DEPARTMENT OF CIVIL ENGINEERING
ANNA UNIVERSITY, CHENNAI

OUR VISION:

Department of Civil Engineering, Anna University, shall strive hard to develop and impart technical knowledge and professional skills required for Civil Engineering practice through excellence in teaching, research and consultancy to address sustainable infrastructure development needs at local, national and International levels.

OUR MISSION:

Department of Civil Engineering, Anna University shall contribute to technological and social development by
1. Providing a firm scientific and technological base in Civil Engineering to achieve self-reliance.
2. Providing quality education through innovation in teaching practices at par with global standards.
3. Nurturing leadership and entrepreneurship qualities with ethical values.
4. Developing and disseminating latest knowledge and technologies in emerging areas of Civil Engineering.
5. Sharing intellectual resources and infrastructure facilities through collaborative partnership.
6. Ensuring supporting conditions for enhancing the employability skills.
1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the Programme M. Tech. Ocean Technology will

I. Gain knowledge and skills in Ocean Technology which will enable them to have a Successful career and Professional accomplishment in Academy, Public or Private Sector Organizations.

II. Successful consultants in Ocean Technology and handle Turbulent Ocean, Climate Change, Environmental Policies, Marine Environmental Impact Assessment, Design and Construction in Marine Environment.

III. Contribute to the enhancement of knowledge in Ocean Technology by performing Quality research in institutions of international repute or in Research organizations or Academia.

IV. Practice the profession with Good communication, Leadership, Challenges, Ethics and Social Responsibility and formulate solutions that are technically sound, economically feasible, and socially acceptable.

V. Functions in multi-disciplinary teams in national and international level and adapt to evolving technologies through life-long learning and innovation.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Remote Sensing and Geomatics Graduates will exhibit ability to:

<table>
<thead>
<tr>
<th>PO#</th>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>Research Aptitude</td>
<td>An ability to independently carry out research / investigation and development work to solve practical problems</td>
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<tr>
<td>PO2</td>
<td>Technical documentation</td>
<td>An ability to write and present a substantial technical report/document</td>
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<tr>
<td>PO3</td>
<td>Technical competence</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
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<tr>
<td>PO4</td>
<td>Engineering knowledge</td>
<td>An ability to apply various advanced tools and techniques to develop efficient Hardware solutions</td>
</tr>
<tr>
<td>PO5</td>
<td>Design/development of solutions</td>
<td>Design a system or a component to meet the design requirements with constraints exclusively.</td>
</tr>
<tr>
<td>PO6</td>
<td>Environment and sustainability</td>
<td>Design the System with environment consciousness and sustainable development.</td>
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MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES:
A broad relation between the programme objective and the outcomes is given in the following table:

<table>
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<th>PEO's</th>
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Correlation Level: 3 – High, 2 – Medium, 1 – Low
## MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

### M.TECH. OCEAN TECHNOLOGY

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Correlation Level: 3 – High, 2 – Medium, 1 - Low
## MAPPING OF PROFESSIONAL ELECTIVE COURSES [PEC]

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### SEMESTER I

#### Theory

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#### Practicals

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**TOTAL** 19 1 4 24 20

* Audit Course is optional

### SEMESTER II

#### Theory

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**TOTAL** 20 0 6 26 21

* Audit Course is optional

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*Annexure*

[Signature]

Director

Centre for Academic Courses
Anna University, Chennai-600 025
### SEMESTER III

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<td>Port and Harbour Engineering</td>
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Total Credits: 32
### PROGRAM ELECTIVE COURSES [PEC]

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### RESEARCH METHODOLOGY AND IPR COURSES (RMC)

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### OPEN ELECTIVE COURSES [OEC]

* (Out of 6 Courses one Course must be selected)

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AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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TOTAL CREDITS: 0

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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Total Credits: 20

TOTAL: 73 CREDITS

SUMMARY

Name of the Programme: M.Tech. Ocean Technology

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TOTAL CREDIT 22 21 16 12 73
OBJECTIVES:

- To impart knowledge in understanding the advantages of various solution procedures of solving the system of linear and nonlinear equations.
- To give a clear picture about the solution methods for solving the BVPs and the system of IVPs.
- To acquire knowledge in solving time dependent one and two dimensional parabolic PDEs by using various methodologies.
- To strengthen the knowledge of finite difference methods for solving elliptic equations.
- To get exposed to the ideas of solving PDEs by finite element method.

UNIT I ALGEBRAIC EQUATIONS 12

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12
Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, collocation method, orthogonal collocation method, Galerkin finite element method.

UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION 12

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 12
Laplace and Poisson’s equations in a rectangular region: Five point finite difference schemes, Leibmann’s iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

UNIT V FINITE ELEMENT METHOD 12

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, students will be able to

- Get familiarized with the methods which are required for solving system of linear, nonlinear equations and eigenvalue problems.
- Solve the BVPs and the system of IVPs by appropriate methods discussed.
- Solve time dependent parabolic PDEs by using various methodologies up to dimension two.
- Solve elliptic equations by finite difference methods.
- Use the ideas of solving PDEs by finite element method.
REFERENCES:

OT5101          OCEANOGRAPHY         L T P C
            3 0 0 3

OBJECTIVES:
• To introduce the students the basic concepts involved in oceanography
• To understand the physical, Chemical, geological and biological processes involved in oceans
• To provide the background needed to undertake oceanographic investigations and sets them in context by incorporating case studies and sample problems based on local and global examples.

UNIT I          PHYSICAL OCEANOGRAPHY
Introduction to physical oceanography- Origin of Ocean and Ocean basin - Introduction to bottom topography - Properties of Seawater - Ocean dynamics and upwelling - Heat Budget – Bottom topography - Coastal landforms - Ocean currents and circulation - waves, tides, sea level - Oceanographic Methods and Instruments

UNIT II          CHEMICAL OCEANOGRAPHY

UNIT III          BIOLOGICAL OCEANOGRAPHY
The Marine realm - Phytoplankton diversity, diurnal vertical migration - Photosynthesis and primary productivity and seasonality - Eutrophication and Harmful algal blooms (HABs) - Zooplankton and Secondary production - Respiration - Nekton –Food Chain – Food Web – Bio Geo Chemical Cycle-Marine microbes and microbial Loop - Limiting nutrients in seawater

UNIT IV          GEOLOGICAL OCEANOGRAPHY
Structure of Earth's interior - Evolution of the Ocean- Continental drift and plate tectonics- tectonic history -Stratigraphy - Geochronology - Sea level rise - Marine sediments classification - Marine microfossils - Paleoceanography and global climate- Geophysical methods and instruments

UNIT V          ENVIRONMENTAL OCEANOGRAPHY
Definitions and development of the DPSIR framework - Drivers and Pressures - State and Impacts-Drivers - Response(s) and Discussion - Case Studies from Indian Coastline - Case Studies - Ocean Data View.

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the student is expected to be able to

CO1 Explains about basic knowledge on ocean and its dynamic upwelling, topography, landforms, currents and circulation.

