT—IVMANAGEMENTMETHODS

Major principles and premises ICZM. Ecological land use/water use planning. Overview of Environmental monitoring and EIA. Ecological Economics – Economic benefits of protected areasand economic valuation. GIS and remote sensing for ICZM. Coastal information management & communication - Basic Principles.

# UNIT—VLAWOFTHESEA

United Nations Convention on the Law of the Sea (UNCLOS) I, II, III – Internal water, Territorial water, Archipelagic water, high sea, continental shelf, Exclusive Economic Zone (EEZ) and its significance, limits of territorial water and International sea bed area. International Convention for the Prevention of Pollution from Ships (MARPOL).

## UNIT–VICurrentadvancesinICZM(NotforExamination)

Currentstatusof Indiancoastalzone,Role ofnationalcoastalzonemanagement authority.

Casestudiesaboutintegratedcoastalzonemanagement.InstituteinvolvedinCoastalzone managements.

## References:

Barnabe,G.,2000.Ecologyandmanagementofcoastalwaters.Praxis,396pp. Bartlett,D.andJ.Smith,2005.GISforcoastalzonemanagement,CRCPress,310pp.

Jean–MarinaMassin,1994.Remotesensingforthecontrolofmarine pollution.Academic Pub- lishers, Plenus Press, 466pp.

JohnR.Clark.1995.Coastalzonemanagementhandbook.Lewispublishers,Washington, D.C.

694pp.

Kay,R.andJ.Aider,2005.,Coastalplanningandmanagement,2/e.TaylorandFrancis,

380pp.

Qasim,S.Z.andG.S.Roonwal,1998.India’sExclusiveEconomicZones.OmegaScientificPublish

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ers.NewDelhi.

Ray,G.C.andJ.M.Ray,2004.Coastalmarineconservationscienceandpolicy.BlackwellPublis h- ing,327pp.

Sindermann,C.I.,2006.Coastalpollution.Taylor&Francis,280pp.

**Courseoutcome**

* 1. Learningabout coastalzoneandits importance
  2. NeedandscopeofICZM
  3. Multipleusesofcoastalzone
  4. Variouscoastalecosystemanditsimportances
  5. Humanimpactoncoastal zone-Artisanalfishing,Aquacultureand tourism
  6. Effectsofportactivitiesoncoastal ecosystem
  7. MajorprinciplesandpremisisofICZM.Ecological economics
  8. Coastalzonemanagementprogrammes

# DEEPSEAEXPLORATION

**Max.Marks(CIA=25+UE=75)=100;Credits=4)**

# OBJECTIVES:

Tobrieflyintroducesomeimportant techniquesneeded forunderstandingthefield of offshoremarine science.Tounderstandimportantcomputeraided packagesusedforpresentdaydeepsea exploration.

# UNIT–I INTRODUCTION

Introduction to oceanography: the world’s oceans and seas, properties of seawater, physico-chemical factors in the marine environment such as temperature, density, nutrients, salinity, dissolved gases, waves, tides, oceanic currents,

# UNIT—IIDEEPSEAENVIRONMENT

Marine geological setting, genesis and occurrence of Metalliferous sediments, Phosphorites (including mineralogy and geochemical environments of modern deposition). Marine mineral resources: Importance, biotic and abiotic. Polymetallic nodules, Cobalt and other related crusts, Hydrothermal sulfide deposits including black and white smokers.

# UNIT—IIIEXPLORATIONINSTRUMENTS

Sampling equipment: water samplers such as Niskin sampler, Hydro-Bios sampler, Rosette samplers; sedimentsamplerssuch asvanVeen grabs and corers.Principlesofelectricalsurveyatsea—Instruments— Data acquisition and interpretation: Princi-ples of gravity survey at sea—Instruments—Data acquisition, Reduction, Gravity anomalies and interpretation– Principles of radiometric survey at sea—Instruments— Data acquisition, Reduc-tion, radiometric anomalies.

# .UNIT—IVTECHNICALPRINCIPLES

Principles, instrumentation, methodology and applications of onshore and offshore geophysical explorations - Gravity, magnetic, seismic, electrical and radioactive techniques. Well Logging Techniques: Electrical, Radioactive, Sonic and Miscellaneous. Echosounder and its uses.

# UNIT–V–RECENTADVANCEDTECHNIQUES

Acoustic direction finder, Multibeam Echosounder;Bottom penetrating echosounder; seismic array (SleeveGuns); CTDRosettaframewith water samplers; Deep SeaMooringwith ADCP, current meterand Sediment Trap; Deep Digging Dredge (Triple-D) for sampling benthic macrofauna; Altrap Bottom Lander with larvae collector; Albex multi-purpose Bottom Lander for measurements and experiments at the sea floor; Mobile underwater vehicle (MOVE)

## UNIT—VIMARINESCIENCEDATAANALYSIS(NotforExamination)

Simple linear correlations: Karl Pearson’s *r* and Spearman’s Rank Correlations – Coefficient of determination -Simple LinearRegression – Multiplecorrelation – Coefficient ofmultipledeter-mination - Multiple regression - Cluster Analysis.

