A Master’s Programme consists of a number of courses. Master’s Programme consists of a set of Core Courses.

Core courses are basic courses required for each programme. The number and distribution of credits for core courses will be decided by the faculty.

A course is divided into five units to enable the students to achieve modular and progressive learning.

**SEMESTERS**

An academic year is divided into two semesters, Odd Semester and Even Semester. The normal semester periods are:

Odd Semester: July to November (90 Working days)

Even Semester: December to April (90 Working days)
CREDITS

The term credit is used to describe the quantum of syllabus for various programmes and hours of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design.

The minimum credit requirement for a five year Master’s Programme shall be 225.

ELIGIBILITY

A pass in H.Sc. (10 + 2 level) OR an Equivalent thereto under academic stream in the following subjects viz. Mathematics, Physics, Chemistry and Biology.

COURSES

Each course may consist of lectures / laboratory work / seminar / project work / practical training / report / viva voce etc.

COURSE WEIGHT

Core courses may carry different weightage. For example, a course carrying one credit for lectures, will have instruction of one period per week during the semester, if three hours of lecture is necessary in each week for that course then 3 credits will be the weightage. Thus normally, in each of the courses, credits will be assigned on the basis of the lectures / laboratory work and other form of learning in a 15 week schedule:

(i) One credit for each lecture period per week.
(ii) One credit for every three periods of laboratory or practical work per week.
(iii) One credit for 3 contact hours of project work in a week.
(iv) One credit for every two periods of seminar.

GRADING SYSTEM

The term Grading System indicates a 10-point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class.

DURATION

The duration for completion of a five year Master’s Programme is ten semesters.
STRUCTURE OF THE PROGRAMME

The Master’s Programme will consist of:

(i) Two Language Courses in Part I (Tamil/Hindi/French) and Part II (English) in each semester up to II year (4th Semester)

(ii) One course on Civics, Environmental and Health Science in the First semester

(iii) Two Ancillary courses (two papers each in I and II year).

(iv) Core courses which are compulsory for all students.

Dissertation / Project work / Practical training / Field work can be done in an organization (Government, Industry, Firm, Public Enterprise etc.) approved by the concerned department.

ATTENDANCE

Every teaching faculty handling a course shall be responsible for the maintenance of attendance register for candidates who have registered for the course.

The teacher of the course must intimate the Head of the Department at least Seven Calendar days before the last instruction day in the semester about the attendance particulars of all students.

Each student should fulfil the attendance requirement of 75% as prescribed by the University, to be eligible to appear for the University Examinations.

EXAMINATIONS

The internal assessment for each course carries 25% marks and is based on two sessional tests. The pattern of question paper will be decided by the faculty. The tests are compulsory.

There will be one End Semester Examination (75% marks) of 3 hours duration for each course. The pattern of question paper will be decided by the faculty.

The Internal assessment for each practical course carries 40% of marks while the end semester practical examination of 3 hours duration carries 60% of marks.

EVALUATION

The performance of a student in each course is evaluated in terms of Percentage of Marks (PM) with a provision for conversion to Grade Point (GP). The total performance in each semester will be rated by Grade Point Average (GPA); while the continuous performance from the 2nd Semester onwards will be marked by Overall Grade Point Average (OGPA).

MARKS AND GRADING

A student cannot repeat the assessment of Sessional Test I and Sessional Test II. However, if for any compulsive reason, the student could not attend the test, the prerogative
of arranging a special test lies with the teacher in consultation with the Head of the Department.

A student has to secure 50% minimum in the End Semester Examination.

The student who has not secured a minimum of 50% of marks (sessional plus end semester examination) in a course shall be deemed to have failed in that course.

A candidate who has secured a minimum of 50% marks in all the papers prescribed in the programme and earned a minimum of 225 credits will be considered to have passed the Master’s Programme.

GRADING

A ten point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master’s Programme.

<table>
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<tr>
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<th>Grade</th>
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<td>Fail</td>
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</table>

The successful candidates are classified as follows:

I Class – 60% Marks and above in overall percentage of Marks (OPM).

II Class – 50-59% Marks in overall percentage of marks.

Candidates who obtain 75% and above but below 90% of marks (OPM) shall be deemed to have passed the examination in FIRST CLASS (Distinction) provided he / she passes all the papers prescribed for the programme at the first appearance.

For the Internal Assessment Evaluation, the details shall be as follows:

| Test (2 tests) | -       | 15  |
| Assignment    | -       | 5   |
| Seminar       | -       | 5   |
|               |         |     |
| Total         | -       | 25 Marks |
COURSE – WISE LETTER GRADES

The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

A student is considered to have completed a course successfully and earned the credits if he / she secures an overall letter grade other than F. A letter grade F in any course implies a failure in that course. A course successfully completed cannot be repeated for the purpose of improving the Grade point.

The F grade once awarded in the grade card of the student is not deleted even when he / she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the odd / even semester in which the candidate has appeared for clearance of the arrears.

A student who secures F grade in any course which is listed as a core course has to repeat it compulsorily when the examination is held next. If it is an Elective course, the student has the option to repeat it when it is offered next or to choose a new elective if he / she so desires in order to get a successful grade. When new elective is chosen in the place of failed elective, the failed elective will be indicated as dropped in the subsequent grade card.

If a student secures F grade in the Project Work / Field Work / Practical Work / Dissertation, he / she shall improve it and resubmit it if it involves only rewriting incorporating the clarifications of the evaluators or he / she can re-register and carry out the same in the subsequent semesters for evaluation.
M.Sc. OCEAN SCIENCE AND TECHNOLOGY

5 YEAR INTEGRATED PROGRAMME

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**VI Semester**

| IOST 61    | Air – Sea Interaction                             |
| IOST 62    | Fluid Mechanics                                   |
| IOST 63    | Waves and Tides                                   |
| IOST 64    | Instrumentation and Analytical Methods            |
| IOSP 65    | Practical XV (IOST 61)                            |
| IOSP 66    | Practical XVI (IOST 62)                           |
| IOSP 67    | Practical XVII (IOST 63)                          |
| IOSP 68    | Practical XVIII (IOST 64)                         |

**VII Semester**

| IOST 71    | Coastal and Marine Resources                      |
| IOST 72    | Survey Technology of Coastal Environment          |
| IOST 73    | Satellite Oceanography                             |
| IOST 74    | Marine instrument for oceanographic Measurements  |
| IOST 75    | Ocean Management                                   |
| IOSP 76    | Practical XIX (IOST 72)                           |
| IOSP 77    | Practical XX (IOST 73)                            |
| IOSP 78    | Practical XXI (IOST 74)                           |

**VIII Semester**

| IOST 81    | Geographic Information System                     |
| IOST 82    | Renewable energy systems                          |
| IOST 83    | Dynamical Oceanography                            |
| IOST 84    | Disaster Management                                |
| IOST 85    | Fishery Technology                                 |
| IOSP 86    | Practical XXII (IOST 81)                          |
| IOSP 87    | Practical XXIII (IOST 82)                         |
| IOSP 88    | Practical XXIV (IOST 85)                          |

**IX Semester**

| IOST 91    | Underwater Acoustics and Optics                   |
| IOST 92    | Coastal and estuarine dynamics                    |
| IOST 93    | Numerical modeling for coastal processes          |
| IOST 94    | Environmental Impact Assessment                   |
| IOST 95    | Marine Recreation                                 |
| IOSP 96    | Practical XXV (IOST 91)                           |
| IOSP 97    | Practical XXVI (IOST 92)                          |

**X Semester**

| IOST 101   | Project Planning Analysis and Management          |
| IOST 102   | Dissertation and Viva-Voce                       |
# M.Sc. OCEAN SCIENCE & TECHNOLOGY

**(Five Year Integrated CBCS Course)**  
*(For the students admitted during the year 2018 – 2019 onwards)*

## SEMESTER WISE SCHEME OF COURSES AND CREDITS

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(L – Lecture Hours   P – Practical Hours   C – Credits)

Overall credits - 225
I SEMESTER
IANM 14 ANCILLARY MATHEMATICS - I

Objectives:
On completion of the course the students will familiar with Matrices and Determinants, simultaneous linear algebraic equations, numerical differentiation, Numerical solution of Ordinary differential equations and Theory of equations

UNIT I – Theory of Equations


UNIT II - Matrices and Determinants


UNIT III – Solution of Simultaneous Linear Algebraic Equations


UNIT IV – Numerical Differentiation

Lagrange’s interpolation formula for unequal intervals to find the derivative - Newton – Gregory Forward difference formula to compute the derivatives - Newton – Gregory Backward difference formula to compute the derivatives – Newton – Gregory Central difference formula to compute the derivatives.