CO2 Summarize the chemical components of the oceans, their reactions, and their pathways of transformation

CO3 Assess the relationship between marine organism and their environment, impact of biotic and abiotic factors on marine ecosystems

CO4 Estimate about different marine sediments, paleo oceanography and different instruments used in oceanographic measurements

CO5 Analyze the overall impact of the human activities on the sea, considering the DPSIR framework based on case studies.

REFERENCES:

| CO – PO MAPPING – OCEANOGRAPHY |
|-----------------|---------|---------|---------|---------|---------|
|                 | PO1     | PO2     | PO3     | PO4     | PO5     |
| CO1             | 2       |         | 1       | 2       |         |
| CO2             | 3       | 2       | 1       | 2       | 2       |
| CO3             | 3       | 2       | 2       | 2       | 1       |
| CO4             | 3       | 2       | 2       | 1       | 1       |
| CO5             | 3       | 2       | 1       | 1       | 1       |
| Overall Correlation of COs and POs | 3 | 2 | 1 | 1 | 1 |

OT5102 WAVE HYDRODYNAMICS

OBJECTIVE:
- To make the students be aware of ocean wave classification, the mass, momentum and wave energy transformations and wave kinematics that are happening in nature and enable them in the prediction and analysis of the wave data.
UNIT I CONSERVATION OF MASS, MOMENTUM AND ENERGY

Conservation of mass, momentum and Energy; Euler Equation – Bernoullis Equation. Potential and Stream function.

UNIT II CLASSIFICATION OF OCEAN WAVES

Introduction - wind and waves - Sea and Swell - Introduction to small amplitude wave theory - use of wave tables- Mechanics of water waves - Linear (Airy) wave theory, Introduction to Tsunami Linear wave theory : Governing Equation, Boundary Conditions and solutions, Dispersion relation, Constancy of wave period.

UNIT III WAVE KINEMATICS


UNIT IV WAVE THEORIES


UNIT IV WAVE ANALYSIS AND WAVE PREDICTION


TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Understand the concept of mass, momentum and wave energy transformations.

CO2 Estimate the different classification of ocean waves

CO3 Explain the wave kinematics and wave loads along with its properties.

CO4 Classify the various nonlinear wave theories including the Stokes second order theory, solitary and cnoidal wave theories.

CO5 Analyse and forecast the long term and short term waves.

REFERENCES:

CO – PO MAPPING - WAVE HYDRODYNAMICS

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OT5103 MARINE AND COASTAL RESOURCES MANAGEMENT

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

UNIT I MARINE AND COASTAL RESOURCES
Estuarine and Mangrove Ecosystem – Soft Sediment Ecosystem – Salt Marsh Ecosystem – Coral Reef Ecosystem – Seaweed Ecosystem – Seagrass Ecosystem - Types and functions of marine and coastal resources - Coastal zone as an integrated resource area - Marine resources: biotic, mineral and energy resources.

UNIT II LIVING RESOURCES
Living Marine Resources (LMR) and livelihoods, Managing LMR - Recovery and conservation of protected and endangered species - Marine Protected Areas (MPA) - Large Marine Ecosystems (LMEs).

UNIT III NON – LIVING RESOURCES
Marine minerals - Placer deposits - Hydrocarbon deposits - Polymetallic nodules - Extraction of natural minerals - Methyl/ Gas Hydrates - Sea Salt - Seabed mining, Beach sand mining; Renewable energy from the ocean - Hydrocarbons, Gas, Wind, Wave - Tides - Currents - OTEC.

UNIT IV RESOURCE EXPLORATION AND MANAGEMENT

UNIT V BLUE ECONOMY
Overview of Blue Economy - Development of Blue Economy in India and other countries - Blue Economy and Security - Legal Regime for Exploration and Exploitation of Marine Resources - Review of Business opportunities and Constraints in India

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the student is expected to be able to

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<th>Identify the different coastal and marine resources.</th>
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<td>Describe the Living Marine Resources and its conservation.</td>
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<td>CO3</td>
<td>Assess the non-living resources and extract energy from it.</td>
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<td>CO4</td>
<td>Apply the knowledge to design appropriate methods to exploration and exploitation of strategies for sustainable management of coastal and marine resources.</td>
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<tr>
<td>CO5</td>
<td>Illustrate the sustainable use of ocean resources for livelihoods and economic growth.</td>
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REFERENCES:
5. Blue Economy Vision 2025 in India, FICCI Task Force, 2017

CO – PO MAPPING – MARINE AND COASTAL RESOURCES MANAGEMENT

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RM5151 RESEARCH METHODOLOGY AND IPR LT P C 2002

OBJECTIVES:
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations
UNIT II LITERATURE REVIEW
Effective literature studies approaches, analysis, plagiarism, and research ethics

UNIT III TECHNICAL WRITING / PRESENTATION
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR)

TOTAL: 30 PERIODS

OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

REFERENCES:

OT5111 MARINE WATER AND SEDIMENT QUALITY LABORATORY

OBJECTIVES:
- To analyze the physical and chemical parameters of marine water and sediment
- To build an understanding on the various computing techniques available for marine and coastal pollutants

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<td>Introduction to NABL, Demo of water quality field kit, Field measurements, Water sample collection and transport, introduction to analytical laboratory, Good Laboratory Practices and Quality Control.</td>
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<td>Determination of Physical parameters of Marine water sample pH, Salinity, EC, Turbidity, TDS, TSS) and Marine sediment sample Soil Texture (Sand, Silt, Clay)</td>
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<td>Determination of Chemical parameters of Marine water sample Ammonia, Nitrate, Total Nitrogen, Inorganic Phosphate, Total Phosphate, Silicate)</td>
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<td>Determination of Microplastics in the Marine water &amp; Marine Sediment sample.</td>
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<td>Determination of Heavy metals in the Marine water &amp; Marine Sediment sample. (Copper, Mercury, Arsenic, Lead, Zinc, Cadmium etc.)</td>
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TOTAL: 60 PERIODS
OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1. Summarize the basic sampling and techniques involved in Marine water and Marine sediment sample.

CO2. Examine the physical parameter in the Marine water quality and Sediment based on the standards.

CO3. Experiment the chemical elements presents in Marine water sample.

CO4. Evaluate the Microplastic concentration in the sea water and sediment samples.

CO5. Assess the Heavy metals concentration in the sea water and sediment samples.

