ANNEXUE – B

Curriculum and Syllabus of M.Tech – Ocean and Coastal Safety Engineering

FIRST SEMESTER

No	Course code	Course Title	Hrs/ week	Credits				Marks		
				L	T	P	C	INTL	EXTL	Total
1	OSE2101	Basics of Ocean, Coastal and Harbour Engineering	4	3	1	0	4	50	50	100
2	OSE2102	Port and Harbour Structures	4	3	1	0	4	50	50	100
3	OSE2103	Coastal Planning	4	3	1	0	4	50	50	100
4	OSE2104	Marine Instrumentation	4	3	1	0	4	50	50	100
5	OSE2105	Advanced Engineering Mathematics	4	3	1	0	4	50	50	100
6	OSE2106	Wave Hydrodynamics	4	3	1	0	4	100	--	100
7	OSE2107	Marine Instrumentation Lab	4	0	0	4	2	100	--	100
		Total	28	18	6	4	26	450	250	700

M.Tech - Ocean and Coastal Safety Engineering

SECOND SEMESTER

No	Course code	Course Title	Hrs/ week	Credits				Marks		
				L	T	P	C	INTL	UTY	Total
1	OSE2201	Research Methodology	4	3	1	0	2	50	50	100
2	OSE2202	Health, Safety and Environment Management	4	3	1	0	4	50	50	100
3	OSE2203	Maritime Laws and Regulations	4	3	1	0	4	50	50	100
4	OSE2204	Coastal Surveillance and rescue operations	4	3	1	0	4	50	50	100
5	OSE2205	Coastal Engineering Lab	4	0	0	4	2	100	--	100
6		Elective - I	4	3	1	0	3	50	50	100
7		Elective - II	4	3	1	0	3	50	50	100
		Total	28	18	6	4	22	400	300	700

M.Tech - Ocean and Coastal Safety Engineering

THIRD SEMESTER

No	Course code	Course Title	Hrs/ week	Credits				Marks		
				L	T	P	C	INTL	EXTL	Total
1	OSE2301	Project Phase I	4	0	0	4	6	100	--	100
2	OSE2302	Industrial Training	4	0	0	4	2	100	--	100
3	OSE2303	Seminar	4	0	0	4	2	100	--	100
4		Elective -III	4	3	1	0	3	50	50	100
5		Elective - IV	4	3	1	0	3	50	50	100
		Total	20	6	2	12	16	400	100	500

M.Tech - Ocean and Coastal Safety Engineering

FOURTH SEMESTER

No	Course code	Course Title	Hrs/ week	Credits				Marks		
				L	T	P	C	INTL	EXTL	Total
1	OSE2401	Project Phase II	24	0	0	24	12	70	30	100
		Total	24	0	0	24	12	70	30	100

LIST OF ELECTIVES

		L	T	P	C
	Second semester				
OSE2206	Port Planning & Management	3	1	0	3
OSE2207	Mining and Dredging	3	1	0	3
OSE2208	Coastal Engineering & Design	3	1	0	3
OSE2209	Ocean structures	3	1	0	3
OSE2210	Marine Electrical and Electronic Engineering	3	1	0	3
OSE2211	Marine Corrosion and Prevention	3	1	0	3
	Third Semester				
OSE2304	Marine Pollution, Prevention and Control	3	1	0	3
OSE2305	Marine navigation and communication systems	3	1	0	3
OSE2306	Coastal Resource Management	3	1	0	3
OSE2307	Coastal Hazards and Management	3	1	0	3
OSE2308	Marine Survey and Monitoring	3	1	0	3
OSE2309	Integrated Coastal Zone Management	3	1	0	3
OSE2310	Ocean Dynamics and Modeling	3	1	0	3
OSE2311	Fire Engineering And Explosion Control	3	1	0	3
OSE2312	Ocean Energy	3	1	0	3
OSE2313	Computational Fluid Dynamics	3	1	0	3
OSE2314	Remote Sensing and GIS	3	1	0	3

SEMESTER I

OSE2101 BASICS OF OCEAN, COASTAL AND HARBOUR ENGINEERING

Name of the course	M.Tech - Ocean and Coastal Safety Engineering
Name of subject	Basics of Ocean, Coastal and Harbour Engineering
Subject code	OSE2101
Semester	01
duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

OBJECTIVE:

• To provide an overview of the analysis and design procedures used in the field of ocean, coastal and harbour engineering.

UNIT I

Introduction to Oceanography – Ocean Circulation, Tides, Waves, Currents, Tsunami and Storm surges – origin, generation, propagation and characteristics; Different materials for marine applications - metals, concrete, geo-synthetic products and other materials for marine environment; Marine corrosion and control; Introduction to physical modeling of coastal and offshore and harbour engineering problems.

UNITII

Ocean circulation – Conservation equations and transport processes, momentum balances, geostrophy, large scale circulation, wind-driven circulation, abyssal ocean circulation, boundary currents, friction and Ekman layers; Waves – Origin and evolution, characteristics, classification, Tsunami, Tides – Origin, characteristics, tidal generation forces, equilibrium tide, tidal analysis and prediction

UNIT III

Different types of ocean structures and systems (fixed, floating, semi-submersibles, submersibles, pipelines, etc.,) for exploitation and production of oil and gas, minerals and energy. Brief outline of planning, design and construction.Towing, launching and installation.

UNIT IV

Beach, coast and shore; Beach features - beach cycles - beach profiles – beach stability - beach erosion and sedimentation; Engineering aspects in coastal oceanography; Coastal protection structures – natural and artificial – design of shore protection structures, seawalls, groins, breakwaters; Types and factors determining selection and stability of breakwaters; Sand bypassing and artificial beach nourishment - latest technologies in shore protection techniques; Environmental impacts of coastal developments.

UNIT V

Types of ports and harbors; harbour layout and terminal facilities - piers, break waters, wharves, jetties, quays; Spring fenders, dolphins and floating landing stage environmental issues in port planning and operations; Harbor oscillations, seiches; Inlets – siltation of inlets and harbors – remedial measures; Onshore and offshore sediment transport - transport rate – estimation methods; Dredging .

REFERENCES:

Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey,1994.
Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc., New York, 1978.
Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, New York, 1978.
Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Department of the Army, US Army Corps of Engineers, Washington DC,2006.
Kamphuis, J.W., Introduction to Coastal Engineering and Management, 2000.