UNIT V - Numerical solution of Ordinary differential equations


REFERENCE BOOKS

IOST15 MARINE INVERTEBRATES & PROCHORDATES

Objectives

The marine invertebrates are of ecological and economic significance. Studies pertaining to marine invertebrates are prerequisite. In this regard, the student of ocean science and technology can understand different aspects of invertebrates on classification/systematic, biology, larval development and life history, evolution and paleontology, adaptive radiation and phylogenetic relationship.

UNIT - I


UNIT - II


UNIT - III

Crustacean – classification, comparative morphology, crustacean appendages, and larval forms.

UNIT - IV

Mollusca – classification, general characters, torsion and adaptive radiation.

UNIT - V

Echinodermata – classification, water vascular system, reproduction and larval forms. Prochordates- classification, reproduction and early development.

PRACTICAL I : IOSP 17 : MARINE INVERTEBRATES & PROCHORDATES

1. Identification of coastal invertebrate fauna of Parangipettai
2. Mounting of gastropod radulae
3. Mouth parts of Squilla and appendages of shrimps
4. Anatomy of shrimp, gastropod and bivalve

REFERENCE BOOKS

Objectives:

The objectives of this paper is to impart knowledge on morphology, classification and identification, biology of vertebrates (finfish, reptiles, birds and mammals) in the marine environment.

UNIT - I Teleost fishes


UNIT - II Elasmobranchs

General characters-External morphology of Sharks, skates and Rays. Type study: Scoliodon, Rhiniodon and Dasyatis - Types of fins and dentition – Respiratory structure - Parental care - Economic importance.

UNIT - III Reptiles

Reptilia: General characters and classification - Type study - sea turtles, crocodiles, sea snakes – Importance of the reptiles - Origin of reptiles and effects of terrestrialisation - Extinct reptiles.

UNIT - IV Birds


UNIT - V Marine Mammals

PRACTICAL II : IOSP 18 - MARINE VERTEBRATES

1. External morphology of fishes teleost and elasmobranch-scales and teeth
2. Dissection of digestive system of a teleost fish
3. Studies on food and feeding habits of finfish
4. Identification of elasmobranchs-sharks, skates and rays
5. Identification of teleost fishes
6. Identification of marine reptiles-sea snakes, turtles and crocodiles
7. Identification of sea birds

REFERENCE BOOKS

II SEMESTER

IANM 24 ANCILLARY MATHEMATICS - II

Objectives:

On completion of the course the students will be familiar with Solving the algebraic and transcendental equations, ordinary differential equations, numerical integration, empirical laws and curve fitting and assignment problem.

UNIT – I: Solution of Algebraic and Transcendental Equations


UNIT – II: Numerical Integration


UNIT – III: Numerical solution of Ordinary differential equations

Milne’s Predictor Corrector Method – Adam’s – Bashforth Predictor Corrector Method – Picard’s Method.

UNIT – IV: Empirical Laws and Curve Fitting

Laws reducible to the linear law – Method of Group averages – Method of Least Squares – Method of Moments.

UNIT – V: Assignment Problem


REFERENCE BOOKS

Objectives:
To get a good exposure to the basic concepts of chemistry to enable them to pursue careers related to chemistry.

UNIT-1: METALLURGY
Mineral wealth of India - Important minerals in India - Minerals exported and imported to India. Basic principles of metallurgy - Extraction of the following metals: Fe, Cr, Pb and Zn. Manufacture of steel and stainless steel, heat treatment of steel - General methods of preparation and properties of alloys of the following metals: Zn, Cu, Pb, Ni, Fe and Cr.

UNIT-2: ORGANIC CHEMISTRY
Electronic displacement effects: Inductive, resonance and steric effects. Their effect on Ka and Kb on organic acids and bases - Organic reaction mechanisms: SN1 Vs. SN2 reaction of alkyl halides : mechanism only - Aromatic electrophilic substitution; nitration, halogenation, Friedel - Craft’s alklyation and acylation

UNIT-3: PHYSICAL CHEMISTRY
Solutions: Types and examples of solutions: gas in liquid and liquid in liquid (totally miscible, partially miscible and immiscible liquid pairs) - Henry’s and Raoult’s laws, ideal and real solutions, deviation from ideal behaviour-Vapour-Pressure composition diagram for a totally miscible binary liquid system obeying Raoult’s laws- Partially miscible liquid system (Phenol-water) - Phase Rule: Definition of phase, component and degree of freedom, Phase rule (statement only) - Application of phase rule to a one-component system (water)

UNIT-4: KINETICS AND CATALYSIS
Rate expression for I and II order, methods of determining order of a reaction, order and molecularity - Catalysis : homogeneous and heterogeneous, catalyst used in Contact and Haber’s processes - Concept of energy of activation and Arrhenius equation – technologically important catalysis.

UNIT-5: INDUSTRIAL CHEMISTRY
Natural rubber:Composition, cis-structure, elasticity, manufacture and uses of synthetic rubber (neoprene, Buna-S), Vulcanization of rubber-Plastic: Manufacture and uses of PVC, Bakelite, acrylates, PET, PUF, and Polystyrene
Corrosion: Causes of corrosion of metals, Prevention: Galvanization, electroplating and cathodic protection.
PRACTICAL III : IOSP 27 : CHEMISTRY

a. Identification of acidic, basic, phenolic and neutral organic substances
b. Detection of N, S and halogens
c. Test for aliphatic and aromatic nature of substances.
d. Test for saturation and unsaturation.
e. Identification of functional groups
   i) Carboxylic acid
   ii) Phenols
   iii) Aldehydes
   iv) Ketones
   v) Esters
   vi) Carbohydrates
   vii) Primary amines
   viii) Amides

REFERENCE BOOKS

Objectives

This paper covers the general introduction to the marine microbes, non-flowering and flowering plants of the coastal and marine environs. This also covers the aspects relating to productivity, economic and ecological importance including ecosystem services. Laboratory culture of microbes and field cultivation and transplantation are emphasized in addition to the identification of marine microbes to mangroves.

UNIT - I Marine Microbial Flora

General characteristics of marine microbial flora – viruses, bacteria, actinobacteria and fungi - occurrence and distribution in the oceans, microbial associations- importance of marine microbial flora.

UNIT - II Marine Phytoplankton

Marine phytoplankton - diatoms, dinoflagellates, coccolithophoids, cyanobacteria - importance as primary producers, harmful algal blooms - red tides – causes and effects - laboratory culture of phytoplankton.

UNIT - III Seaweeds

Seaweeds - Chlorophyceae, Pheophyceae and Rhodophyceae – distribution, economical importance, cultivation and use as biological indicators.

UNIT – IV Seagrasses

Seagrasses - Composition - distribution in tropical and temperate waters – adaptation, ecological and economical importance – threats, conservation and transplantation.

UNIT – V Mangroves

Mangroves – definition- distribution – types of mangrove forests- adaptations - economic and ecological importance.

PRACTICAL IV : IOSP 28 : MARINE PLANTS

1. Isolation of marine microbes (*Vibrio*, *Bacillus*, *Streptomyces*, *Penicillium*)
2. Collection, preservation and identification of marine phytoplankton (Bloom formers)
3. Collection, preservation and identification of seaweeds
4. Collection, preservation and identification of seagrasses
5. Collection, preservation and identification of mangroves
REFERENCE BOOKS

Objective:
- Understand the basic concepts of elasticity, Surface tension and viscosity their practical applications.
- Explain the behaviour of thermal expansion of solids, liquids and gases.
- Explain the SHM and Ultrasonics
- Explanation of geometrical and physical optics.
- Explanation of Electromagnetic spectrum, uv radiation, radiation dose effects.

Unit-1 Mechanics and General Properties of Matter:

Elasticity: Strain and stress, elastic limit, Hooke’s law; Moduli (Young’s, Bulk, Rigidity) and Poisson’s ratio, Surface tension: Surface tension and surface energy, angle of contact, capillary action, Flow of liquids and gases: Streamline and turbulent flow, equation of continuity, Bernoulli’s theorem, Torricelli’s theorem; Coefficient of viscosity, Reynold’s number and critical velocity, Stoke’s law; Turbulence and chaos.

Unit-2 Thermal Physics:

Thermodynamics: Laws of thermodynamics and interpretation; derivation from first principles; Entropy and disorder, free-energy and chemical potential. Brownian motion: Elementary ideas of Brownian motion, equipartition energy; Random Walk and Stochastic processes (additive and multiplicative), Diffusion: Mean free path and drift speed.