## Reference:

Jones,E.J.W.,1999.MarineGeophysics.JohnWiley,474p.

Kearey,P.,M.Brooks,I.Hill,2002.AnIntroductiontoGeophysicalExploration,3e.JohnWiley,474p. Stein, S. and M. Wysession, 2000. An Introduction to Seismology, Earthquakes, and Earth Struc-tureKearey, P., K. A. Klepeis and F.J. Vine, 2009. Global Tectonics, 3e. John Wiley.

## Courseoutcome:

1. Learningaboutunderwater design
2. Preparationofdeepseaexplorationprcedure.
3. Understandingstructureofoceanenvironment
4. SamplingandDataanalysis
5. Recentadvancementinunderwaterechniques
6. Statistificalsignificanceanalysis-pvalue,Zandttestetc.
7. RegressionandClusteranalysis

# MARINEGEOPHYSICS

## Max.Marks(CIA=25+UE=75)=100;Credits=4)

**Objectives:**

* 1. Tounderstandthetypes ofrocksanditspropertiesinseabed
  2. Tolearntheapplicationandtypesofseismicsurvey, researchvessels

# UNIT—ISEABEDCHARACTERISTICS

Types of Rocks: Igneous, Sedimentary and Metamorphic Rocks – Oceanic Crust - Rheological Properties – Electrical Properties – Elastic Properties – Magnetic Properties - Radioactivity -Heat flow—Locating Offshore Observations—Deep-Sea Geophysics.

# UNIT—IISEABEDEXPLORATION—ELECTRICAL,GRAVITYANDRADIO- ACTIVITY

Principles of electrical survey at sea—Instruments—Data acquisition and interpretation: Princi- ples of gravity survey at sea—Instruments—Data acquisition, Reduction, Gravity anomaliesandinterpretation–Principlesofradiometricsurveyatsea—Instruments—Data acquisition, Reduc- tion, radiometric anomalies.

# UNIT—IIIGEOMAGNETICSURVEYATSEA

Geomagnetism - Paleomagnetism - Rock magnetism - Natural remanent magnetization- Thepastandpresent geomagneticfield-Polarwanderingcurve-Seafloorspreadingand transform faults - Marine magnetic anomalies - Geomagnetic reversals - The Vine– Matthews hypothesis - Magnetostratigraphy - Dating of the oceanfloor.

# UNIT—IVSEISMICSURVEYATSEA

Seismic waves and their propagation – Seismic noise and its causes - Marine seismic data acqui- sition – Energy sources - Seismic reflection and refraction surveys – single and multichannel re- flection profiling, common depth point technique, sonobuoysurveys; 3D seismics and Seismic tomography - Seismic data processing and interpretation – time- depth sections.

# UNIT—VAPPLICATIONOFGEOPHYSICALMETHODS

Seabed Imaging by Sonar and Lidar—Application of geophysical methods for placer deposits; oil and natural gas and other minerals of the continental margin. Survey and exploration of differ- ent types of sediments and minerals of the deep ocean floor. Geophysical Observations in Off- shoreBoreholes.

## UNIT–VIAdvancesInInstrumentation(NotforExamination)

Biosensor, solar energy capturing Tidal energy, ocean thermal energy, Optically inbuilt high sensor for under water mining, Robotics techniques and Recent advancement, Nano fibre Technology for geophysical exploration.

## References

Jones,E.J.W.,1999.MarineGeophysics.JohnWiley,474p.

Kearey,P.,M.Brooks,I.Hill,2002.AnIntroductiontoGeophysicalExploration,3e.John Wiley, 474 p.

Stein,S.andM.Wysession,2000.AnIntroductiontoSeismology,Earthquakes,and Earth Struc- ture

Kearey,P.,K.A.KlepeisandF.J.Vine,2009.GlobalTectonics,3e.JohnWiley.

## Courseoutcome

1. Knowingaboutsubmarinegeology
2. Learningaboutseabedexplorationmethods
3. understandingaboutgeomagneticsurvey
4. Learningfundamental0f seismicsurvey
5. Basicstudaboutvariousgeophysicalmethodsforocean studies
6. Learningaboutvariousrocktypesanddistributedintheoceanfloor
7. Studyingaboutvariousofsedimentdistribution pattern
8. Knowingapplicationofgeophysicsinoceanstudies

# AQUACULTURE

**Max.Marks(CIA=25+UE=75)=100;Credits=4)**

# OBJECTIVES:

1. To understand the current technology and techniques of commercially important cultivable fin fish and shell fish.
2. Toimpartknowledgeaboutspawning, larvalrearing, waterqualityand feedingofcommercially important cultivable fin fish and shell fish.
3. Toknowaboutthefeedformulationtechniqueandtheirapplicationin aquaculture.