OSE2102 PORT AND HARBOUR STRUCTURES

Name of the course	M.Tech - Ocean and Coastal Safety Engineering
Name of subject	Port and Harbour Structures
Subject code	OSE2102
Semester	01
duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

OBJECTIVE:

- To provide students understanding of ports and harbour structures, design layout and area selection.
- To enable students apply these engineering principles in coastal, ocean and harbour engineering.

UNIT 1 - Ports and harbours as the interface between the water and land infrastructure- an infrastructure layer between two transport media- History of port growth- factors affecting growth of port- Classification of harbour- Planning, justification, volume and commerce of a port

UNIT II - Fundamentals of port structures design, design codes, guidelines and functional requirements. Structural, geotechnical, and materials considerations, for a variety of environmental conditions, including extreme wave and current environments, ice, and seismic loading- Dry infrastructures-Wet infrastructures –Support vessels- Meteorological, hydrological and oceanographic data required for port design- Determination of location- Economic viability.

UNIT III - Different types of Breakwaters, jetties & quay walls and dolphins- Hydrodynamic loading on such structures and Structural Design aspects.Functional designing of the various components of ports and marine terminals, including steel, concrete, timber, and stone structures. Design procedures for breakwaters, bulkheads, wharves, dolphins, piers, fender and mooring systems and revetments.

UNIT IV - Size and shape of harbour and turning basin – Type, location and height of Breakwaters – Location and width of entrance to harbour – Depth of harbour and navigational channel – Number, location and type of docks or berths or jetties- Shore facilities for Marine terminals and fishing harbours.

UNIT V- Case studies of breakwater failures and other types of structures. Partial safety Factors.Codal Requirements. Mooring, berthing and ship motion inside the port; model studies, physical and mathematical studies

TEXT BOOKS & REFERENCES

Muir Wood, A.M., and Fleming.C.A.,"Coastal Hydraulics Sea and Inland Port Structures", 1 st Edition, Hallstead Press, 2002.
Ozha&Ozha, "Dock and Harbour Engineering", 1 st Edition, Charotar Books, Anand., 1990
R. L. Silvester, "Coastal Engineering Volume I & II, Elsevier Publishers, 2000.
Per Brunn, "Port Engineering", 1 st Edition, Gulf Publishing Company, 2001
Muir Wood, A.M., and Fleming. C.A "Coastal Hydraulics Sea and Inland Port Structures" 1st Edition,Hallstead Press, 2002.
Hans Agershou "Planning and Design of Ports and Maritime Terminals": 2ed,: Thomas Telford

OSE2103 COASTAL PLANNING

Name of the course	M.Tech in Coastal and Harbour Engineering
Name of subject	Coastal Planning
Subject code	OSE2103
Semester	01
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

OBJECTIVE:

- To provide students understanding of social, economical and environmental considerations of coastal planning.
- Understand key issues in coastal planning like population growth, demographic change, infrastructure demand and climate change

UNIT 1

Introduction - Language of coastal planning, defining coastal areas, unique characteristics of coastal areas; History of coastal planning; Coastal management issues - population growth, urbanisation, coastal use, resource exploitation; Fisheries, forestry, gas, mining; Infrastructure, transportation; Shore protection, defence; Impact of human use; Pollution - industrial waste, sewage;

UNIT II

Coastal management issues-population growth and urbanisation-coastal use-resource exploitation-fisheries-forestry-gas-mining-infrastructure-transportation-shore protection-defence-Impact of human use-pollution-industrial waste-sewage-administration and legal issues.

UNIT III

Introduction to Cost and Benefit Analysis (CBA); CBA versus investment appraisal; Concept of external costs and benefits; Characteristics of Coastal Adaptation Projects against Climate Change; Concept of Ecosystem and Ecosystem Services; Demand and supply analysis; Framework for measurement and valuation; Economic framework to estimate the value of ecosystem services; Assessing the exposed Infrastructure against extreme weather events: flooding and infrastructure; Scenarios construction; Discounting and Net Present Value; Aggregation and weighing, discounting, net present value NPV and time scale of benefits and costs.

UNIT IV

Background to ICM – Sustainability and Sustainable ICM – ICM and Social Nature – Competing Claims and Visions of the Coast – ICM and Interdisciplinary-Livelihoods along the Coast – Local Knowledge – Sustainable Livelihoods – Vulnerability and Resilience – Changing Livelihood Dynamics.Understanding Institutions – Property Rights and Coastal Management –

UNIT V

Competing Property Rights and Resource Claims – Statutory and Customary Law – Institutional Change and Coastal Management.Existing Policies Governing the Coast – Good Governance – Making Sense of Policies – Reconciling Conflicting Agendas – Future of ICM.review of project planning and environmental clearance, environmental management plan, monitoring, compliance, variations from projected impacts, etc for an existing port

REFERENCES:

Kay, R and Alder, J. Coastal planning and management, Taylor and Francis, New York, 2005.

Schari, A. Environmental online communication, Sprimger, London 2010

Reeve, D.,Chadwick,A and Fleming, C. Coastal Engineering, Process, Theory and Design practices, Taylor and Francis, New York, 1998.

Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, New York, 1978.

Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Department of the Army, US Army Corps of Engineers, Washington DC,2006.

Kamphuis, J.W., Introduction to Coastal Engineering and Management, 2000.

OSE2104 MARINE INSTRUMENTATION

Name of the course	M.Tech in Coastal and Harbour Engineering
Name of subject	Marine Instrumentation
Subject code	OSE2104
Semester	01
Duration	17 WEEKS
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To provide students with a sound understanding of the use of electronic instrumentation and to familiarise the students with sensors commonly used in coastal and habour engineering applications.

UNIT 1

Types of marine instrumentation; in-situ and remote sensing instruments; operating platforms-fixed, ship, platform and buoy based; output formats; telemetry, velocity, wave height, wave period, tidal height, tidal period and ocean depth etc

UNIT II

Types of tide gauges: principles, operation and applications. Wave radars, rain gauge, seabed observatories Types of buoys; principles, application and operations for measurement of wind, temperature, current, wave height and direction and other environmental sensors, Satellite telemetry systems

UNIT III

Surveying equipment: echo-sounder, multibeam sonar, sub-bottom profiler, side scan sonar, boomers, sparkers, magnetometers, positioning and tracking equipment

UNIT IV

Types of acoustic transducers: piezoelectric and magnetostrictive; sonar transducers for echosounder, acoustic sub-bottom profilers, tide gauges, wave height and period sensors, data buoys, test and calibration of marine instruments.