Unit-3 Sound:


Unit-4 Optics:


Unit-5 Radiation Effects on Biological Systems:

Electromagnetic spectrum, Effects of visible, ultraviolet and high energy radiation on biological systems – Natural and artificial isotopes – alpha, beta and gamma radiation - GM counter and Scintillation counter. Radiation effects of living systems. Medical and biological applications
PRACTICAL V : IOSP 37 : ANCILLARY PHYSICS - I

1. Vernier microscope -radius of capillary tube
2. Young's modulus - Non-uniform bending - Pin & microscope
3. Young's modulus - Uniform bending - Optic lever
4. Rigidity modulus - Torsional pendulum (without identical masses)
5. Rigidity modulus and moment of inertia - Torsional pendulum (With identical masses)
6. Surface tension and interfacial surface tension drop weight method
7. Coefficient of viscosity of liquid - Graduated burette (radius of capillary tube by Mercury pellet method)
8. Sonometer - verification of laws and frequency of tuning fork
10. Specific heat capacity of a liquid - Newton's law of cooling
11. Specific heat capacity of liquid - Method of mixtures (Half-time correction)
12. Focal length, Power, R and u of a long focus convex lens
13. Focal length, Power, R and u of a concave lens

REFERENCE BOOKS

3. A text book of sound – Brijlal & N. Subramanyam S.Chand & Co.,
Iöst 35 OceAn And CoastAl ecology

Objectives:

The paper is aimed at teaching the students on varied aspects of coastal and marine ecology. This paper includes the knowledge about the Ocean and coastal Ecology apart from Coral, estuary and mangrove ecology. Upon completion of this course, the student will be able to understand the nature of different ecosystems, distribution of living organisms and their adaptations in the respective ecosystems.

Unit -I Introduction to Marine Ecology

Marine Ecology- definition- importance of marine ecology – uniqueness of marine environment - major groups of marine organisms- Uniqueness of marine organisms. Hydrothermal vents and cold seep communities

Unit – II Ocean ecology

Pelagic zone of ocean - Epipelagic zone, Mesopelagic zone, Bathypelagic zone, Abyssalpelagic zone, Hadalpelagic zone- adaptations of the organisms associated with the zones. Benthic zone of ocean - Bathyal zone, Abyssal zone, Hadal zone –adaptations of the organisms associated with the zones.

Unit - III Coastal Ecology

Pelagic zone of coastal environment – adaptations of organisms in the pelagic zone.

Benthic zone of coast - Intertidal zone, Rocky shores, Sandy shores, Muddy shores - Continental shelf or sub-tidal zone of coast – Adaptations of organisms

Unit - IV Ecology of Coral Reef Ecosystem

Importance of coral, Coral distribution, Types of coral reefs, Ecology of Coral Reefs, Organisms associated with reefs, Species interactions and ecology of reefs, Ecology of Reef fishes

Unit - V Ecology of Estuary

Estuarine environment –definition- types of estuaries- estuarine organisms - adaptation of estuarine organisms - estuarine productivity - estuarine food webs.

Practical VI : IOsp 38 Ocean And Coastal Ecology

1. Identification of marine organisms in different environments
2. Observation of various adaptations of marine organisms to their respective environments
3. Field visits to landing centers, sandy shore, rocky shore and muddy shores
4. Preparation of reports for the field visits
REFERENCE BOOKS

 IOST 36  STATISTICS

Objectives:

Students will be able to distinguish between categorical and quantitative variables or data and, within each type, respectively, to distinguish between ordinal and non-ordinal categorical variables and between discrete and continuous quantitative variables; define distributions and frequency tables; distinguish between bimodal, unimodal, normal, leptokurtic, platykurtic, skewed, and symmetric distributions; construct histograms from raw data, including setting category boundaries for continuous data (or discrete data with low frequencies within data classes); calculate the value of a summation notation expression; calculate summary statistics (mean, mode, median, range, interquartile range, standard deviation, and variance) from raw data.

UNIT I

Scope and limitations of Statistics, Type of Data. Concept of a statistical population; qualitative and quantitative data. Presentation of data: construction of tables with one or more factors of classification. Diagrammatic and graphical representation of grouped data. Frequency distribution, cumulative frequency distributions and their graphical representation, histogram. Frequency polygon.

UNIT II


UNIT III

Small sample tests – Student ‘t’ test for mean, difference of two means, Paired ‘t’ test, test for correlation and regression coefficients. Chi-square test for goodness of fit and independence of attributes. ‘F’ test for equality of variances.

UNIT IV


UNIT V

Covariance matrix – Correlation Matrix – Multivariate Normal density function – Principal components – Sample variation by principal components – Principal components by graphing.

Statistical and graphing software: Excel, SPSS Sigma plot, SYSSTAT
PRACTICAL VII : IOSP 39 STATISTICS

1. Methods of sampling and collection of biological data.
2. Calculation of mean, median, mode, standard deviation, standard error and coefficient of variation, kurtosis, skewness, t and $\chi^2$
3. Calculation of correlation coefficient values and finding out the probability values.
4. Calculation of b and a values and plotting of regression lines.
5. Calculation of F value and finding out the probability value for F value

REFERENCE BOOKS

IV SEMESTER

IANP 43 ANCILLARY PHYSICS – II

Objective:

- To understand the basic concepts of elasticity, ballistic Galvanometer, Potentiometer and their practical applications.

- Explanation of the basic concepts of magnetic materials, electric and magnetic circuits, Ferrites.

- Explanation of the Photo electric effect, Wave mechanics

- To understand characteristics of nuclear forces, particle accelerators and elementary particles

- Explanation of laser actions, applications of lasers and Laser Raman Spectrometer

Unit - IElectricity


Unit – II Magnetism

Magnetism : Basic concepts of magnetic materials – magnetic properties of Dia, Para and Ferro magnetic materials – Area of (B-H) loop – electric and magnetic circuits – Curie temperature – applications of Ferrites in computer memory.

Unit – III Modern Physics and Wave mechanics

Modern Physics: Photo electric effect – Einstein’s photo electric equation – verification of Einstein’s photo electric equation by Millican’s experiment – photo electric cells – applications.


Unit – IV Nuclear Physics

Unit – Laser Physics


PRACTICAL VIII : IOSP 46 : ANCILLARY PHYSICS - II

1. Potentiometer – Ammeter calibration
2. Potentiometer – Low range voltmeter
3. Potentiometer – emf of a thermocouple
4. M and H – absolute determination using deflection and vibration magnetometer
5. Field along the axis of the coil – Determination of M
6. Moment of magnet – Tan C position

REFERENCE BOOKS

Objectives:

To introduce students to physical oceanographic concepts and principles. The main emphasis of the course will be on physical forces in the ocean, especially those forces that drive ocean currents. The student will be expected to understand concepts relating to atmospheric-oceanic coupling, planetary forces and thermohaline circulation.

UNIT – I Geographical features

History of oceanography, origin of ocean basins and seawater, bottom topography, abyssal hills and plains, submarine canyons, trenches and ridges. Classification of the marine environment.

UNIT – II Physical properties of seawater

Physical properties of seawater – temperature, dissolve oxygen, density, viscosity, surface tension and conductivity of seawater - their distribution in space and time - Formation and classification TS diagram -acoustical and optical characteristics of seawater – SOFAR channel – shadow zone

UNIT – III Heat Budget


UNIT – IV Circulation

Currents – forces causing surface and deep currents - trade winds - major currents of the world oceans - boundary currents - equatorial currents - turbidity currents - geostrophic currents - gyres Langmuir circulation - upwelling - El Nino and La-Nina

Unit – V Indian Ocean

PRACTICAL IX : IOSP 47 : PHYSICAL OCEANOGRAPHY

Sampling Devices

2. Light measuring devices – Secchi disc, Lux meter, Turbidity meter.
3. Temperature and pressure measuring devices – towing surface thermometer, Six’s maximum and minimum thermometer, Reversing thermometer, Bathythermograph, Fortin’s barometer

Estimation of physical properties of seawater

1. Determination of density and salinity of seawater and its interrelationship
2. Determination of Surface tension of seawater and its correlation with salinity
3. Determination of viscosity of seawater and its correlation with salinity
4. Computation of Density using temperature and salinity (TS diagram)
5. Determination of turbidity using turbidity meter

REFERENCE BOOKS

IOST 45 CHEMICAL OCEANOGRAPHY

Objectives:

Students should be able to: Describe the important processes controlling the distribution of chemical species in seawater and sediments. Calculate the average duration of different elements in the ocean. Describe the interaction between marine chemical processes and the biological, geological, and physical processes in the oceans. Explain the impact of chemistry of the oceans on the future of planet Earth.

UNIT - I Distribution of water on the earth

Distribution of water on the earth, hydrological cycle - Ocean as a chemical system, structure of water molecules, differences between freshwater and seawater.