CO – PO MAPPING – MARINE WATER QUALITY AND SEDIMENT LABORATORY

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REFERENCES


OT5201 COASTAL ENGINEERING L T P C 3 0 0 3

OBJECTIVES:

- To provide students with an introduction to coastal engineering with strong focus on wave behavior and sediment dynamics
- To diverse them in topics like coastal structures, shore protection methods and its techniques using case studies

UNIT I NEAR SHORE WAVE DYNAMICS 9

Introduction - coastal morphology and landforms - Beach, coast and shore - wind, waves, Tides & currents - Sea and Swell – sea level – Behavior of waves in shallow waters, Introduction to non-linear waves and their properties - Waves in shallow waters - Wave Refraction, Diffraction and Shoaling –Hindcast wave generation models, wave shoaling; wave refraction; wave breaking; wave diffraction.
UNIT II  
SEDIMENT DYNAMICS AND BEACH EVOLUTION  

UNIT III  
COASTAL STRUCTURES  
Classification of coastal structures– ports and harbor structures; breakwaters, jetties, etc. Harbour buildings, harbour and marine terminal layout, navigation channels, Power plants; nuclear power plants, desalination plants, Design of Sea water Intakes and outfalls structures, fish landing centers and jetties, Land reclamation by dredged materials, Potential impacts of coastal plants and structures on Marine ecosystem.

UNIT IV  
DESIGN OF BREAKWATER  

UNIT V  
COASTAL PROTECTION STRUCTURES  
Planning of coast protection works - Design of shore defense structures; Hard Engineering measures- Sea walls, Revetments, Bulkheads, Dikes, Groynes, Breakwaters; Soft Engineering measures – Artificial Reefs, Beach nourishment, Dune regeneration, Salt marsh Creation - Bioshields - Case studies - Latest technologies in shore protection techniques.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

CO1 Discuss the concept of near shore wave behaviour and understand the pattern of short term and long-term wave analysis with respect to domains.
CO2 Describe about the sediment dynamics and beach evolution.
CO3 Classify different coastal structure, layout and potential impact on marine ecosystem.
CO4 Design the Breakwater with safety consideration
CO5 Adopt different shore protection structures in order to prevent the shore from erosion.

REFERENCES:

CO – PO MAPPING - COASTAL ENGINEERING

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OBJECTIVES:
- To describe the basic principles of remote sensing including: orbits, electromagnetic radiation, diffraction, electro-optical, and microwave systems will be taught.
- To provide the GIS platforms in oceanographic applications of satellite remote sensing in coastal environments

UNIT I REMOTE SENSING

UNIT II IMAGE PROCESSING AND CLASSIFICATION

UNIT III GEOGRAPHIC INFORMATION SYSTEM

UNIT IV OCEANOGRAPHIC APPLICATION

UNIT V MARINE AND COASTAL APPLICATIONS

TOTAL : 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to:
- CO1 Understand the physical principles of remote sensing and Ocean Satellites.
- CO2 Interpret and analysis of Digital Image Processing.
- CO3 Illustrate the basic components in Geographical Information System and understand the different data structures.
- CO4 Summarize to use oceanographic applications of satellite remote sensing
- CO5 Apply the concept of remote sensing in marine and coastal environment

REFERENCES:
OBJECTIVES:

- To introduce the students to the basic terms and techniques involved in sea-surveying
- To study marine geo physical survey, tidal, current and other parameter measurements along with its associated instrumentation

UNIT I  BASICS OF SURVEYING  9
Shape of the Earth - Ellipsoid - Local Sphere - Geoid Datum - Types of Datum - Horizontal and Vertical Datum - Coordinate Systems - Principles of Cartography - Projections - Different types - Universal Transverse Mercator (UTM) projection - Survey of India - Topographic surveying applied to hydrography- Global Positioning systems (GPS) - Electronic Distance Measurements- RTK measurements

UNIT II  SEA SURVEYING  9

UNIT III  COASTAL SURVEYING  9
Modern instrumentation - Total station, Drones and Satellite telemetry system -LIDAR surveying for Digital Elevation Models (DEM) – Fields of applications and uses - large scale coastal land surveying - Beach Profile - Hydrographic surveys for coastal regions - Delineation of high tide, low tide and coastline and demarcation – Coastal Surveillance.

UNIT IV  METOCEAN OBSERVATION  9
Metocean – Types of buoys - Sensors - Measurement of meteorological parameters: wind, air temperature, solar radiation, pressure, humidity – Physical Oceanography parameters : Wave height, direction, tidal height, tidal period and ocean depth - Environmental parameters: conductivity, temperature, pH, salinity, dissolved oxygen, turbidity, sediments, chlorophyll,
fluorescence and pollution - Real time data Transmission by radio, GPRS, GSM, satellite or AIS to a Control Centre - Accuracy and reliability.

UNIT V TIDAL AND CURRENT MEASUREMENTS


OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Understand the basics information of shapes of earth, coordinate systems, cartography, Projection and its types.
CO2 Apply the modern electronic instruments for sea surveying
CO3 Explain the modern instrumentational methods in coastal survey.
CO4 Estimate the different types of buoys, sensors and its use for the application and operations for measurement of wind, temperature, current, wave height and direction
CO5 Extend the knowledge of Tides and currents

REFERENCES:


CO – PO MAPPING – SEA SURVEYING AND INSTRUMENTATION

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OBJECTIVES:

- To make the students to understand the basic principles of Offshore Technology and Offshore structures.
- To provide an overview of site exploration of marine sediments and sampling techniques.
- To learn about the concepts of oil and gas exploration, Study, control, and prevention of the industry's impact on the marine environment and its living resources.
- To learn about the concepts of fixed offshore platform design factors
- To learn about ultimate strength, fatigue, and design principles of offshore floating systems.

UNIT I MARINE SEDIMENTS AND SAMPLING TECHNIQUES
Planning and site exploration - marine sediments classification and its properties. Consolidation and shear strength characteristics of marine sediments. Sampling techniques - Drilling, Laboratory testing, In situ testing methods and geophysical methods. Current design practices of pile supported and gravity offshore structures.

UNIT II OFFSHORE STRUCTURES

UNIT III FIXED OFFSHORE PLATFORM

UNIT IV FLOATING OFFSHORE PLATFORM DESIGN FACTORS

UNIT V OFFSHORE OIL AND GAS OPERATIONS
Offshore oil and gas exploration - Geology – Geophysical Survey, Exploration & Production of Oil & Gas - Enhanced recovery methods, Subsea Pipelines Installation & maintenance

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Describe the overview of site exploration of marine sediments and sampling techniques.
CO2 Understand the basic principles of Offshore structures Technology.
CO3 Explain the concepts of oil and gas exploration and to study about the Subsea Pipelines Installation & maintenance
CO4 Learn about the concepts of fixed offshore platform design factors
CO5 Enumerate the design principles of offshore floating systems.
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OT5211 REMOTE SENSING AND GIS LABORATORY

OBJECTIVES:
- To give practical exposure to the students to data input, data storage, data analyses and data output capabilities of a standard GIS software (proprietary and open software’s)
- To enhance the skills in mapping techniques and prepare students for geospatial workforce