UNIT V

Automatic Weather Station – Floats - Acoustic Navigation. Min Max thermometer – Aneroid Barometer – Wind cock – Velocity meter – sunshine – Evaporation pan – Radar storm warningsystem – Humidity meter – Rain gauge - GPS

REFERENCES:

Walt Boyce, "Instrumentation Reference Book" Butterworth Heinemann IIIrd edition, 2003
Srinvasan,D.(1989) Indegenous Instruments for Oceanographic measurements published by NIOT
WilliamJ.Emrey and Richard E. Thomson (2014) "Data Analysis methods in Physical Oceanography" Third ed.,

OSE2105 ADVANCED ENGINEERING MATHEMATICS

Name of the course	M.Tech - Ocean and Coastal Safety Engineering
Name of subject	Advanced Engineering Mathematics
Subject code	OSE2105
Semester	01
duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

OBJECTIVE:

- To enable students understand advanced engineering mathematics application.

UNIT 1 – SPECIAL FUNCTIONS

Introduction to Some Special Functions: Gamma function, Beta function, Bessel function, Error function and complementary Error function, Heaviside's function, pulse UNIT height
and duration function, Sinusoidal Pulse function, Saw tooth wave function, Triangular wave function, Halfwave rectified sinusoidal function, Full rectified sine wave, Square wave function.

UNIT II – FOURIER SERIES

Fourier Series and Fourier integral: Periodic function, Trigonometric series, Fourier series, Functions of any period, Even and odd functions, Half-range Expansion, Forced oscillations, Fourier integral

UNIT III – DIFFERENTIAL EQUATIONS

Ordinary Differential Equations and Applications: First order differential equations: basic concepts, Exact differential equations, Integrating factor, Linear differential equations, Bernoulli equations, Modeling , Orthogonal trajectories of curves.Linear differential equations of second and higher order: Homogeneous linear differential equations of second order, Modeling: Free Oscillations, Euler - Cauchy Equations, Non homogeneous equations, Solution by undetermined coefficients, Solution by variation of parameters. Series Solution of Differential Equations: Power series method, Theory of power series methods, Frobenius method.

UNIT IV- TRNASFORMATION TECHNIQUES

Laplace Transforms and Applications: Definition of the Laplace transform, Inverse Laplace transform, Linearity, Shifting theorem, Transforms of derivatives and integrals Differential equations, UNIT step function Second shifting theorem, Dirac's delta function, Differentiation and integration of transforms, Convolution and integral equations, Partial fraction differential
equations, Systems of differential equations

UNIT V- PARTIAL DIFFERENTIAL EQUATIONS

Partial Differential Equations and Applications: Formation PDEs, Solution of Partial Differential equations, Nonlinear PDEs first order, Some standard forms of nonlinear
PDE, Linear PDEs with constant coefficients, Equations reducible to Homogeneous linear form, Classification of second order linear PDEs. Separation of variables use of Fourier series, D'Alembert's solution of the wave equation, Heat equation: Solution by Fourier series
and Fourier integral

REFERENCES

Advanced Engineering Mathematics (8th Edition), by E. Kreyszig, Wiley
Engineering Mathematics Vol 2, by Baburam, Pearson
W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005)
R. V. Churchill and J. W. Brown, Fourier series and boundary value problems (7th Edition), McGraw-Hill (2006).
Applied Mathematics for Engineering and Physicists by Louis A. Pipes.
The use of Integral Transforms by I.N. Sneedon.

OSE2106 WAVE HYDRODYNAMICS

Name of the course	M.Tech - Ocean and Coastal Safety Engineering
Name of subject	Wave Hydrodynamics
Subject code	OSE2106
Semester	01
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

OBJECTIVE:

• To provide an overview of the wave hydrodynamics.

• To enable students apply these engineering principles in coastal, ocean and harbour engineering.

UNIT 1 FUNDAMENTALS OF WAVE THEORY

Conservation of mass, moment and energy; Euler and Bernoullis equations; Potential and stream functions; Classification of ocean waves; Linear wave theory - governing equation, boundary conditions and solutions, dispersion relation, constancy of wave period; Wave kinematics - wave celerity, water particle velocities, accelerations, displacements and pressures; Approximations for deep and shallow water conditions.

UNIT II HIGHER-ORDER WAVE THOERIES

Various perturbation schemes for solving water wave problems; Stokes' wave; Derivation of second order governing equations and outline of their solution; Mass transport and momentum principle (radiation stresses); Limitations of the Stokes' solution; Cnoidal and solitary waves; Wave breaking criteria.

UNIT III WAVE DEFORMATION

Wave transformations - shoaling, bottom friction and damping, refraction, reflection and diffraction; Wave breaking - types of breaking; Surf similarity parameter; Keulegan-Carpenter number, Ursell parameter, scattering parameter, Reynolds number.

UNIT IV WAVE FORCES

Wave loads – non-breaking wave forces on slender structures; Morison equation; Diffraction theory; Source distribution method.

UNIT V RANDOM WAVES

Spectral representation of ocean waves - determination of wave spectra, Wave spectra from measurements; Semi-empirical formulations of wave spectra; Statistics of wave heights;Representation in the time domain; Long-term wave statistics; wave energy spectra – PM, JONSWAP, ETC.

REFERENCES:

Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, inc., New York, 1978

Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994

Sarpkaya, T. and Isaacson, M., Mechanics of Wave Forces on Offshore Structures, Van Nostrand Reinhold Co., New York, 1981

Weigel, R.L.Oceanographical Engineering, Prentice Hall Inc, 1982.

Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, New York, 1978.

Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Department of the Army, US Army Corps of Engineers, Washington DC,

OSE2107 MARINE INSTRUMENTATION LAB

Name of the course	M.Tech - Ocean and Coastal Safety Engineering
Name of subject	Marine Instrumentation Lab
Subject code	OSE2107
Semester	01
duration	17 weeks
Lecture	Nil
Tutorial	Nil
Practical	03 hours/week
Exam- Internal	100
Exam- External	--

Objective:

- To enable students to acquire practical knowledge on theoretical aspects covered during the semester. Develop engineering skills to perform various activities covered in the course.