UNIT – II Chemical composition of seawater

Chemical composition of seawater - concept of chlorinity and constancy of composition of seawater. Major and minor constituents, trace element, their distribution and importance.

UNIT – III Dissolved gases

Dissolved gases – carbon dioxide, oxygen, nitrogen, hydrogen sulfide, noble gases, methane, origin, distribution and importance in the marine environment. Ozone depletion and global warming.

UNIT – IV Organic matter


UNIT – V Nutrients

Nutrients – inorganic nutrients, origin, role in productivity. Significance of Redfield ratio. Speciation of nutrients and their distribution and cycling. Analytical methods.

PRACTICAL X : IOSP 48 : CHEMICAL OCEANOGRAPHY

Titrimetric Procedures

1. Chlorinity
2. Salinity
3. Alkalinity
4. Dissolved oxygen
5. Calcium and magnesium
Colorimetric Procedures to pollutants

6. Bromide, fluoride and iodide
7. Nitrite
8. Nitrate
9. Phosphate
10. Total Phosphorus
11. Particulate organic carbon
12. Hydrogen Sulphide
13. Ammonia
14. Organic nitrogen
15. Reactive Silicate

REFERENCE BOOKS

V SEMESTER

IOST 51 BIOLOGICAL OCEANOGRAPHY

Objectives:

This paper will help students of Ocean Science & Technology to gain a basic knowledge about different groups of marine organisms, their occurrence and distribution with regard to space and time, in addition to biological oceanographic processes, current attempts and methodologies to address them.

Unit – I

Sea as a biological environment- classification and characteristics of marine environment – light, temperature, salinity, pressure and water movement. Comparison of marine and terrestrial environment.

Unit – II


Unit – III

Nekton: Environmental characteristics, composition, adaptations, body shape, defence, camouflage, sense organs, echolocation, reproduction, life cycle and migration.

Unit – IV


Unit – V

Biological processes: marine primary production - carbon sequestration - detritivory and herbivory - predation, parasitism and pathogenesis - fouling and boring-competition and succession - dispersal and settlement-marine food chains.
PRACTICAL XI : IOSP 56 BIOLOGICAL OCEANOGRAPHY

1. Identification of phytoplankton and zooplankton (diatoms, dinoflagellates, hydromedusae copepods, pterpods, chaetognatha, thaliaceae and planktonic larvae).
2. Identification of locally available macroalgae, seagrass and halophytes including mangrove plants.
3. Determination of primary production using light and dark bottle technique.
5. Field trips to study animal communities in different biotopes- mud flat, sandy and rocky shores, mangroves, oyster beds, fouling and boring organisms, symbionts, parasites, commensals and phyal fauna.

REFERENCE BOOKS

IOS 52 ATMOSPHERIC SCIENCE AND METEOROLOGY

Objective: To know and understand the atmospheric process and fundamentals and concepts of Meteorology.

Unit – I Fundamentals of Meteorology


UNIT – II Cloud Physics and Dynamic Meteorology:


UNIT – III General Circulation and Climate Modelling:

Observed zonally symmetric Circulations, Meridional circulation models, Mean Meridional and Eddy transport of momentum and Energy, Angular momentum and Energy budgets; Zonally asymmetric features of general circulation; Standing eddies; East-West circulations in Tropics: Climate variability and Forcings; Feedback processes, Low frequency variability, MJO Madden-Julian oscillation), ENSO, QBO (quasi-biennial oscillation) and Sunspot cycles. Basic principles of general circulation modelling; Grid-point and Spectral GCMs; Role of the ocean in climate Modeling; Internal variability of ocean fields (SST, winds, circulation, etc.) and its Relationship with Monsoon, Concepts of Ocean – Atmosphere coupled Models.

UNIT – IV Synoptic Meteorology:

Tropical Meteorology: Trade wind inversion, ITCZ; Monsoon trough tropical cyclones, Their structure and Development theory; Monsoon depressions; Western disturbances; SW and NE monsoons; Synoptic features associated with onset, Withdrawal, Break active and Weak monsoons and their prediction. Air masses and fronts: Sources, Origin and Classification of Air masses; and Fronts, Frontogenesis and Frontolysis; Structure of Cold and Warm fronts; Weather systems associated with fronts. Extra-Tropical synoptic scale features: Extratropical Cyclones and Anticyclones.
UNIT – V Satellite Meteorology


REFERENCE BOOKS

Objectives

This course will provide an introduction and overview of this critical portion of our planet. Emphasis will be from a geological perspective of the systems that operate within, over, and adjacent to the World oceans and seas. The students are exposed to the fundamental concepts in Marine Geology, tectonic process and morphology of the near shore and ocean basin, weathering and sedimentary cycle and transport mechanism, major coastal deposits and land forms, plate tectonics, continental drift, earth quakes and marine mineral resources and concepts of exploration.

Unit–I Introductory concepts in Earth Science

Origin of the universe and earth; earth’s interior – crust, mantle and core; Geological time scale, division of geological time. Pangaea – continental drift and paleomagnetism, crustal movement plate tectonics, isostacy sea floor spreading. Emergent and submergent margins, convergent and divergent boundaries, changing sea level. Crustal deformation-folds, faults.

Unit–II Products of Earth process

Materials of earth’s crust – igneous rock, metamorphic rock and sedimentary rock,. Weathering and erosion – mechanical and chemical weathering, rates of weathering. Erosion by wind, water and glaciers.

Unit–III Introduction and Concepts in Marine Geology


Unit–IV Depositional environment and features


Unit–V Marine mineral resources

Beach placers, hydrocarbon resources, manganese nodules, phosphotites, sulphur, dissolved salts, limestone deposits, evaporates; their mechanism of origin and global distribution pattern. Methods of deep sea exploration of mineral resources - gravity, magnetic and seismic methods – principle and techniques.
PRACTICAL XII : IOSP 57 : MARINE GEOLOGY

3. Mineral separation techniques. Provenance interpretation
4. Identification of important sedimentary minerals
5. Interpretation of seismic data (travel time and intercept)

REFERENCE BOOKS


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OBJECTIVES:

The objective of this course is to provide students with an understanding of the sources, links and biological effects of major classes of pollutants in the marine environment. The course will help prepare students for careers in academic programs, research centers and consulting firms by providing them with an in-depth understanding of causes, consequences and methods of assessment of marine pollution.

UNIT - I

Definition, major pollutants, sources, transport pathways, monitoring methods, biological indicators, bioaccumulation and biomagnification.

UNIT - II


UNIT - III


UNIT - IV

Oil pollution – composition, sources, and fate of spilled oil, biodegradation and biological impact of oil on marine life.

UNIT - V

Thermal pollution – sources, waste heat disposal, uses of waste heat, role of biocides (Chlorine), ecological impacts.

PRACTICAL XIII : IOSP 58 : MARINE POLLUTION

Analysis and estimation of critical pollutants in seawater.

1. Estimation of Ammonia (NH\text{3}) in seawater
2. Estimation of hydrogen sulfide (H\text{2}S) in seawater
3. Estimation of BOD in seawater
4. Estimation of COD in seawater
5. Pesticide residue in seawater
6. Petroleum hydrocarbon in seawater
7. Heavy metals (Cu, Cd, Pb, Hg) in seawater, sediments & animal tissues
REFERENCE BOOKS

IOST 55 COMPUTER APPLICATIONS – III

Objectives:

The important objective of this course is to provide academic training in programming and application of computer languages. The students learn adequate information about the different structures, functions, operation and applications of these programs in different areas of coastal and marine environment.

UNIT – I : C

Introduction to C – Alphabets – Identifiers - Keywords- Constants - Basic Data types- Enumerated data types-Comments in C - Input & output statements - Type definitions- Variable declarations - Expressions – Operator – Control structures – Functions - Arrays – String manipulation- Structures and Unions- Pointers - File I/O.

UNIT – II : C++


Class and Objects : Specifying a Class – Defining Member Functions – A C++ Program with Class – Making an Outside Function Inline – Nesting of Member Functions – Private Member Functions – Arrays within a Class – Arrays of Objects.