# UNIT-I:INTRODUCTIONTOAQUACULTURE

Overview-importance of aquaculture, global scenario, present status in India-prospects and scope. Commercially important cultivable finfishes, shellfishes and aquatic plants, criteria for selection of candidate species. Culture techniques-monoculture, polyculture-pond, raceway, cages, pens, raft and rope culture.

# UNIT-II:AQUAHATCHERY

Types of hatchery, criteria for site selection for hatchery-topography, water supply, seed production technology for edible finfishes, ornamental fishes, shrimp, crab, lobster and molluscs-maturation, induced breeding and spawning, larval rearing, water quality, feeding, diseases in larvae and health management.

# UNIT-III:AQUAFARMING

Aqua-farming systems-traditional, extensive, semi-intensive, intensive. Criteria for site selection for aqua farm-topography, soil type, water supply. Aqua farm construction, pond preparation, culture of commercial important species i.e. Seaweeds-(Gracilaria, Gelidiella, Kappaphycus) Finfishes (seabass, grouper, pearl spot, mullet, milkfish, cobia, silver pompano and ornamental fishes). Shellfishes (shrimps, crabs, lobsters, mussels, edible oysters, pearl oysters, clams).

# UNIT-IV:AQUAFEEDTECHNOLOGY&AQUACULTUREBIOTECHNOLOGY

Types of feed, feed formulation, feed ingredients, micro diets, nutritional quality of compoundedfeeds, culture of live feeds-microalgae, rotifer, Artemia, cladoceran, copepods and polychaetes, nutritional composition of live feeds, bioenrichment, cryopreservation of fish gametes, sex reversal, transgenic fish production, fish cell line.

# UNIT-V:POSTHARVESTTECHNOLOGY&FISHERYBYPRODUCTS

Fish handling and transportation, fish spoilage, methods of prevention of spoilage, Post harvest technology-freezing,canning,drying,saltcuring,smokingandionizingirradiation,qualitycontrol and factorysanitation, Fish by products-fish oil- methods of production, fish meal, fish ensilage FPC, etc.,

# UNIT-VI:TECHNOLOGICALINNOVATIONSINAQUACULTURE

Recirculating Aquaculture Systems (RAS), Integrated Multitrophic Aquaculture (IMTA), Zero Water Exchange Aquaculture Production Systems (ZWEAPS), Solar power in sustainable aquaculture, Biofloc aquaculture system, Copefloc aquaculture system.

## References:

ChiranjibChakraborty andArupKumarSadhu.,2001.Biology,hatchery andculturetechnology of tiger prawn and giant freshwater prawn. Daya Pub., New Delhi, 99 pp.

Govindan,T.K.,1992.FishprocessingTechnology,Oxford&IBHPub.,NewDelhi.,252 pp.

Pillai, T.V.R., 2005. Aquaculture principals and practices, Culinaryand HospitalityIndustryPub., 624 pp.

Santhanam,P.,A.R.ThirunavukkarasuandP.Perumal.,2015.AdvancesinMarineand Brackishwater Aquaculture. Springer Publications (ISBN 978-81-322-2270-5). 263 pp.

**Courseoutcome:**

* 1. PresentstatusofworldandIndianfisheriesandaquaculture
  2. Marinefishhatcheryand farmingtechniques
  3. Shrimphatcheryandgrow-outtechnology
  4. Aquafeed andnutrition technology
  5. Aquaculturebiotechnology
  6. Marineaquariumtradeandhealthmanagement
  7. Postharvesttechnology
  8. Fisherybyproductsdevelopment

# BIOLOGICALOCEANOGRAPHYANDFISHERYSCIENCEPRACTICAL

Max.Marks (CIA=40+UE=60)=100;Credits=6)

BIOLOGICALOCEANOGRAPHY

* + 1. Phytoplankton-identificationofcommonforms
    2. Identificationofcommonzooplankton
    3. Estimationofprimaryproduction(LightandDarkbottletechnique)
    4. EstimationofChlorophyll‘a’concentration
    5. Determinationofzooplanktonbiomass
    6. Seaweeds-identificationofcommerciallyvaluablegroups
    7. Mangroves-identificationofcommonspecies
    8. Finfishes-identificationofcommonfoodspecies
    9. Identificationofcultivableshrimpsandprawns
    10. Crabs-identificationofcommonediblegroups
    11. Identificationofcommonformsofgastropodsandbivalves
    12. VisittoMarineandFisheriesInstitutes
    13. FieldvisittoGulfofMannarMarineBiosphereReserve
    14. Industrialvisittofishhatcheryandgrow-outfarm

# NONMAJORELECTIVE–II;MARINEENVIRONMENT

## MaxMarks(CIA=25+UE=75)=100;Credits=3)

M. Sc. Marine Science students will choose one course from any of the courses with a minimum of 2 credits of- fered by other departments of the University. Courses are commonly tutored on Thursdays’ afternoons.

ForcoursesofferedbyDepartmentofMarineScienceforstudentsofotherprogrammes of study see at the end of this book of syllabi.