Strain Gauges, displacement transducers, pressure guages, wave guages, data acquisition, measurement of velocities using a Pitot tube and current meter in open channel, calibration of a venturiflume, wave data measurement and analysis, coastal field surveys, beach profile and bathymetry data analysis.

SEMESTER II

OSE2201 RESEARCH METHODOLOGY

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Research Methodology
Subject code	OSE2201
Semester	02
Duration	17 WEEKS
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

COURSE OBJECTIVES:

- Aware of the research process.
- Familiarize the tools and skills to investigate a research.
- Preparation of an effective report.
- Learn to focus on a research problem using scientific methods
- Learn basic instrumentation and data collection methods

UNIT I Introduction to Research Methodology.
Types of research, research methods Vs methodology - stages of research process. Literature review – Problem definition

UNIT II Sampling Fundamentals
Types of sampling: probability and non-probability sampling. Sampling theory, sampling distribution and sample size determination. Tools and techniques of data collection: Questionnaire and schedule for field surveys, interview, observation, simulation, experimental and case study methods. Collection, recording, editing, coding and scaling of data. Scale classification and types. Measurement of validity, reliability and practicality.

UNIT III Descriptive and Inferential Statistics
Data analysis and interpretation –testing of hypothesis, testing of population mean, variance and proportion –Z test – t test – F test - chi square test.– standard error of the estimate. Testing goodness of fit. Brief introduction to non parametric tests, factor analysis, discriminant analysis and path analysis (description only).

UNIT IV Meaning of Interpretation and Inference
Importance and care for interpreting results. Presentation of reports: structure and style. Parts of a research report. Guidelines for writing research papers and reports Ethics in research. Use of computers and internet in research.

UNIT V Writing Technical Reports and Thesis
Importance of effective communication-Applications of results of research outcome-Professional ethics- Ethical issues-Copy right-Royalty-Intellectual property rights and patent law-Trade related aspects of Intellectual property rights-Plagiarism-citation & acknowledgement -Reproducibility and accountability.

REFERENCES:

C. R. Kothari, Research Methodology, Methods and techniques (New Age International Publishers, New Delhi, 2004).
R. Panneerselvam, Research Methodology (Prentice Hall of India, New Delhi, 2011).
Ranjit Kumar, Research Methodology, A step by step approach (Pearson Publishers, New Delhi, 2005.
K. N. Krishnaswami, Appa Iyer and M Mathirajan Management Research Methodology:, Pearson Education, Delhi, 2010
M N Borse, Sree Nivas Publications Hand Book of Research Methodology :, Jaipur, 2004
William G Zikmund Business Research Methods:, South – Western Ltd, 2003
P K Majumdar Research Methods in Social Science, Viva Books Pvt Ltd, New Delhi, 2005
Norman Blaikie Analysing Quantitative Data, SAGE Publications, London, 2003

OSE2202 HEALH, SAFTEY AND ENVIRONMENT MANAGEMENT

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Healh, Saftey and Environment Management
Subject code	OSE2202
Semester	02
duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To educate students about how to reduce workplace hazards and to encourage the standard of safety health and environment, so as to aim 0% accident and 100% safety

UNIT I INTRODUCTION TO SAFETY ASPECTS

Introduction to safety, health and environmental management – Basic terms and their definitions – Importance of safety – safety assurance and assessment – safety in design and operation – organizing for safety; Hazard classification and assessment – hazard evaluation and hazard control

UNIT II ENVIRONMENTAL ISSUES IN SAFETY

Environmental issues and Management – atmospheric pollution – flaring and fugitive release – water pollution – drilling waste, produced water, oil spills, cooling water, processed water – soil waste – rock cutting, oil sludge, drilling soil waste, production waste – Environmental monitoring – environmental impact and decommissioning – environmental management

UNIT III SAFETY MODELLING AND DESIGN

Accidents modeling – release modeling – fire and explosion modeling – toxic release and dispersion modeling – accident investigation and reporting – concepts of HAZOP and PHA

Safety measures in design and process operations – inerting, explosion, fire prevention, sprinkler systems

UNIT IV RISK ASSESSMENT AND MANAGEMENT

Risk assessment and management – Risk picture – definition and characteristics – risk acceptance criteria – quantified risk assessment – hazard assessment – fatality risk assessment – Marine systems risk modeling – risk management principles and methods and concepts optimization for offshore petroleum industry

UNIT V CASE STUDIES

Analysis of causes of accidents, safety measures and risk assessment based on case studies from offshore and petroleum industry.

REFERENCES

Skelton, B. (1997). *Process safety analysis,* Gulf Publishing Company, Houston, 210pp.

Jan Erik Vinnem (2007). *Offshore Risk Assessment: Principles, Modeling and Applications of QRA studies.*Springer, 577pp.

TerjeAven and Jan Erik Vinnem.(2007). *Risk Management with applications from Offshore Petroleum Industry*.Springer, 200pp.

Jorg Schneider. (1997). *Introduction to Safety and Reliability of Structures.* Structural Engineering Documents Vol. International Association for Bridge and Structural Engineering (IABSE), 138pp.

Lees, F.P. (1996). *Loss Prevention in Process Industries: Hazard identification, Assessment and Control,* Vol. 1-3, Butterwort-Heinemann, Oxford, 1245pp.

Patin, Stanislav.(1999). *Environmental Impact of the Offshore Oil and Gas Industry.* Eco Monitor Publishing, USA, 425pp.

William J. Cairns (Ed), 1992. *North Sea Oil and the Environment: Development Oil and Gas Resources, Environmental Impacts and Responses*, International Council of Oil and the Environment.

OSE2203 MARITIME LAWS AND REGULATIONS

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Maritime Laws and Regulations
Subject code	OSE2203
Semester	02
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To give an insight to the students into various rules, regulations and guidelines related to ocean and coastal activities, statutory bodies, law application jurisdiction, types of pollution, laws and penalties.