UNIT – III : C++


**UNIT – IV : MATLAB**


**UNIT – V : MATLAB**


**PRACTICAL XIV : IOSP 59 COMPUTER APPLICATION - III**

**I. C LANGUAGE**

1. To find Area of Circle and Rectangle
2. To find the Result of four function calculator using Switch Case
3. Fibonacci Numbers
4. Given number is PALINDROM or not
5. To Print Book no, name and author using Array of Structure
6. Factorial using Function

**II. C++ LANGUAGE**

1. Class and Object
2. Bubble Sort
3. Grade marks using Switch Case
4. Matrix addition
5. Function overloading
6. Operator overloading
7. Mark list preparation of using Multiple Inheritance
III. MATLAB

1. Matrix Function
2. Mathematical Function
3. Circle plotting
4. 2-D and 3-Dimensional plot
5. Switch case
6. For and while Loops
7. Function Visualization

REFERENCE BOOKS

7. MATLAB Manuals
8. Rudra Pratap, 2006. Getting started with MATLAB 7: a quick introduction for scientists and engineers,
Objective:
The student’s undergoing this course will get a sufficient knowledge about the various meteorological events in the atmosphere and its impact on sea surface. Significant attention is also focused on weather forecasting technique and satellite in forecasting technique.

Unit – I Introduction to Atmosphere

Unit – II Moisture, Atmospheric stability and Precipitation

Unit – III Air pressure, Wind and circulation of Atmosphere

Unit – IV Upper ocean dynamics
Oceanic heat budget, factors influencing heat budget terms, radiative and turbulent fluxes, bulk method for computation of fluxes, dominant forces for ocean dynamics, and equation of motion.

Unit – V Cyclone and thunderstorms, weather forecasting
Inter Tropical Convergence Zone (ITCZ), Tropical cyclones– formation, classification and structure, Strom surges, EL-Nino Southern Oscillation (ENSO), cyclone tracking–thunderstorms– forecasting technique–standard tool in weather forecasting–satellite in weather forecasting.
PRACTICAL XV : IOSP 65 : AIR – SEA INTERACTION

1. Illustrating the concept of atmospheric pressure-construction of graph to measure how Pressure changes with height above earth surface.
2. Illustrating the temperature profile for various class of stability
   i. Stable
   ii. Unstable
   iii. Inversion
3. Determination of Relative Humidity and Dew point temperature at a place.
4. Illustrating the effect of terrain roughness on the wind velocity profile for various Surface conditions.
5. Construction of wind rose diagram at a given location over a period
6. Rainfall measurement.
7. Analysis of rainfall (i.e.) determination of mean, monthly and annual rainfall etc.

REFERENCE BOOKS

Objectives:

By studying this subject Fluid mechanics, a student will understand that the study of fluid flow assuming the fluid as ideal frictionless is quite useful. The mathematical analysis becomes simple. It gives a thorough study of the influences of inertial force (equal to the product of mass and acceleration of the fluid particles), normal surface force and body force. It also solves a number of practical problems.

Unit – I: Basic concepts and properties

Fluid-definition, distinction between solid and fluid- units and dimensions- properties of fluids- density, specific gravity, specific weight, specific volume, temperature, viscosity, compressibility, vapour pressure, ideal and real fluid, capillary and surface tension.

Unit – II: Fluid statics


Unit – III: Fluid kinematics

Description of fluid flow- velocity of fluid particles-types: steady & unsteady- uniform & uniform- laminar & turbulent flow –rotational and irrotational flow-one, two and three dimensional flow –flow pattern: stream line, stream tube and path line-basic principles of fluid flow-continuity equation- rotational and irrotational motion.

Unit – IV: Fluid dynamics

Introduction- forces acting on fluid in motion-Euler’s equation of motion-Bernoulli’s equation –pressure velocity relationship- application of Bernoulli’s equation- flow measurement in open cannel, estuary: pitot tube, weir, notches- rectangular& triangular – Hot wire anemometry- LASER anemometry- flow visualization techniques.

Unit – V: Fluid machines

Classification on the basis of general features- specific speed –impulse and reaction principles.

Pumps: definition and classifications - Centrifugal pump: classifications, working principle, work done - Reciprocating pump: classification, working principle, Basic principles of indicator diagram.
PRACTICAL XV : IOSP 66 : FLUID MECHANICS

1. Determination of coefficient of discharge of a Rectangular Notch.
2. Determination of coefficient of discharge of a Triangular Notch.
3. Determination of coefficient of discharge of a Mouth piece.
4. Determination of coefficient of discharge of an Orifice.
5. Determination of coefficient of discharge of an Orifice meter.
7. Determination of Metacentric height of a ship model
8. Verification of Bernoulli’s theorem.
9. Determination of Reynold’s number for the fluid flow.
10. Determination of efficiency by using centrifugal pump.
11. Determination of efficiency by using Kaplan turbine

REFERENCE BOOKS

Objectives:

This course will aim to learn the following

- Wave Motion and Speed, Wave height
- Deep Water and Shallow Water Waves
- Refraction / Reflection / Diffraction
- The Surf Zone
- Tsunami, Internal Waves, Standing Waves
- Tide Patterns and Levels
- Tidal Currents and Tidal Bores
- Equilibrium Tidal Theory
- Dynamic Tidal Analysis
- Predicting Tides and Tidal Currents

Unit – I Introduction to wave motion

General characteristics of waves, small amplitude waves – phase speed, group speed, orbital motion of water particles, wave energy and momentum, internal waves

Unit – II Finite amplitude waves

Gestner’s wave – vorticity, Stoke’s third order wave – phase velocity and wave profile, Stoke’s drift, Crappers, Cnoidal and solitary waves

Unit – III Long Waves

Introduction to long waves, phase speed of long wave, Kelvin waves and Rossby waves, seiches, Co-tidal oscillation

Unit – IV Wind waves

Generation of wave by wind, their growth, propagation and decay, theories of wave generation, significant wave height and period, wave spectrum, principles of wave forecasting, SMB and PNJ methods

Unit – V Tides

Tide generating forces, tidal theories, tidal analysis and prediction - Harmonic analysis, response method, tides at the coast, in estuaries, in bays and in open ocean, tidal currents.
PRACTICAL XVII : IOSP 67 : WAVES AND TIDES

1. Deployment and retrieval procedure for the Directional wave Recorder
2. Study of wave characteristics from wave recorder data
3. Computation of wave energy using significant wave height, density and gravity
4. Study of Tide characteristics from tide gauge data
5. Deployment and retrieval procedure for the Current meter
6. Study of Current characteristics from current meter data

REFERENCE BOOKS

OBJECTIVES:

The main objectives of this paper are to expose students to state-of-the-art instrumentation, to introduce them to the methods of various instruments used in the marine environment, and to prepare them to use these techniques in their own research.

The course is a combination of lectures and demonstrations on the principles and functioning of these instruments. Instruments in each category are provided to work with and conduct field and laboratory trials.

UNIT I MINOR EQUIPMENTS


UNIT II MICROSCOPY

Principle, design and function of Light microscope, Phase contrast microscope – Epifluorescent microscope – Electron microscope

UNIT III SPECTROSCOPY


UNIT IV CENTRIFUGATION & ELECTROPHORESIS

Centrifugation: Centrifugal force and principle of sedimentation – sedimentation coefficient – types of centrifuges and rotors – Types of centrifugation – Differential centrifugation, density gradient centrifugation, zonal centrifugation, isopycnic centrifugation

Electrophoresis: General principle, factors affecting mobility of charged molecules – (i) electric field strength (ii) sample (iii) buffer (iv) supporting medium. Principle and use of electrophoresis using paper, cellulose acetate and thin layer of gels – PAGE

UNIT V CHROMATOGRAPHY

Principle, working procedures and use of paper, thin layer, gas, ion-exchange and High performance liquid chromatograph.
PRACTICAL XVIII: IOSP 68: INSTRUMENTATION AND ANALYTICAL METHODS

1. Separation of Proteins using Polyacrylamide gel electrophoresis
2. Separation of amino acids using Paper chromatographic technique
3. Spectrophotometer: Estimation of nutrients in seawater
4. Spectrofluorometer: Estimation of dissolve petroleum hydrocarbon in seawater
5. Flame Photometer: Estimation of Na, K and Ca in seawater
6. ICP Spectrometer: Estimation of heavy metals in seawater

REFERENCE BOOKS

VII SEMESTER
IOST 71 COASTAL MARINE RESOURCES

Objective:

- To assess the various living and non-living resources, resource exploration and exploitation and strategies for sustainable management of coastal and marine resources.
- To link marine ecology and environmental policies for effective management of coastal resources

UNIT- I Coastal and marine resources

Types and functions of coastal and marine resources – Coastal zone as an integrated resource area – Marine resources: biotic, mineral and energy resources

UNIT - II Non-living marine resources


UNIT - III Living marine resources

Environmental variability on marine fisheries resources – Interactions between fisheries and the ecosystem – Marine Protected Areas (MPA) – Large marine Ecosystems (LMEs) – Climate effects on living marine resources – Biological monitoring of marine ecosystems

UNIT – IV Resource exploration and exploitation


UNIT - V Coastal and marine resource management

Resources as common property – Defining resource management – Conflicting interests with other Marine Resources: Food and Recreation/Tourism – Management tools – Ecosystem health and protection of biological diversity – Ecotourism – Future uses of the oceans
REFERENCE BOOKS


Objectives:

The students undergoing this course will have a wide knowledge about different kinds of surveying and control techniques both in land and sea. Various techniques adopted for sounding, theory of tides and establishing mean sea level were thoroughly dealt in hydrographic surveying. The positioning system both satellite and acoustics and the function of various sensors provides the broad exposure about the survey techniques used in the marine environment.