EXERCISES:
1. Satellite data products: commercial and open source
2. Land use Land cover Classification- Unsupervised and supervised.
3. Data Conversion – Vector to Raster, raster to Vector
4. Georeferencing of toposheet and creating vector layers
5. Geodatabase creation and Digitization of point, line and Polygon features
6. Creation of attribute tables and layout preparation
7. Transformation of Data from Google earth to GIS Environment & Excel sheet to GIS Environment
8. File conversion from .kml to .shp.
9. DEM analysis using ArcGIS
10. Analysis of spatial information- clip – buffer
11. Overlay Analysis using ArcGIS
12. Interpolation of Point data to create Spatial Maps
13. Mapping of Sea Surface Temperature
14. Mapping of Shoreline changes
15. Coastal Land Use/Landcover mapping

TOTAL: 60 PERIODS
OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Gain knowledge about reception, product generation, storage and ordering of satellite data
CO2 Understand the concept of different image processing techniques and interpretation of satellite data
CO3 Create GIS data base through Digitization and Georeferencing
CO4 Perform Spatial Analysis of Data using GIS tools
CO5 Apply the Remote sensing and GIS tool in Coastal environment

REFERENCES:

CO – PO MAPPING -REMOTE SENSING AND GIS LABORATORY

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OT5212 COASTAL HYDRODYNAMIC MODELLING LABORATORY L T P C 0 0 2 1

OBJECTIVES:
• To give practical exposure to hydrodynamic modelling to the students about Model setup, data input, model calibration, validation and simulation.

1. Overview of marine hydrodynamic Model
2. Creating computational mesh
3. Creating mdf-file from raw xyz data
4. Adjusting boundary data into a domain and triangulation of the domain
5. Variety of Hydrographic Boundary Conditions
6. Hydrodynamic Setup

Attested

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Centre for Academic Courses
Anna University, Chennai-600 025

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7. Creating the bathymetry
8. Creating the Input parameters: Wave condition, Wind conditions, Current Condition
9. Model Setup – Flow Model – Model Calibration – Model extraction
10. Compare model results and measured values.

TOTAL : 30 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

CO1 Understand the knowledge on modelling application used in softwares
CO2 Relate the valuable information gained on modelling operations and environment.
CO3 Understand and describe the basics of hydrodynamic modelling.
CO4 Able to understand the fundamental of flow modelling.
CO5 Compare model results and measured values.

REFERENCES:

CO – PO MAPPING – COASTAL HYDRODYNAMIC MODELLING LABORATORY

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OT5301 DEEP SEA TECHNOLOGY L T P C 3 0 0 3

OBJECTIVE:
- To explain the basic principles of deep-sea technology and modern instruments of deep sea resource explorations.
- To learn the various non-living resources and deep ocean biodiversity exploration and strategies for sustainable management of coastal and marine resources.
UNIT I DEEP SEA TECHNOLOGY AND MISSION


UNIT II DEEP OCEAN NON-LIVING RESOURCES

The deep oceans mineral resources - Polymetallic nodules; cobalt rich manganese crust and hydrothermal deposits. Utilizing this mineral wealth for the benefit of mankind will be the focus of ocean mining activities in future. Polymetallic nodules have valuable metals such as Copper, Cobalt, Nickel and Manganese; Gas hydrates; Overview of proposed technologies for utilization of deep-sea resources.

UNIT III DEEP SEA PROBES AND SUBMERSIBLES


UNIT IV DEEP SEA EXPLORATION VEHICLES


UNIT V DEEP OCEAN BIODIVERSITY


TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Understand the basic principles of deep-sea technology and modern instruments.

CO2 Learn about the exploration and exploitation of deep ocean mineral resources such as polymetallic manganese nodules, gas hydrates, hydrothermal sulphides etc.

CO3 Understand the Deep Sea Technologies involved in manned and unmanned underwater vehicles and its application.

CO4 Understand about the application of subsibles and survey methods

CO5 Learn on specific underwater exploration technologies for such scenarios in reefs, shelf, pipe laying and marine safety standards.

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### OT5302 PORT AND HARBOUR ENGINEERING

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**COURSE OBJECTIVES**

To make the students understand the basic principles of design of port and harbour structures.
- Explain the significance of ports and harbours as a mode of transport.
- Demonstrate the fundamental principles of wave hydrodynamics and port cargo handling.
- Understanding the Maintenance of waterways, Port and harbor layout for safe and efficient vessels and Dredging for navigation improvement, pipelines and cables, soil replacement.
- Analysis the basic design of port layout and its issues
- Explain the construction, maintenance and renovation aspects of ports and sustainable development strategies for cities and ports

### UNIT I INTRODUCTION AND PORT DESIGN

Introduction: Planning and Development of port and harbours, Types and classification of ports and harbours in India, Natural ports and manmade ports, major ports, minor ports, Port designs and layouts - Design of port infrastructures with regards to cargo handling, cargo storage and integrated transport of goods - planning multipurpose port terminals - Development of new ports and expansion of existing ports and harbours by SAGARMALA.

### UNIT II DESIGN OF HARBOUR AND DESIGN ISSUES

Design of harbour Infrastructures -Breakwaters, jetties and quay walls - design of break water - shore attached and offshore breakwaters design - design of harbor basin, approach channel, and turning basin, harbours and passenger terminals. Fisheries harbours: Passenger terminals and Cargo terminals - Design issues: Sea port and harbour layout with regards to wave action, hydrodynamic conditions, siltation, navigability and berthing facilities.

### UNIT III WATERWAYS OF PORT AND HARBOUR

Maintenance of waterways, Port and harbor layout - Safe and efficient vessels navigation, cargo loading and unloading- Navigation channels and dredging - Shore infrastructure and utilities - Land reclamation - Environmental and economic considerations -Capital and annual Dredging - Dredging
equipment - Dredging for navigation improvement, pipelines and cables, soil replacement. Potential effects of dumping of dredged materials on oceanic environment, environmental laws and factors.

UNIT IV  PORTS AND HARBOURS OPERATIONS

Introduction, Design of wave conditions, tidal condition, navigational depths - Capital dredging, and annual dredging for cargo handling - Human safety on quays, swells and breakwaters - VTMS (Vessel-Traffic-Management-System) - Design of wave conditions - Forecasting /nowcasting / hind casting of wave and current conditions for port operations - Capital and annual dredging and navigability - hazard scenarios - Management of computerized container terminal - Safety: handling of fire, oil spill, rescue, etc., -Annual port operation.

UNIT V  SUSTAINABILITY AND CLIMATE CHANGE

Introduction, development of green ports and harbours, Planning and construction, expansion of existing port and harbours and renovation of port and Inland Port Infrastructure by sustainable approach. Global trade and port restructuring/reforms along with sustainability, Numerical Modeling studies for impact of possible climate change scenarios against waves, tides, currents and sea level rise, coastal structures, sustainable development strategies for coastal cities and ports.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to
  CO1 Describe the basic principles of design of port and harbour structures.
  CO2 Design the harbour Infrastructures with multipurpose ports and harbours terminals, passenger terminals.
  CO3 Understanding the Maintenance of waterways, Port and harbour layout for safe and Dredging for navigation improvement, reclamation, pipelines and cables, soil replacement.
  CO4 Analysis the basic operations of port and harbour and to design wave conditions for forecasting / nowcasting / hind casting of wave and current conditions for port operations
  CO5 Explain the construction, maintenance and renovation aspects of ports and sustainable development strategies for coastal cities and ports

REFERENCES


CO-PO MAPPING – PORT AND HARBOR ENGINEERING

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Attested...