UNIT I STATUTORY BODIES AND CONVENTIONS

International Maritime Organization (IMO) – Organization and its Role. UNCLOS III, High Seas – its meaning, Freedom of the High Seas meaning, fishing on the High Seas. Piracy – its object and where it can be committed, Right of hot pursuit. International Humanitarian Law and the Geneva Conventions of 1949, the First Geneva Convention (for wounded and sick), the Second Geneva Convention (Maritime Convention), the Third Geneva Convention (Treatment of POWs), the Fourth Geneva Convention (Civilians), and the Geneva Convention Act, 1960 (CGO 12/89).

UNIT II MARITIME ZONES AND REGULATIONS

The Maritime Zones. The Maritime Zones of India (Regulations of Fishing by Foreign Vessels) Act, 1981 and Rules framed there under (MZI Rules, 1982) The Territorial Waters, Continental Shelf, Exclusive Economic Zone and Other Maritime Zones Act, 1976.

UNIT III COAST GUARD CONTROLS ON COASTAL ACTIVITIES

Coast Guard Law – Procedures relating to Summary Trial, Board of Inquiry, Recording of Evidence, and Abstract of Evidence, hearing of charge and disposal. Fisheries Regulations and Fishing rights, fishing gear Materials – classification of fishing gears, trawl net-classification of trawl gear, Bull trawl. Protected marine species.

UNIT IV MARINE POLLUTION PREVENTION ACTS

The Environment (Protection) Act, 1986 – Definitions, General Powers of the Central Government, Prevention, Control and Abatement of Environmental Pollution, and Miscellaneous provisions. Maritime Conventions relating to maritime environment and prevention and control of marine pollution ratified by India. Offshore oil rigs and management of oil exploration. SPMs and oil/gas submarine pipeline.

UNIT V PENALTIES AND PROCEDURES

The Water (Prevention and Control of Pollution) Act, 1974 – Definitions, Prevention and Control of Water Pollution (Chapter V), Penalties and Procedure (Chapter VII).The Merchant Shipping Act, 1958 – General Administration (Part III), Certificates of Officers (Part VI), Collisions, Accidents at sea and liability (Part X and XA). Prevention and containment of pollution of the sea by oil (Part XIA), Wreck and Salvage (Part XIII).

REFERENCES:

D.W.Nixon, Marine and Coastal Law: Cases and Materials.,Praeger Publishers, 1994
Brown, J.R. Admirality Judges: Flotsam on the Sea of Maritime Law?.,
Wilson,D. and Sherwood, D., Oceans Governance and Maritime Strategy., Allen &Unwin, 2000
Juda.L, International Law and Ocean Use management.,Routledge 1996
Paleri., Integrated Maritime Security, Vij books India

OSE2204 COASTAL SURVEILLANCE AND RESCUE OPERATIONS

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Coastal Surveillance and Rescue Operations
Subject code	OSE2204
Semester	02
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To make students aware of different surveillance, patrol, search and rescue operations carried out in coastal and ocean regions.

UNIT I

Terminology & Definition. Scouting, Search and Patrol, Method of Search and Patrol, Tracking and Reconnaissance, Terms used in Scouting: Track spacing, Sweep width, Coverage factor. Factors affecting and Planning of Scouting Mission.Aim, Initiation of Scouting operations, Consideration in search design, Security of search, Economy in use of scouts, Accuracy of Navigation, Effectiveness of search.Area of Search.Entry probable area, Calculation of drift factor.

UNIT II

Search and Patrol Types of Search: Rectangular search, expanding square search, intercepting search. Types of patrol: Fixed station patrol, Linear patrol, Cross over patrol. Principles of boarding operations, Conduct of anti-smuggling/poaching operations. Gradual use of force.

UNIT III

Marine environment – Pollution response and pollution control. Concept for marine environment; Pollution response action; Coast Guard role; Legislation – NOS-DCP; National & International legislation including merchant shipping Act 1958; Environment protection Act; Indian port Act; Fund convention; MARPOL 73/78 annex-I; IOPC fund; Filing of claims. Coast Guard Pollution equipment – Pollution Response equipment with Coast Guard; Usage and operation

UNIT IV

Search & Rescue – Objectives and benefits of SAR; Component of SAR.SAR Organization – Various international conventions; Role of Coast Guard for SAR; National SAR organization; National SAR plan; National SAR Communication system. SAR Operation

UNIT V

Various maritime and aeronautical Distress; False alerts and their prevention; Sea-Air coordinated search Techniques; Planning and operations; Rescue planning and Operations; Rescue planning and operations; Mission orders.

REFERENCES

Ince, A.N., Topuz,E. Panayirci, E. and Isik,C. Principles of Integrated Maritime Surveillance Sustems. Springer 1998.

Survival at sea, pub: Australian maritime safety authority

“surveillance, Search and Rescue “, Conf. Proc. RINA, UK, 2003

OSE2205 COASTAL ENGINEERING LAB

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Coastal Engineering Lab
Subject code	OSE2205
Semester	02
Duration	17 Weeks
Lecture	NIL
Tutorial	NIL
Practical	04 hours/week
Exam- Internal	100
Exam- External	--

Objective:To enable students to acquire practical knowledge on coastal theoretical aspects covered during the semester. Develop engineering skills to perform various activities covered in that course.

CONTENTS

Grain size distribution of sand , Specific Gravity of sand, Maximum and minimum density of Sand, Specific Gravity of Marine clay, Liquid limit and plastic limit of Marine clay, Consolidation test, Triaxial shear test, Direct shear test , Hydrometer Analysis, Calibration of Wave Flume, Determination of Wave Characteristics, Experiments on marine structures, Experiments on Breakwaters

Remote Sensing and GIS, Introduction to satellite Images. Geo-referencing, Digitization, terrain analysis, spatial analysis.Introduction to data management and numerical modeling using MIKE

REFERENCES:

Walt Boyce, "Instrumentation Reference Book" Butterworth Heinemann IIIrd edition, 2003

Srinvasan,D.(1989) Indegenous Instruments for Oceanographic measurements published by NIOT

WilliamJ.Emrey and Richard E. Thomson (2001) "Data Analysis methods in Physical Oceanography" second ed., Elsevier.