Unit – I Introduction, Chain & Compass surveying


Unit – II Level & Theodolite surveying


Unit – III Hydrographic surveying


Unit – IV Basics of Geodetic surveying


Unit – V Advanced methods of surveying

PRACTICAL XIX : IOSP 72 SURVEY TECHNOLOGY

1. Ranging a line.
2. Determination of area of an extent by cross-staff survey.
3. Traversing with compass and chain (open- river or estuary).
4. Traversing with compass and chain (closed- pond or lake).
5. Levelling – simple and differential (determination of R.L of various stations by
   a).Height of collimation method.  b) Rise and fall method.
6. Inverted levels
7. Contours- Block contouring
8. Theodolite- Measurement of Horizontal angles by repetition method.
9. Determination of width of a river or distance between two inaccessible points by
   using a theodolite
10. Determination of height of a building or a structure like light house by measuring
    vertical angle.
11. Determination of shortest distance between two places on the earth surface
    (Measuring latitude and longitude by using a GPS).

REFERENCE BOOKS

IOST 73  SATELLITE OCEANOGRAPHY

Objectives:

The main objectives of this course are to expose students to remote sensing instruments, to introduce them to the methods of satellite oceanography, and to prepare them to use these techniques in their own research.

Satellite instruments have become critical tools to monitor global climate changes, ocean circulation, SST, waves, upwelling, mixed layer, coastal and estuarine dynamics. Satellites can provide global continuous temporal coverage of the earth. However, interpreting these remote measurements is delicate, because the relationships with traditional in-situ properties of the ocean are generally complex. Introducing students to these new tools has become a necessity.

Unit – I Introduction to Remote Sensing

Introduction to Remote Sensing: Definition of terms, Concepts and types of remote sensing; evolution of remote sensing technology - advantages of RS over conventional methods of survey. Evaluation of remote sensing with special reference to Indian Scenario, NNRMS, MARSIS, NRSA, IIRS, SAC, INCOIS. Kepler’s laws of planetary motion, Basic principles of aerial photography, scale, ground coverage, fundamentals photogrammetry-measurements of height.

Unit – II Spectral Signature

Solar and terrestrial radiation, Electromagnetic spectrum: Characteristics of electro-magnetic radiation; spectral reflectance of earth surface features in different wavelength regions of electromagnetic spectrum; concept of signature. Atmospheric effects, Mie scattering, rayleigh scattering spectral response of some natural earth surface and coastal features.

Unit – III Space Platforms

Basic principles of optical, thermal, hyperspectral and microwave remote sensing, satellite altimetry, synthetic aperture radar, characteristics of space platforms – LANDSAT, SPOT, IRS series (IRS-P6, oceansat I and II), SEASAT, ERS, JERS, RADARSAT. Characteristics of sensors – MSS, TM, LISS I – IV, VHRR, AVHRR, CZCS, MOS, SeaWiFS, OCM & MODIS. High resolution sensors – IKONOS, Quickbird, CASI.

Unit – IV Image Processing and Analysis

Acquisition of data, image processing: sub setting, geometric, radiometric and water column corrections, data generation, data analysis: visual analysis, digital techniques, supervised and unsupervised classifications. Retrieval of ocean colour properties, chlorophyll and SSC. Sea surface Temperature mapping.
Unit – V Applications of Remote Sensing


PRACTICAL XX : IOSP 77 SATELITE OCEANOGRAPHY

1. Identifying different regions of the electromagnetic spectrum
2. Spectroradiometer usage
3. Spectral differences of different natural earth surfaces
4. Selection and retrieval of data
5. Differentiating various sensors products (OCM, PAN, WiFS and LISS)
6. Band Combinations
7. Image sub setting / mosciking / image enhancement
8. Geometric correction
9. Radiometric correction
10. On screen visual interpretation of digital data (water, vegetation, mangrove, corals etc.)
11. Supervised Classification
12. Unsupervised Classification
13. Chlorophyll retrieval
14. SSC retrieval
15. SST retrieval
16. Map composer

REFERENCE BOOKS


IOST 74 MARINE INSTRUMENT FOR OCEANOGRAPHIC MEASUREMENTS

Objectives:

The main objectives of this paper are to expose the students to state of the art instrumentation, to introduce them to the methods of various instruments used in the marine environment and to prepare them to use these techniques in their own research.

The students also learn the facilities available are research vessels and the navigational techniques. Instruments in each category are provided to work with and conduct field and laboratory trails.

UNIT I – Introduction

Marine Instrumentation; In-situ and Remote Sensing Instruments, Operating platforms-fixed, ship, Platform and Buoy based; Output Formats; Telemetry

Parameters to be measured/user Requirements – Temperature, salinity, sound velocity, wave Height, Wave Period, Tidal Height, Tidal Period and Ocean Depth etc.,

UNIT II – Fixed platform Based Instruments

Different types of Tide Gauges – Pressure sensor based, Acoustic based; Principle, operation and application; Benchmark and Datum fixing

Wave Radars, Rain Gauge, Temperature Sensors, Bottom Observations

UNIT III – Buoy Based Instruments

Different types of buoys; Principles, application and operations of Wind, Temperature, Currents, Wave Height and Direction and Environmental Sensors

Satellite Telemetry Systems

UNIT IV – Ship Based and submersible Based Instruments

Basics of Surveying; Principle, operation and applications of Surveying Equipment – Echosounder, Multibeam Sonar, Sub-bottom Profiler, Side Scan Sonar, Boomers, Sparkers, Magneto meters, Positioning and Tracking Equipment

UNIT V – Marine Sensors

Acoustic transducers – Piezo electric type, magnetostrictive type; Sonar transducers for Echosounder, Acoustic Sub-bottom Profiler, Multibeam Sonar; Non-acoustic Sensors – Biosensors, Chemical Sensors.

General Methods of Test and Calibration
PRACTICAL XXI : IOSP 78 : MARINE INSTRUMENT FOR OCEANOGRAPHIC MEASUREMENTS

Demonstration

1. GPS
2. Wave recorder
3. Electromagnetic Current meter
4. Echo Sounder
5. CTD

Data processing

1. Sea bed mapping using single beam Echo sounder data
2. Vertical profile of conductivity and temperature from CTD data
3. Vertical profile of sound velocity
4. Vertical profile of Argo data set
5. Meteorological data analysis from Buoy data
6. Oceanographic data analysis from Buoy data

REFERENCE BOOKS

IST 75 OCEAN MANAGEMENT

Objectives:

Students will gain an understanding of the interrelationships between the marine sciences (including the issues, research areas and the scientists) and public policy through exploration of the concepts and implementation processes of integrated coastal and ocean management. Through this effort, students will learn how the needs of the science and the understanding of marine science principles compare with the needs of policy development, resource use and regulation/management. The paper will allow the student to synthesize information from a variety of sources and explore some aspect of public policy from the perspective of a marine scientist. The students can also learn about different aspects of disaster management, as the marine environment is high vulnerable to disasters.

UNIT – I Developmental Activities and Impacts

Seas and Ocean – Coastal zone importance – coastal developmental activities such as mariculture, tourism, shorefront construction and their impacts – global and national coastal problems such as loss of habitat, sea level change, degradation of water quality and fisheries resource depletion.

UNIT – II Coastal zone management issues

Coastal zone management issues – major ecological, social and economic trend and their importance – coastal zone regulations, aquaculture authority bill - CZM programs – Integrated coastal zone management – environmental economics – comparison between developed and developing countries, temperate and tropical countries and their CZM – Marine Fisheries management policies.

UNIT – III Ocean management


Role of international, national agencies and organizations in ocean management – Law of the sea, CBD, IOC-UNESCO, WTO, UNEP, FAO, IUCN, WWF, IMO, CMS, CITES, ICES, IOI (Malta), SCAR, SCOR, LOICZ.