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
OBJECTIVES:
- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Coastal Management in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

SYLLABUS:
The students individually undertake training for a minimum period of two weeks in reputed organisations during the summer vacation or they can participate training programmes organized by Anna University for a minimum period of two weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination.

OUTCOME:
- They are trained in tackling a practical field/industry orientated problem related to Coastal Engineering.

OBJECTIVES:
- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:
The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

OUTCOME:
- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.
OBJECTIVES:
- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:
The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS

OUTCOME:
- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

OT5001  MARINE POLLUTION MONITORING AND MANAGEMENT  L T P C
3 0 0 3

Objective:
- To educate the students about the marine pollution sources and its impacts to environment
- To identify the effects of marine pollution and methods for monitoring, and control of it.

UNIT I  MARINE POLLUTION SOURCES  9
Marine pollution: Sources of Marine Pollution- Point and Non point sources, kinds and quantities of pollutants entering oceans, Pollution caused by Oil Exploration, Dredging, Offshore structures, ocean dumping - fate of pollutants - toxic effects and nuclear waste disposal- Land based sources of Marine pollution.

UNIT II  POLLUTANT IN MARINE ENVIRONMENT  9
Plastics in the marine environment - The “garbage patch,” - Plastic in the marine environment - Prediction of Marine Debris Drifting - Impacts of Marine Debris on Marine Life - Impacts of marine litter on human- Trace metals as pollutants - Factors influencing the toxicity of trace metals to marine organisms - Important contaminant metals in marine systems - Mercury, Cadmium, etc.

UNIT III  MARINE POLLUTION EFFECTS AND MEASURES  9
Oil Pollution (Oil spills) - Oil spills- Sources of oil pollution - Environmental effects - Cleanup and recovery - Prevention - Environmental Sensitivity Index (ESI) mapping -Thermal Pollution - Thermal Effluents - Major Causes - Effects of Increased Water Temperature - Biotic Effects of Thermal Pollution - Remediation and prevention measure for thermal pollution - Emerging Pollutant.
UNIT IV  MARINE POLLUTION MONITORING

UNIT V  POLLUTION ABATEMENT PROGRAMS
Pollution abatement programs in developed countries – case studies. Assessing pollution damage. Law pertaining to marine pollution– Biodegradation and bioremediation.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Understand the source of marine pollution
CO2 Define the impact on pollutant in Marine Environment.
CO3 Illustrate the effects of marine pollution and adopt proper measures.
CO4 Describe techniques and practices for the monitoring of pollution in the coastal marine environment
CO5 Acquire knowledge on abatements pertaining to marine pollutions.

REFERENCES:
1. Ricardo Beiras, “Marine Pollution sources, fate and effects of pollutants”, Elsevier science, 2018
2. Houma Bachari Fouzia, “Monitoring of Marine Pollution”, IntechOpen, 2019

CO – PO MAPPING – MARINE POLLUTION AND MONITORING

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OBJECTIVES:

- To introduce the various fisheries and aquaculture systems and technology development including the basics of fishery, fishing gear and craft technology, economics in fishery and its management
- To describe history of aquaculture, general principles, infrastructural facilities, selection of suitable culturable species, and technologies involved in it.

UNIT I  BASICS AND FUNDAMENTALS OF FISHERIES

Introduction of Marine Fisheries – Major and Minor marine fisheries of the world and particularly India. Classification of marine fisheries, Current status of Indian capture and industrial fisheries - Fishery resource of EEZ of India. Methods of surveying the fishery resources – Sampling of feed up on small marine organisms like copepods, acoustic method and aerial method, potential fishing zone method.

UNIT II  FISHING GEAR AND CRAFT TECHNOLOGY


UNIT III  FISHERY ECONOMICS & FISHERIES RESOURCE MANAGEMENT

Basic of Economics Theories of demand, supply– Types of market - Marketing channels in Fisheries- Principles and objectives of co-operation-Fisheries Co-operatives- Role of NABARD, NFDB, MPEDA, FISHCOFED in fisheries development - Fisheries legislation: Overview of fisheries and aquaculture legislations in World and India -CCRF-UNLCOS - Indian Fisheries Act, 1897, CRZ, Marine Fisheries Regulations of different states- Ecosystem approach for fisheries management.

UNIT IV  AQUACULTURE

History of aquaculture – Global coastal aquaculture development and management – General Principles - Infrastructural facilities and Human resources – Water resources and quality for aquaculture and management - Survey and Selection of suitable sites – Site selection for aquaculture using remote sensing and image processes techniques - Selection of cultivable species – Exotic species for aquaculture, Water discharges problems from aquaculture pond post-harvest of fishes.

UNIT V  AQUACULTURE TECHNOLOGIES


TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

- CO1 Classify fisheries resources of the world and Indian fisheries.
- CO2 Understand types of gear and craft used for fishing.
- CO3 Explain the fisheries economics and resource management
- CO4 Learn about coastal aquaculture development and management, Site selection for aquaculture using remote sensing.
- CO5 Gain the knowledge on Fin fish and shellfish seed production technology, by-products, preservation and processing Technology.
REFERENCES:
1. Dholakia, A.D., “Fisheries and Aquatic resources of India”, Daya Publishing House, Delhi, 2004

CO – PO MAPPING : FISHERIES AND AQUACULTURE TECHNOLOGY

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OBJECTIVES:

- To introduce the usefulness and versatility of numerical, ecological, and water quality modeling in the context of environmental problem solving.
- 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

Types of models – physical and mathematical models - Modeling of coastal processes - Model development and validation - Basic numerical tools used in mathematical models. Equations governing processes in coastal environment - Case studies of numerical solutions of equations governing coastal processes.

UNIT II HYDRODYNAMIC AND SEDIMENT MODELLING


UNIT III WATER QUALITY AND ECOLOGY MODELLING

Mass Balance for a well-mixed system - Steady State & Time dependent solution to a well-mixed system - Modelling Feed-forward & Feedback systems - Water Quality Modelling - Advection and Diffusion - water quality response to inputs - Introduction to Ecological Models- Model development and validation

UNIT IV TSUNAMI MODELLING

Tsunami: Interpretation of Seismic Records - acceleration, velocity and displacement; Frequency and Time Domain parameters- Epicenter and magnitude determination - Earthquake induced Tsunami hazard - Consideration for Tsunami hazard mapping.

UNIT V STORM SURGE MODELLING


TOTAL :45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Define the basic numerical tool used in modelling.

CO2 Perform hydrodynamic and sediment modelling based on governing equations of waves and sediment.

CO3 Synthesize water quality and ecology modelling based on time, advection, diffusion and quality response.