Akroyd - "Soil Testing"; Alam Singh - "Soil testing"; Head - "Soil testing Vol I & II"

A. T. Ippen, “Estuary and Coastline Hydrodynamics,” McGraw-Hill Book Company, Inc., New York, 1966.

SEMESTER III

OSE2301 PROJECT PHASE I

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	PROJECT PHASE I
Subject code	OSE2301
Semester	03
Duration	17 weeks
Lecture	Nil
Tutorial	Nil
Practical	03 hours/week
Exam- Internal	100
Exam- External	---

Objective: To get students a hands on experience in practical design problems in any of coastal/harbor engineering aspects. The same project can be developed further into a full-fledged final semester M.Tech course project.

OSE 2302 INDUSTRIAL TRAINING

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Industrial Training
Subject code	OSE2302
Semester	During vacation period – summer/winter
Duration	2 weeks (10 working days)
Lecture	Nil
Tutorial	Nil
Practical	06 hours/day
Exam- Internal	100
Exam- External	---

Objective: To have the students an exposure in port and harbour activities, ship and cargo handling, coastal protection methods, etc.

OSE2303 SEMINAR

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Seminar
Subject code	OSE2303
Semester	03
Duration	17 weeks
Lecture	Nil
Tutorial	Nil
Practical	03 hours/week
Exam- Internal	100
Exam- External	--

Objective: To have the students an exposure in port and harbour activities, ship and cargo handling, coastal protection methods, etc.

SEMESTER IV

CHE2401 PROJECT PHASE II

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	PROJECT PHASE II
Subject code	CHE2401
Semester	04
duration	17 weeks
Lecture	Nil
Tutorial	Nil
Practical	24 hours/week
Exam- Internal	70
Exam- External	30

Objective: To give the students an opportUNITy to apply the knowledge which he/she acquired over the past three semesters in the programme to some design and analysis problems in the area of coastal/harbor engineering. These projects can be carried out in related industry and/or R&D organisations, which would help the student in job placement also. The students should always have a guide in the university, in addition to the guide at the place where the project is carried out.

ELECTIVES SEMESTER II

OSE2206 PORT PLANNING AND MANAGEMENT

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Port Planning and Management
Subject code	OSE2206
Semester	02
duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To provide a detailed analyses on planning and operating conditions for port. It introduce the students to the principles and practices of port operations and also provides with a comprehensive knowledge of the nature of port, its development and management. It also introduces students to the roles and functions of ports in the economic and transport infrastructure of a territory.

UNIT I PORT LAYOUT AND DESIGN ASPECTS

Seaport layout with regards to (1) wave action (2) siltation (3) navigability, berthing facilities. Design of Port Infrastructures: Design of port infrastructures with regards to (1) cargo handling (2) cargo storage (3) integrated transport of goods, planning multipurpose port terminals.

UNIT II ENVIRONMENTAL ASPECTS

Allowable wave conditions for cargo handling, wave conditions for human safety on quays and breakwaters, forecasting / hind casting of wave and current conditions for port operations, navigability, hazard scenarios; VTMS and management of computerized container terminal, safety & environment (handling of fire, oil spill, rescue, etc.).

UNIT III WATERWAYS

Maintenance of waterways, construction of environmentally engineered banks, dredging and disposal processing and storing of polluted dredged materials, development of river information services.

UNIT IV PORT INFRASTRUCTURE

Planning, construction, expansion and renovation of port and Inland Port Infrastructure. Global trade and port restructuring/reforms, impact of possible climate change scenarios, sustainable development strategies for cities and ports.

UNIT V

Safety regulations and procedure, Formal safety assessments inports,HAZAMT and the handling of dangerous goods, Accident reporting and investigation,Occupational safety and health

REFERENCES:

Muir Wood, A.M., and Fleming.C.A.,"Coastal Hydraulics Sea and Inland Port Structures", 1 st Edition, Hallstead Press, 2002.

Ozha&Ozha, "Dock and Harbour Engineering", 1 st Edition, Charotar Books, Anand., 1990.

S.Seetharaman, "Construction Engineering and Management", 4 thEdition ,Umesh publications, New Delhi, 1999.

Richand L. Silister, "Coastal Engineering Volume I & II, Elsevier Publishers, 2000. 3. PeraBrunn, "Port Engineering", 1 st Edition, Gulf Publishing Company, 2001 ****** 39 GVPCE(A) M.Tech. Infrastructure Engineering and Management 2014

OSE2207 MINING AND DREDGING

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Mining and Dredging
Subject code	OSE2207
Semester	02
duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To provide the students the knowledge of mining & dredging techniques in marine engineering.

UNIT I MINING METHODS

Introduction to mining, stages of mining, surface and underground mine development and mining methods. Design criteria for surface mines including scheduling, materials handling, waste dump and pit dewatering.

UNIT II MINE VALUATION AND MINERAL RESOURCE ESTIMATION

Aspects of geological conditions and geological control that relate to mineral resource estimates.Mineral resource estimation using conventional and geostatistical techniques.Mine valuation andpreliminary feasibility studies.

UNIT III SEABED MINING

Nature of deep sea bed resources - technical requirements of deep Ocean Mining - Deep sea mining systems - hydraulic and pneumatic life devices.

UNIT IV TYPES OF DREDGERS

Purpose and development of dredging,types of dredging, dredgers and their classification; Mechanical dredgers – Bucket dredger, Grab dredger, dipper dredger, rock breaker, back hoe dredger; Hydraulic dredgers: Plain suction dredger, cutter suction dredger, wheel dredger, trailer suction dredger; Pneumatic dredger,.

UNIT V DREDGING METHODS AND MATERIAL DISPOSAL

Special dredger equipments, underwater drilling and blasting. Improving the efficiency of surface blasting; Dredging methods - dredge pumps (centrifugal and Jet) - their characteristics and selection; Disposal of dredged materials- pipeline transport of solids - characteristics of solid - water slurry flor in pipelines.

REFERENCES:

Howard, L.Hartman, Introductory Mining Engineering, Pub: John Willey & Sons

Bray R N, Bates A D,and Land J M. Dredging – A hand book for Engineers, Arnold London. 1997.

Copper Practical Dredging.

Cormick, Vol. I & II, Dock and Harbour Engineering.

OSE2208 COASTAL ENGINEERING AND DESIGN

Name of the course	M.Tech in Coastal and Harbour Engineering
Name of subject	Coastal Engineering and Design
Subject code	OSE2208
Semester	02
duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To provide the students the knowledge of wave transformation, sediment transport, coastal protection methods and coastal structure design.