UNIT – IV Land sea interactions

Multiple uses of the coastal zones and conflicts. Coastal settlements - human impacts on the coastal zones with special emphasis on artisanal fishing, coastal aquaculture and coastal tourism. Coastal vulnerability - mangroves, wetlands, sand dunes, sea-grasses, lagoons and enclosed seas, islands, coral reefs and other protected areas.
UNIT – V Coastal ecosystem monitoring

Coastal and marine ecosystem monitoring –Estuaries, mangroves, lagoons, backwater, reef etc. Effect of port activities and coastal pollution on mangroves, corals and beaches. Role of national and international agencies for coastal and Ocean management.

REFERENCE BOOKS

VIII SEMESTER

IOST 81 GEOGRAPHIC INFORMATION SYSTEMS

Objectives:
By completing this course, students will:

- Gain a basic, practical understanding of GIS concepts, technical issues, and applications.
- Learn where GIS fits in the world of Information Systems and maps, how it is unique and why it is important.
- Know the issues involved in choosing a GIS package, obtaining and evaluating data, and implementing and managing a GIS project.
- Be able to explain the benefits and costs of GIS.
- Understand the technical language of GIS.
- Gain practical experience using Arc View, a powerful and popular desktop GIS package.

Understand GIS career options and how to pursue them.

Unit – I
Introduction to GIS: Definitions, Basic Concepts, history and evolution, Components, Need, Scope, interdisciplinary relations, and overview of GIS.
Map: Types of map, map scale, classes of maps. Map projection: fundamentals and types; precision and errors; Base Maps & Thematic Maps; Map Legend, Symbols & Border Information; label placement

Unit – II

Unit – III
Data Sources: Data collection, modes of data acquisition- Primary and secondary methods of acquisition of spatial and non-spatial data - GPS data. Map scanning and digitizing, topology building, editing and cleaning, linking of spatial and non-spatial data. Data Processing: Updation, corrections, modifications, scale changes, geometric transformations and map projection transformations, conflation sliver removal, edge matching, interactive graphic editing, rubber sheeting.
Unit – IV

Spatial Analysis, Integration and Modelling: Logic operations, general arithmetic operations, general statistical operations, geometric operations, query and report generation from attribute data, geometric data search and retrieval, classification reclassification, integrated geometry and attributes, overlay, buffer zones, raster data overlay, integrated data analysis. GIS- Packages-Arc GIS, Definition and concept of Web GIS-advantages and limitations of web GIS, overview of Web GIS.

Unit V

Applications in Marine sciences: Marine resources exploration, Mapping and Marine Resources Information System; GIS in Marine and Coastal Zone Management. Mapping and monitoring of pollution, changes in coastal zones. Applications in Disaster Management: Tsunami- types, causes, RS and GIS applications for post Tsunami damage assessment and rehabilitation. Creating custom GIS software applications and user interface.

PRACTICAL XXII : IOSP 86 GEOGRPAHIC INFROMATION SYSTEM

1. DATA Encoding
   a. Raster Encoding
   b. Run — Length coding
   c. Quad tree coding
   d. Scanning and conversion of images

2. Digital mapping
   a. Overview of Arc View and Arc GIS tools.
   b. Digitizing / Creating new shape files and area estimation
   c. Edited coverage: – Clipping, merging, Intersect, Union, Dissolve and Assign data by location (Spatial Join).
   d. Buffering
   e. Projection and Transformation
   f. Downloading GPS data and other XY coordinates data for GIS use
   g. Preparation of contour maps using different Softwares :
      i) Surfer
      ii) Arc GIS
   h. Chart preparation
   i. Lay out preparation / Labeling and Annotation
   j. DEM – Demo
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Objectives:

Aim of this course is to introduce various renewable energy sources like solar energy, biomass energy and hydropower energy and their applications. Introduction to wind, geothermal energy, and their uses in generation of heat and electricity are explained. Various schemes and devices for getting power from Tidal and wave energy are discussed.

Unit – I: Solar energy

Introduction – types of energy – resources and importance- environmental aspects of energy utilization – types of renewable energy.-extraterrestrial solar radiation - radiation at ground level-collectors-solar cells-applications of solar energy

Unit – II: Biomass energy and Hydropower energy


Hydropower Energy: Introduction-basic concepts- site selection-types of turbines-small scale hydropower.

Unit – III: Wind and geothermal

Wind Energy: Introduction-basic theory-types of turbines-applications.

Geothermal Energy: Introduction-geothermal resource types applications for heating and electricity generation

Unit – IV: Tidal and wave energy

Tidal Energy: Introduction-origin of tides-power generation schemes

Wave Energy: Introduction-basic theory-wave power devices

Unit – V: Other renewable energy sources

OTEC: Introduction-Open and Closed OTEC cycles- biophotolysis - Salinity Gradient Devices- Environmental Aspects.
PRACTICAL XXIII : IOSP 87 RENEWABLE ENERGY SYSTEM

1. Solar still
2. Flat plate Solar Water heating system
3. Solar Air Heater
4. Solar Cooker
5. Bio-Mass Gasifier

REFERENCE BOOKS

1. Non Conventional energy resources – G.D. Rai, Khanna Publishers
2. Energy Technology – S. Rao & Dr. B. Parulkar, Khanna Publishers
Objectives:

To introduce and describe mathematically a number of commonly occurring flows in the ocean. The objective is for the students to gain an appreciation of how to use mathematics to model simple aspects of these flows and to provide the student with an understanding of the physical processes that controls the distribution of water properties and the movement of those properties in the ocean. A theme of the course will be the range of time and space scales that exist from small scale mixing processes, to the grand global circulation.

UNIT – I Statics and Kinematics

Statics of the ocean: fields of gravity, pressure and mass, barotropic and baroclinic fields, sigma-t surfaces, static stability, double diffusion, representation of field of motion in the sea, equation of continuity.

UNIT – II Equations of Motion-Nonlinear and Magnetic terms

Equation of motion, non-linear terms in the equation of motion, equation of mean flow, Reynold’s stress and eddy viscosity, scaling equation of motion, dynamic stability.

UNIT – III Currents without Friction

Currents without friction, inertial motion, Geo potential, Geo potential surface and isobaric surface, Margules’s equation for a two layer ocean, geostrophic current, relative current and slope current, Hellan-Hansen’s formula, thermal wind equations, level of no motion and absolute currents.

UNIT – IV Currents with Friction

Currents with friction, Ekman’s solution to the equation of motion with friction present, Ekman transport and upwelling, bottom friction and shallow water effect, Swerdrup’s equation and its application, equatorial undercurrent, stream line and path line, Stommel's theory of western boundary currents, vorticity, Munk’s theory, equitorial under current.

UNIT – V Thermohaline Effects

Thermohaline circulation, thermodynamic and salinity circulation, Antarctic circumpolar current, topographic steering, equations for salt and temperature conservation, Reynold’s fluxes and eddy diffusivity, mixed layer of the ocean.
REFERENCE BOOKS

IOST 84 DISASTER MANAGEMENT

Objectives:

The main objectives of this paper are to expose students about the coastal natural disasters, technological hazards and its characteristics. The course is a combination of lectures on the state-of-the-art disaster preparedness and management strategies and to prepare them to use these techniques whenever needed.

UNIT - I Coastal natural disasters

Hazards and Disasters - Description and distinction – Atmospheric (Flood, Drought and Cyclone and dust storms) Geologic (Landslide, Earthquake, Tsunami, Volcanoes) Hydrologic (coastal, riverine flooding and saltwater intrusion), meteor impact – Sea level rise and its effects

UNIT - II Technological hazards

Manufacturing (with hazardous substances & processes) Storage (of hazardous substances) Transport (of large numbers of people and/or hazardous substances) Waste & Contamination (due to hazardous substances) – oil spills

UNIT - III Characteristics of disasters/ hazards

Suddenness – uncertainty – potential risk- dynamism – rarity – disruption of communication, power supply and transportation – People’s unusual behaviour – theft and robbery – derailed law and order

UNIT - IV Disaster preparedness

Creation of awareness on disasters - Preparedness in the event of disasters – developing shelter facilities – stocking food and other essential items – mobile health facilities – self regulation during emergency – vulnerability and risk analysis – bioshields and/ or artificial structures for protection, control and redirection

UNIT - V Managerial components

Rehabilitation and reconstruction - strengthening livelihoods, improving nutrition & health – ensuring safe house and site, proper protection - good governance - preparedness assessment and planning - electrical malfunction - internal flood - bomb threat - civil disturbance - six principles of resilience: homeostasis, omnivory, high flux, buffering, flatness, redundancy
REFERENCE BOOKS

Objectives:

The objective of this paper is to make the students familiarize the major and minor fishery resources of the world and our country apart from imparting knowledge about the common crafts and gears used for fishing. Further this paper also deals with the preservation and processing of the catch.