CO4 Investigate Tsunami Modelling and interpret using seismic records.

CO5 Evaluate Storm surge modelling based on meteorological factors like bathymetry, wind speed, intensity of cyclone and precipitation.
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OT5004 EIA AND OCEAN GOVERNANCE L T P C 3 0 0 3

OBJECTIVES:
- To highlight the purpose and role of EIA in the decision-making process
- Know formats of EIA Report (Environmental Impact Statement, or Environmental Statement)
- Understand the purpose of developing follow-up procedures, and options for designing these procedures in essential sectors according to the issues
- To understand the various law and ocean governance in CRZ for proper development of ICZM plan

UNIT I INTRODUCTION
Principles of EIA, EIA Requirements; Environment related legislation in India - Legislation for EIA, Coastal regulations, Environmental clearance.

UNIT II COMPONENTS AND METHODS
UNIT III  QUALITY CONTROL AND INSTITUTIONAL ARRANGEMENTS  9
Procedures to be followed - screening -scoping - preparing Terms of Reference - carrying out an EIA - mitigation - Ocean Technology plans - environmental monitoring systems - capacity building for quality assurance - institutional arrangements for EIA - appraisal of proposals - quality control of EIA.

UNIT IV  EIA- ESSENTIAL SECTORS AND ISSUES  9

UNIT V  OCEAN GOVERNANCE  9

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

CO1  Understand the fundamentals of EIA requirements including EIA legislation in India
CO2  Assess the impact on environment for decision making process.
CO3  Describe the various procedure involved in quality control and institutional arrangement.
CO4  Apply EIA methodologies as well as knowledge of science and engineering in preparing EIA for different sectors
CO5  Understand the various law and ocean governance in CRZ for proper development of ICZM plan

REFERENCES:
4.  UNESCAP. Assessment of the environmental impact of port development. United Nations, 1992
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OBJECTIVES

- To highlight the need for exploring alternative energy sources especially renewable sources like ocean energy.
- To facilitate the students to achieve a clear conceptual understanding on ocean thermal energy conversion, tidal, wave energy and the technologies involved in its operation and maintenance.

UNIT I INTRODUCTION


UNIT II OCEAN THERMAL ENERGY CONVERSION

Working principle, Resource and site requirements, Location of OTEC system, Electricity generation methods from OTEC, open cycle and closed cycle OTEC systems, Advantages and disadvantages, Applications of OTEC.

UNIT III TIDAL ENERGY

Origin and nature of tidal energy, Basic principle of tidal power generation, Components of tidal power plants, Tidal energy technology, Tidal range power, Basic modes of operation of tidal systems. Advantages and limitations.

UNIT IV WAVE ENERGY


UNIT V OCEAN ENERGY SYSTEMS TECHNOLOGIES

Offshore wind turbines/ Wind mills - Floating Wind Turbine-Mooring and anchoring systems - Farm layout - Offshore electrical grid and connection systems - Offshore operations and maintenance - Shore based solar panel system - Water turbines - High pressure hydraulic systems - Power generation- Power evacuation - Energy storage -Maritime safety issues

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Define the alternative energy sources from the ocean.
CO2 Explain the principles, requirement, types and components of OTEC.
CO3 Discuss the concept of Tidal Energy
CO4 Describe the various types of Wave Energy, arrays turbines based on design criteria.
CO5 Understand the various types of Ocean Energy Systems Technologies

REFERENCES

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OT5006 COASTAL HAZARDS AND MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:
• To provide students understanding of the major natural and coastal hazards: floods, earthquakes, tsunamis, landslides
• To manage these hazards based on the laws, policies and disaster management strategies

UNIT I INTRODUCTION 9
Introduction to Environmental and Human induced hazards - Natural vs. Man-made hazard - Hazard and disaster, vulnerability, resilience - coping mechanisms.

UNIT II COASTAL HAZARDS 9
Coastal hazards- Cyclones, Earthquakes, Tsunami, Coastal Floods, Storm surges, Coastal erosion.
Sea Level Rise-Technological Hazards - causes - impacts - responses - mitigation strategies - early warning systems.
UNIT III   LAW AND POLICY
Disaster management law and policy in India - Hyogo framework - changing paradigm of disaster management in India - response and recovery framework - enabling institutions- institutional coordination.

UNIT IV   DISASTER MANAGEMENT
Disaster risk response frameworks - Mapping and planning for disaster management - capacity building - risk transfer mechanisms - Bioshields - community based disaster management systems - indigenous knowledge for disaster management - NDMA guidelines - Building codes, land use planning and disaster management.

UNIT V   CASE STUDIES
Green card concept - Reduction of carbon footprints - Case studies of Earthquake (Bhuj), tsunami (2004 Indian Ocean tsunami), cyclones (supercyclone, 1999 Odisha), other cyclones, coastal erosion, oil spills, chemical disasters, nuclear disasters - vulnerability of coastal megacities - lessons from building back better.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

CO1 Highlight the concepts of hazards and their related physical process
CO2 Recall the concepts of natural and manmade hazards.
CO3 Explain the various laws and policies involved in - institutional coordination of India.
CO4 Summarize about the indigenous knowledge practiced in India, mapping and planning of disaster management
CO5 Manage the hazards based on case studies and respond in the event of a disaster by appropriate strategies.

REFERENCES:
2. Rajib Shaw and RR Krishnamurthy, “Disaster Management: Global Challenges Local Solutions”, University Press, 2009
3. National Disaster Management Agency - Guidelines issued by NDMA such as for earthquakes, tsunamis, cyclones, chemical disasters etc. www.ndma.gov.in
4. National Disaster Management Division, Ministry of Home Affairs, GoI. http://www.ndmindia.nic.in/ Regularly issued guidelines and training materials especially for disaster management policy, reconstruction of buildings etc
5. United Nations office for Disaster Risk Reduction www.unisdr.org various publications and guidelines that are constantly updated
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TOTAL: 45 PERIODS
OBJECTIVES:
- To understand the need for integrated coastal management
- To study the goals, framework and prioritizing issues in ICM
- To know the basic regulation associated with the coastal zone protection and management

UNIT I THE NEED FOR ICM AND FUNDAMENTAL CONCEPTS
Introduction: The Coasts – Unique, Valuable and Threatened – Examples of Interactions among Coastal and Ocean Uses and Their Environments – Early Efforts at Coastal Management - The Need for ICM

UNIT II ICM FRAMEWORK AND PROCESSES

UNIT III ICM TOOLS AND TECHNIQUES
Administrative tools - policy and legislation, zoning, regulation and enforcement, spatial planning, marine spatial planning; Social tools: Stakeholder analysis, conflict resolution, customary practices, capacity building – Technical tools: strategic environmental assessment, risk assessment and evaluation, cost benefit analysis, problem tree analysis.

UNIT IV INTEGRATING DISCIPLINARY PERSPECTIVES
Social science insights – Natural science insights – Horizontal integration – Vertical integration – Problem and objective analysis– Developing indicators for Monitoring and evaluation, adaptive management.