UNIT I

Waves in shallow waters – Shoaling, refraction, diffraction and breaking– Interaction currents and waves- near shore currents-wave run-up and overtopping

UNIT II

Coastal sediment characteristics- Initiation of sediment motion under waves- Radiation stress-wave set-up and wave set- down- mechanics of coastal sediment transport –Limits for littoral drift – Suspended and Bed Load – alongshore sediment transport rate – Distribution of alongshore currents and Sediment transport rates in Surf zone

UNIT III

Physical modeling in Coastal Engineering - Onshore offshore sediment transport – Stability of tidal inlets- Coastal features – Beach Features – Beach cycles– Beach Stability – Beach profiles -Coastal erosion, Planning and methods of coast protection works – Design of shore defense structures

UNIT IV

Non-breaking and breaking wave forces on coastal structures -Breakwaters- Classification, Design and application in coastal protection and harbor planning- Case studies on coastal erosion and protection-Generation, propagation and effect of tsunami.

UNIT V

Types of environmental loads- structural action of ocean structures- planning guidelines and design principles- regulations and codes of practice- foundation of ocean structures- sea bed anchors- dredging methods and equipments.

REFERENCES:

Horikawa,K., Coastal Engineering, University of Tokyo press, 1978
Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, New York, 1978
Kamphius,J.W. Introduction to coastal Engineering and Management, Advances on Ocean Engineering-Volume 16, World Scientific,2010
Reeve,D., Chadwick, A. and Fleming, C. Coastal Engineering-Processes, theory and design practice, Spon Press, Taylor & Francis Group, London & Paris,2018
Silvester,R. and Hsu,J.R.C. Coastal Stabilisation, Advances on Ocean Engineering-Volume 14, World Scientific, 1997.
Coastal Engineering Manual, U.S.Army Corps of Engineers, Washington, DC 20314-1000, Vol. 1 to 3, July 2003.

OSE2209 OCEAN STRUCTURES

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Ocean Structures
Subject code	OSE2209
Semester	02
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To provide the students the knowledge of ocean resources, regulation and codes &different materials used for marine applications.

UNIT I

Brief introduction of ocean and its resources and uses– near shore structures. Different types of ocean structures and systems (fixed, floating, semi-submersibles, submersibles, pipelines, etc.,) for exploitation of oil and gas, minerals and energy of planning, design and construction.

UNIT-II

Regulation and codes of practices - The environment and environmental forces - structural analysis - Foundation and seabed anchors - Towing, launching and installation.

UNIT-III

Different materials for marine applications: Metals, concrete and other materials for marine environment - Principles of corrosion, properties and selection of materials, welding of materials and metals for marine use. Non-destructive protection of materials

UNIT IV

Inspection and testing of marine structures- methods and equipments- non-destructive techniques.Repair and rehabilitation of marine structures.structural health monitoring of marine structures.

UNIT V

Introduction to stochastic dynamics of ocean structures- Stationary process- stochasticprocess- Random environmental processes-Response spectrum- Narrow band processreturn period- fatigue prediction-

References:

Ben C.Gerwick, Jr., Construction of Marine and Offshore Structures, CRC Press, New York

Reddy, D.V.andArockiasamy, M., Editors, Offshore Structures, Vol.I and II, Krieger Publishing Company, Florida, 1991

PerBruun, Port Engineering, Volume I and II, Gulf Publishing Company, 1989

OSE2210 MARINE ELECTRICAL AND ELECTRONIC ENGINEERING

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Marine Electrical and Electronic Engineering
Subject code	OSE2210
Semester	02
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To provide the students the knowledge of marine electrical & electronic equipments and also the communication systems used in marine field.

UNIT-I : Introduction

What is Electricity? Electrical Symbols, Electric shock and safe working practices, Voltage, Current, Resistance, Power, Energy, TorqueOhm's Law and its applications, Series and Parallel circuits, Numerical examples, Kirchhoff's Current and Voltage Law & its applications, Numerical Examples. Direct Current, Alternating Current, AC Single phase, three phase and multi phase system, Wye and Delta Connections, Power factor, Reactance & Resonance.DC Systems: Cells and Batteries, Different types of Marine batteries, charging systems for batteries, DC Distribution system on-board a vessel.DC Generation – DC Generators, AC-DC and DC-DC Converters, Alternative methods of DC Generation on-board vessels using Solar Photo-voltaic systems.

UNIT II: AC Fundamentals and Machines

Electromagnetic Induction, Faraday's laws of Electromagnetic induction, Lenz's law, Self inductance and mutual inductance, Fleming's Right & Left hand rules.Transformers- Parts and types of transformers, transformer ratio, Losses and efficiency of a transformer – AC Three phase Induction Motors – types and uses, AC Single phase Induction Motors – types and uses. Selection of motor for different on board applications, Starting methods- DOL, Star-Delta and VFD starter working and connections.AC Generation and Distribution System: Single phase and three phase AC generation system, three phase synchronous generators – parts, working. Automatic voltage regulator (AVR) - requirement and function Synchronisation of AC Generators- requirements, essential conditions, methods of synchronisation, Auto-synchroniser and Check synchronisation relay Ship's Main, Auxiliary and Emergency power distribution systems, Protection and annunciation systems- relays, circuit breakers, Fuses, MCB, MCCB, ELCB, etc.

UNIT III: Basic Electronics

Semiconductor materials, P-type and N-type crystals, Diodes & its types, Transistors & its types, FET, JFET, MOSFET, IGBT, Thyristors, ICs, OP-Amp circuits .Rectifiers:Half wave, Full wave and bridge rectifiers, Transistor as Amplifier & Oscillator, Modulators and Demodulators, Electronic Components – Passive and active components – Resistors, Capacitors, Inductors and its applications. Digital Electronics: Binary number system, Logic gates, Half & Full adder circuits, Parity Generator & checker, Multiplexer & De-multiplexer, Flip-Flops, Registers and counters.

UNIT IV: Marine Electronic Equipments

Principle and working of all Electronic Equipments used on board ship and its operation Navigational equipments: Radar, Global positioning system (GPS) Automatic Identification System (AIS)Communication equipment : MF, HF & VHF equipments, INMARSAT system.

UNIT V

Fish finding equipments:Echo Sounder/Fish finder, Net sounder,SONAR Emergency Equipments& GMDSS: Emergency Position Indicating Radio Beacon (EPIRB), Search And Rescue Radar Transponder (SART), Global Maritime, Distress & Safety System.