UNIT I : Introduction to Marine Fisheries

Major and Minor marine fisheries of the world and India. Present status of world and Indian capture fisheries. Fishery resources of EEZ of India.

UNIT II : Methods of fishery survey

Methods of surveying the fishery resources – acoustic method, aerial method, survey of fish eggs and larvae.

UNIT III : Fishery population assessment

Population dynamics, theory of fishing, mortality, natality, recruitment, fishing pressure, Analysis fish population : assessment of growth – direct and indirect methods, fecundity, fish tagging & marking and recapturing.

UNIT VI : Fishing crafts and gears

Principle methods of exploitation of sea fishes – indigenous and modern crafts and gears – catamarans, country boats, trawlers, modern vessels with refrigeration facility, types of nets - cast net, gill net, trawl nets, purse seine, hook and line etc., mesh size regulation.

UNIT V : Preservation and processing

Principles of preservation and processing. Types of fish spoilage and causative factors. Principle methods of fish preservation and processing in India and other countries.

PRACTICAL XXIV : IOSP 88 FISHERY TECHNOLOGY

1. Identification of fish eggs and larvae
2. Local crafts and gears used
3. Estimation of fecundity and Ova diameter studies
4. Methods of fish preservation and processing techniques
5. Different fish tags
6. Field visit to seafood processing industries and fishing harbours
REFERENCE BOOKS

IX SEMESTER

IOST 91: UNDERWATER ACOUSTICS AND OPTICS

Objectives

To provide students with an understanding of the physics of underwater sound, including propagation in deep and shallow water, the interaction of sound with the seabed and sea surface, making of transducers for generating and receiving underwater sound. Able to understand the concept of light in water, apparent optical properties and ocean colour applications.

Unit–I: Fundamentals of sound transmission

Introduction – sound speed, propagation equation, sound reflection, refraction and transmission, source intensity, directivity, transmission loss, target strength, noise: variability of ambient noise with time and depth, angular distribution of ambient noise field, ship generated noise, reverberation and scattering, spectrum analysers

Unit–II: Transducers

Principle of acoustic transduction, Piezo electric transduction, Langevin projector, resonance behaviour of transducers, multiple matching layer transducers, polar response measurements, hydrophones

Unit–III: Arrays

Transducer array, Linear hydrophone array, polar response, Fourier transform approach to pattern synthesis, array beam steering, directivity index, parametric source, synthetic aperture sonar

Unit–IV: Ocean Optics

Characterization of light field in water, radiance, irradiance, diffuse attenuation coefficient, water leaving radiance – Inherent and Apparent optical properties of sea water – Light scattering by water molecules – Absorption characteristics of water constituents.

Unit–V

PRACTICAL XXV : IOSP 96 UNDERWATER ACOUSTICS AND OPTICS

1. Measurement of velocity of sound in air using Resonance column methods
2. Determination of velocity of sound waves in water and sea water using Ultrasonic Interferometer
3. Determination of velocity of sound waves in various organic liquids using Ultrasonic Interferometer
4. Low frequency noise measurement in ocean water using Hydrophone-Demonstration.
5. Transmission and reflectance study of water constituents using UV-Spectrophotometer.
6. Hyper spectral Radiometer-Demonstration

REFERENCE BOOKS

IOST 92  COASTAL AND ESTUARINE DYNAMICS

Objectives:

This course will explore the circulation of the coastal ocean including continental shelf circulation, upwelling, coastal jets, undercurrents, coastal-trapped waves. Fundamentals of surface waves and tides; tsunamis, wind generation, breaking waves. Estuary classification and circulation patterns; shallow-water processes and beach morphology.

Unit – I: Beach features


Unit – II: Sediment transport


Unit – III: Sea level changes


Unit IV: Estuarine dynamics

General characteristics of estuaries, classification and nomenclature, estuarine circulation and mixing – gravity driven freshwater flow – saline intrusion – stratification and entrainment – tides and tidal currents in estuaries

Unit – V: Estuarine sedimentation


PRACTICAL XXVI : IOSP 96 COASTAL AND ESTUARINE DYNAMICS

1. Measurement and plot of Beach profile.
2. Estimation of longshore sediment transport
3. Preparation and interpretation of Bathymetric charts
4. Preparation of wave refraction diagrams
5. Analysis of wave records
6. Hind casting of ocean waves.
REFERENCE BOOKS

OBJECTIVE:

- To introduce the usefulness and versatility of numerical, ecological, and water quality modeling in the context of environmental problem solving
- The course will have a theoretical and a practical component which will be closely interconnected.
- On the theoretical component, the basic modeling concepts will be presented as well as the implications related to the implementation and application of numerical models.
- In terms of the practical component, the objective is to develop the skills on using numerical models to study physical and biogeochemical processes in coastal systems.

UNIT - I INTRODUCTION

Role of mathematical models - Modeling of coastal processes - Water Quality Modeling - Introduction to Ecology & Ecological Models – Model development and validation - Basic numerical tools used in mathematical models

UNIT - II MODELING OF COASTAL PROCESSES


UNIT - III EQUATIONS INVOLVED IN MODELING


UNIT - IV WATER QUALITY MODELS

Mass Balance for a well mixed system - Steady State & Time dependent solution to a well mixed system - Modeling Feed-forward & Feedback systems

UNIT - V WATER QUALITY MODELING AND FEEDBACK

Incompletely Mixed Systems – Advection and Diffusion – estuarine transport – dispersion coefficient – water quality response to inputs
REFERENCE BOOKS

OBJECTIVE:

• To provide a description of the existing natural and socio-economic environment within the area of influence of the project
• To identify the project components which might have a significant impact on the existing natural and socio-economic environment and the potential impacts of these project components on a local and regional scale
• To analyze the net environmental impacts of the project and suggest mitigating measures or alternatives which might alleviate negative impacts.

UNIT – I INTRODUCTION


UNIT – II COMPONENTS AND METHODS


UNIT – III QUALITY CONTROL AND INSTITUTIONAL ARRANGEMENTS


UNIT – IV EIA ESSENTIAL SECTORS AND ISSUES

Sewage/ Industrial outfall, Coolant water intake/outfall, Desalinisation, Dredging – composition, limit values, disposal options and pre-treatment – Thermal Impact on marine ecosystem – Biofouling and entrainment – Hazardous waste incineration: set up of plants, rotary kiln and liquid wastes
UNIT – V CASE STUDIES

Case studies of EIA of developmental projects and projects on coastal areas – Comparative Review of EIA systems: EIA in the USA, EIA in the European Countries, EIA in developing countries

REFERENCE BOOKS

UNIT – I COASTAL WORLD

Types of beaches - importance of beaches - aesthetic value of beaches - Need for protecting beaches – world important beaches

UNIT – II SCOPE OF MARINE RECREATION

Types of marine recreation - Beach games - Marine tourism - beach visitation, swimming, snorkeling, scuba diving, surfing, wind surfing, fishing, motor boating, sailing, personal watercraft use, rowing, canoeing, kayaking, hunting for waterfowl, beachcombing and nature viewing and photographing - boat races

UNIT – III MARINE RECREATION MANAGEMENT

Marine recreation regulations - Recreational activities: permitted and not-permitted - Recreational marine insurance - Conservation - Coastal zone management with special reference to marine recreation - territorial waters and exclusive economic zone - fishing holiday

UNIT – IV SAFETY IN MARINE RECREATION

Caution and warnings - standardization of recreational appliances and transportation units - Safety of Life at Sea (SOLAS) - preparedness for coastal hazards - natural disasters - Role of coast guards in assuring safety at sea - Pollution due to marine recreation activities - marine debris due to marine recreation

UNIT – V MARINE RECREATIONAL FACILITIES

Recreational opportunities:- Recreational areas: Marine parks - theme parks - Personal Water Craft (PWC) - Jetski - fishing gear - surf board - water ski gear - snorkel and SCUBA - under-water cameras - canoes, boats and cruise liners

References

X SEMESTER
IOST 101- PROJECT PLANNING, ANALYSIS AND MANAGEMENT

Objectives:
This course will aim to train the students to undertake their own project work by way of planning and survey methods. Proper selection procedures, their feasibility and cost estimation for the project work is dealt with. Project monitoring and evaluation process also dealt with.

UNIT-I: PROJECT PLANNING AND SURVEY


UNIT-II: PROJECT SELECTION FACTORS


UNIT-III: FEASIBILITY STUDY


UNIT-IV: PROJECT FINANCE


UNIT-V: PROJECT MONITORING & EVALUATION

Projects Scheduling and Monitoring tools and Techniques – Project management – Information system and Documentation – Project Evaluation.
REFERENCE BOOKS


IOST 102 Dissertation and Viva-Voce