UNIT V COASTAL LAWS, POLICIES, INSTITUTIONS AND GOVERNANCE

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Explain the basic fundamentals of ICM
CO2 Develop ICM framework based on various processes.
CO3 Assess the risk by using various tools and technique in ICM
CO4 Comprehend how different disciplines including engineering and social sciences are integrated
CO5 Determine the international and national legislation and their role in coastal management

REFERENCES:

### CO PO MAPPING - INTEGRATED COASTAL ZONEMANAGEMENT

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### OBJECTIVES:
- The course focuses primarily on coastal biodiversity while maintaining an integrated approach towards management of coastal ecosystems.
- Particular emphasis will be given to teaching the methodology for assessing, monitoring and conserving biodiversity.
- This course is designed to introduce the student in an integrated manner to the field of sustainable development policy and biodiversity conservation and how it applies to the field of biodiversity and conservation as well as related areas.

### UNIT I COASTAL ECOLOGY AND BIODIVERSITY


### UNIT II ECOLOGICALLY SENSITIVE AREAS

Identifying mapping ecologically sensitive areas using remote sensing and other tools- Assessing, monitoring and conserving biodiversity in mangrove ecosystems - role of coastal ecosystems in buffering natural hazards such as cyclones, tsunamis and coastal erosion.

### UNIT III RESOURCE MANAGEMENT

Ecosystem approach to management - Marine protected areas - community based management - indigenous and traditional knowledge in conservation practices - Locally Managed Marine Areas - closed seasons - closed areas - Ecotourism.
UNIT IV  COASTAL BIODIVERSITY THREATS 9
Ecological conditions affecting coastal and marine ecosystems - Natural hazards and ecosystem resilience - Human impacts on marine ecosystems - physical alteration and destruction of habitat - habitat fragmentation - Harmful algal blooms - Coral bleaching - Invasive species - Marine debris - oil spills

UNIT V  NATIONAL POLICIES AND LEGISLATION 9
Indian legislation for environmental protection - coastal protection - wetland rules - environmental policy - Rio conventions - CBD - Jakarta Mandate - Ramsar convention - fisheries conventions

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

CO1 Discover the Importance of Coastal Biodiversity and different ecosystems provided by marine environment

CO2 Understand the methodology for assessing, monitoring and conserving biodiversity in various Coastal and Marine ecosystems

CO3 Manage the resources according to indigenous and traditional knowledge in conservation practices.

CO4 Determine the various threats on Coastal Biodiversity.

CO5 Analysis the national policies and legislation for managing the ecosystems.

REFERENCES:
5. Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel - GEF
7. Taking Steps toward Marine and Coastal Ecosystem-Based Management - An Introductory Guide. UNEP.

CO PO MAPPING - COASTAL ECOSYSTEM AND BIODIVERSITY

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OBJECTIVES:
- To give students the various perspectives on climatic change and the actions societies have taken to address its potential and actual impacts.
- To highlight that natural processes and human activities alter the composition of the ocean and atmosphere, both globally and regionally, that trigger climate change at different temporal and spatial scales.
- To provide a basic conceptual understanding of the complexity of the climate system; and the observed and potential effects of anthropogenic-induced climate change on human and natural systems based on IPCC recommendations.
- To enable understanding of the international and national responses to climate change and consider individual responsibility and future challenges.

UNIT I  CLIMATE CHANGE 7
Historical Overview of Climate Change Science- Changes in Atmospheric Constituents and Radiative Forcing - The Ice Ages: An Introduction - Determining Past Climates - Reconstructing Past Climate Change -- Interannual to decadal variability- Observations: Atmospheric Surface and Climate Change.

UNIT II OCEAN ATMOSPHERE INTERACTIONS 10

UNIT III IMPACTS OF CLIMATE CHANGE 10
Oceans- Heat - Sea Surface Temperature (SST)- Sea Level Rise (SLR), Coastal flooding, Ocean Acidity, Snow and Ice and Ecosystems - Industry, tourism, retail and Commercial services – Insurance - health effects -livelihood impacts, displacement, distributional impacts within and among cities.

UNIT IV ASSESSMENT OF CLIMATE CHANGE 9
The IPCC Assessment Reports - AR5 and AR6 reports -Indicators of climate change - Global Warming- Sea Surface Temperature (SST) - Sea Level Rise (SLR) - RCP and SSP Scenarios - Sim-CLIM model - Shared Socio- Economic Pathways (SSPs) -Prediction of future scenarios

UNIT V ADAPTATION AND MITIGATION 9

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Understand the basics of climate change, its past climate, variability of climate in decades
CO2 Relate the roles of ocean in climate, circulation patterns and its interaction with atmosphere
CO3 Classify the various impacts with reference to climate change
CO4  Asses the impacts of climate change based on various indicators and IPCC Reports
CO5  Develop proper climate mitigation measures and provide necessary adaptations

REFERENCES:
4. MoEF, GOL. Indian Network for Climate Change Assessment
5. Climate Change and India: A 4X4 Assessment - A sectoral and regional analysis for 2030s. New Delhi, 2010

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OT5010  MARINE TOXICOLOGY  L T P C
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OBJECTIVES
• To understand the toxicants on environmental and aquatic toxicology and its measurement
• To assess the risks involved by identifying the sources, pathways, effects of PCBs and adopting proper risks assessment of contaminants on communities and ecosystems.

UNIT I  ENVIRONMENTAL TOXICOLOGY

UNIT II  AQUATIC TOXICOLOGY
Aquatic Toxicology: Causes of Aquatic Contamination, Sources and Transport of Chemicals in Aquatic Systems, The Most Important Experimental Designs and Organisms in Aquatic Toxicology, Factors Affecting the Bioavailability of Chemicals, Chemical Uptake by Organisms, Chemical Distribution in Organisms, Excretion of Compounds from Organisms Interactions, between Chemicals, Bioindicators and Biomarkers Acute and Chronic Toxicity, Effects of Chemicals on Aquatic Populations, Effects of Chemicals on Aquatic Communities and Ecosystems
UNIT III  MARINE ECOTOXICOLOGY AND TOXICANTS
General introduction and principles on marine toxicology - General chemistry of different types of pesticides and toxicants like Organochlorine, organophosphate, Marine Plastics - Microplastics, PCBs, POPs, PAH, Dioxins, heavy metals – Effect of Toxicants on animal physiology - Global transport of POPs - Mercury and Lead cycling in the environment.

UNIT IV  RISK ASSESSMENT
Aquatic toxicology testing methods - Chemical uptake, transformation, elimination, and accumulation - Marine and estuarine invertebrate toxicity tests - Bioassays and biomarkers - multi-species test systems - Biodegradation - Factors influencing bioaccumulation and trophic transfer - Sub-lethal effects - Acute and chronic lethal effects - Risk assessment of contaminants on communities and ecosystems.

UNIT V  CASE HISTORIES AND ECOSYSTEM SURVEYS
Sources, Pathways, and Effects of PCBs, and heavy metals, The Chernobyl Nuclear Power Plant Reactor Accident, Pesticides, The Hudson River — PCB Case Study

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
CO1 Describe about the principles of toxicology
CO2 Illustrate the basic principle of aquatic toxicology
CO3 Determines the toxicity of various pollutants and the ultimate fate of pollutants in marine organisms;
CO4 Estimate the risk assessment of contaminants on communities and ecosystems
CO5 Understand the impact of toxicants

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OBJECTIVES:
- To make students aware of the importance of "human factor" in Coastal management and to recognize that many coastal problems are actually not natural but the product of human presence, behavior and intentions.
- To facilitate students to work across disciplinary boundaries and develop an approach that will enable them to incorporate human society in their understanding of coastal area management.

UNIT I ICM AND THE SOCIAL SCIENCES
Background to ICM - Sustainability and Sustainable ICM — Competing Claims and Visions of the Coast - ICM and Interdisciplinarity

UNIT II STAKEHOLDERS, SOCIETY AND SOCIAL CHANGE
Identifying and classifying Stakeholders, processes of interaction with different stakeholders - Social Change along the Indian Coast, impacts of urbanization, industrialization and calamities on coastal societies

UNIT III LIVELIHOODS AND CULTURE

UNIT IV INSTITUTIONS, PROPERTY AND LAW
Property Rights and Coastal Management - Competing Property Rights and Resource Claims - Statutory and Customary Law - Legal pluralism

UNIT V POLICY AND GOVERNANCE
Existing Policies Governing the Coast --Governance - Institutions for coastal management, Reconciling Conflicting Agendas - Future of ICM

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
CO1 Understand the basic of ICM and the social science
CO2 Identify and classify the stakeholder’s participation, stakeholders’ social changes and calamites of social changes
CO3 Identify the culture and livelihood of coastal dwellers and their indigenous knowledge in Coastal Management.
CO4 Study property rights, statutory law and customary law
CO5 Illustrate the various governing policies of the coast for ICM

REFERENCES:
### CO – PO MAPPING – SOCIO-ECONOMIC ASPECTS OF COASTAL MANAGEMENT

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OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I  OVERVIEW OF BUSINESS ANALYTICS

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II  ESSENTIALS OF BUSINESS ANALYTICS

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III  MODELING UNCERTAINTY AND STATISTICAL INFERENCE
Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK

Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS
Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig.
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) — Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce.
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.
REFERENCES:

Business Data Analytics

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OE5092 INDUSTRIAL SAFETY LT P C 3 0 0 3

OBJECTIVES:
- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION
9
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc. Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING
9
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION
9
UNIT IV  FAULT TRACING
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V  PERIODIC AND PREVENTIVE MAINTENANCE
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

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REFERENCES:

OE5093  OPERATIONS RESEARCH  L T P C
OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems
UNIT I  LINEAR PROGRAMMING  9
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II  ADVANCES IN LINEAR PROGRAMMING  9
Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships —Dual simplex algorithm - Sensitivity analysis

UNIT III  NETWORK ANALYSIS – I  9
Transportation problems -Northwest corner rule, least cost method, Voges's approximation method Assignment problem -Hungarian algorithm

UNIT IV  NETWORK ANALYSIS – II  9
Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V  NETWORK ANALYSIS – III  9
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

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REFERENCES:
OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES
CO1 – Understand the costing concepts and their role in decision making
CO2– Understand the project management concepts and their various aspects in selection
CO3– Interpret costing concepts with project execution
CO4– Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management
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2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988

OE5095 COMPOSITE MATERIALS L T P C 3 0 0 3

OBJECTIVES:
- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9
Definition — Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9
UNIT V STRENGTH
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:
CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
CO2 – Know the various reinforcements used in composite materials.
CO3 – Understand the manufacturing processes of metal matrix composites.
CO4 – Understand the manufacturing processes of polymer matrix composites.
CO5 – Analyze the strength of composite materials.

REFERENCES:

OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices — Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS
Pyrolysis — Types, slow fast — Manufacture of charcoal — Methods - Yields and application — Manufacture of pyrolytic oils and gases, yields and applications.
UNIT III  BIOMASS GASIFICATION

UNIT IV  BIOMASS COMBUSTION
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V  BIO ENERGY
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants — Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Understand the various types of wastes from which energy can be generated CO2 – Gain knowledge on biomass pyrolysis process and its applications CO3 – Develop knowledge on various types of biomass gasifiers and their operations CO4 – Gain knowledge on biomass combustors and its applications on generating energy CO5 – Understand the principles of bio-energy systems and their features

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REFERENCES:
OBJECTIVES
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I  INTRODUCTION TO RESEARCH PAPER WRITING  6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II  PRESENTATION SKILLS  6

UNIT III  TITLE WRITING SKILLS  6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV  RESULT WRITING SKILLS  6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V  VERIFICATION SKILLS  6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES
CO1 – Understand how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

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AX5092 DISASTER MANAGEMENT L T P C
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OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION
6
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS
6

UNIT III DISASTER PRONE AREAS IN INDIA
6
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT
6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT
6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS
OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

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AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE  L T P C  2 0 0 0

OBJECTIVES
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS
Alphabets in Sanskrit  6

UNIT II TENSES AND SENTENCES
Past/Present/Future Tense - Simple Sentences  6

UNIT III ORDER AND ROOTS
Order - Introduction of roots  6

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
UNIT IV  SANSKRIT LITERATURE
Technical information about Sanskrit Literature

UNIT V  TECHNICAL CONCEPTS OF ENGINEERING
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

OUTCOMES
CO1 - Understanding basic Sanskrit language.
CO2 - Write sentences.
CO3 - Know the order and roots of Sanskrit.
CO4 - Know about technical information about Sanskrit literature.
CO5 - Understand the technical concepts of Engineering.

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1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Pratham Deeksha-Vempat Kutumbhastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

AX5094  VALUE EDUCATION

OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

UNIT II

UNIT III
UNIT IV

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

Suggested reading

AX5095 CONSTITUTION OF INDIA L T P C 2 0 0 0

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

UNIT IV ORGANS OF GOVERNANCE
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.
UNIT V  LOCAL ADMINISTRATION

UNIT VI  ELECTION COMMISSION
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party(CSP) under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading
1. The Constitution of India,1950(Bare Act),Government Publication.

AX5096  PEDAGOGY STUDIES

OBJECTIVES
Students will be able to
- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I  INTRODUCTION AND METHODOLOGY
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II  THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.
UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Suggested reading

AX5097 STRESS MANAGEMENT BY YOGA

OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)
UNIT II
Yam and Niyam - Do's and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparyagra.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects - Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. "Yogic Asanas for Group Training-Part-I" : Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dons) - Verses- 71,73,75,78 (dons)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - Shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

Suggested reading
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi, 2010