References:-

Electrical Technology Vol. I & II, B.L.Theraja& A.K. Theraja, S.Chand

Electronic Communication, Robert L.Shrader, McGraw-Hill

Fundamentals of Digital Electronics and Microprocessors, Anokh Singh &A.K.Chhabra, S.Chand

Marine Electronic equipments, C.D Joshy, CIFNETMarine Electrical Technology, Elstan.A.Fernandez,Shroff Publishers

OSE2211 Marine Corrosion and Prevention

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Marine Corrosion and Prevention
Subject code	OSE2211
Semester	02
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: On completion of the course the students are expected to have the knowledge on the Causes of corrosion.• Method of prevention during operation and during construction• Anti-corrosive paints• Corrosion in boilers and IC engines

UNIT I INTRODUCTION

Cathodic Protection – Sacrificial anodes protection – Impressed current system protection – Bimetallic corrosion – Design faults causing corrosion – corrosion of metals in sea water, metallic corrosion.

UNIT II HULL PLATE PREPARATION

Plate preparation during building and repair periods -Atmospheric corrosion Mill scale – flame cleaning – Acid Pickling – Blast cleaning – causes of paint failure – shipboard preparations for painting – power wire brushing – power discing – air hammer – high pressure water blasting – sand blasting shot blasting.

UNIT III MODERN PAINT TYPES

Basic composition of paint Albyd – bitumen or pitch – chlorinated rubber – coal tar epoxy – Epoxy – oleo resinous – phenolic – polyurethane – primers – vinyl – self polishing copolymers – shipboard paint systems – underwater AF paints – boot top anti corrosive paints – super structure paints.

UNIT IV CORROSION IN BOILER

Atoms & Ions, Ph value electrochemical corrosion, Direct chemical attack – Electro chemical attack – reason – remedial measures. Effect of salts & Grease in feed water.Effect of corrosion while boiler not in service – preservation to avoid corrosion. CORROSION IN MARINE DIESEL ENGINES: Corrosive wear of cylinder liners – Reasons and remedies – corrosion of Main Engine Jacket cooling spaces – Reasons and remedies – corrosion in bearings.

UNIT V CORROSION AND ITS PREVENTION

Mechanism of corrosion – Chemical corrosion – Electro chemical corrosion – Anomic &cathodic protection – forms of metallic coatings – anodizing – phosphating.

REFERENCES

Lavery, H.I.,"Shipboard operations" Institute of Marine Engineers Publication

Schweitzer, „ Fundamentals of Corrosion",1st Ed. Taylor & Francis, Indian Reprint 20129 (Yesdee Publishing Pvt. Ltd.)

M.E.P., "Corrosion For Marine & Offshore Engineers ", Marine Engineering Practice, Vol.02,Part 11, IMarEST, London

Francis Laurence LaQue , " Marine corrosion: causes and prevention", 1st Ed., Wiley, 1975

Claire Hellio, Diego M. Yebra, PinturasHempel S.A., "Advances in Marine Antifouling Coatings and Technologies", Woodhead Publishing, 2009 REFERENCES: 1. Pierre R. Roberge, "Corrosion Engineering Principles and Practice", 1st Ed.,McGraw-Hill, 2008 2. Zaki Ahmad, "Principles of Corrosion Engineering and Corrosion Control",1st Ed. Elsevier

ELECTIVES SEMESTER III

OSE2304 Marine Pollution Prevention & Control

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Marine Pollution prevention and control
Subject code	OSE2304
Semester	3
duration	17 weeks
Lecture	3 hours/week
Tutorial	1 hour/week
Practical	Nil
Exam- Internal	50
Exam- End semester(External)	50

Objective:
On completion of the course the students are expected to have the knowledge on the Causes of corrosion. Method of prevention during operation and during construction.Anti-corrosive paints, Corrosion in BOILERS and IC ENGINES.

UNIT I

Marine Pollution: Definition by GESAMP, major sources of pollution, dynamics, transport paths and agents. Sewage and Toxicology: Lethal and sub lethal effects of pollutants on marine organisms, evaluation of toxicity tolerance, bioassaybio-concentration, bio-accumulation and bio-magnifications. Enzymatic removal of hazardous organic substances from aqueous effluents.Domestic, Industrial, agricultural and aquaculture discharges, their composition and fate in the marine environment, toxicity and treatment methods, sewage disposal system.

UNIT II
Oil pollution: Sources and fate of oil, composition and toxicity of oil, biological effects treatment procedures. Behavior of oil; Properties of oil' Air surveillance' Calculation of quantity, direction and speed of slick' Weathering of oil; Spill Response and recovery; Oil spill contingency plan.

UNIT III
Thermal and radioactive pollutants: Source and characteristics, strategies for disposal of RNA and Heated effluents, biological effects and alternative uses of waste dumping, mining and dredging operations, their effects on the organisms and marine environment. Heavy Metal pollution- sources, distribution, fate- analytical approaches; Pesticide pollution classification, sources, distribution, fate and ecological impacts with special reference to marine fishes, birds and mammals.

UNIT IV
Environmental Management and Environmental Monitoring methods: Environment Management and auditing; Environmental monitoring methods for critical pollutants-objectives status limitations- biological indicators - natural bioaccumulations (mussel watch water quality assessment),

UNIT V
Toxicity and types of toxicity tests - Use of analytical instruments AAS, ICP, GLC, and Spectrofluorometer for analyzing Petroleum hydrocarbon, Pesticides, Heavy metals etc

REFERENCES

Advances in Water Pollution Research: B A Southgate,Pergamon,1st edn,1964.
Marine Environment Pollution: Richard A Geyer,Elssevier,1st edn,1981
Marine Outfall Systems:R A Grace,Prentice Hall,1st edn,1978
Ocean Dumping &Marine Pollution: M G Gross

OSE2305 MARINE NAVIGATION AND COMMUNICATION SYSTEMS

Name of the course	M.Tech Ocean and Coastal Safety Engineering
Name of subject	Marine Navigation and Communication Systems
Subject code	OSE2305
Semester	3
duration	17 weeks
Lecture	3 hours/week
Tutorial	1 hour/week
Practical	Nil
Exam- Internal	50
Exam- End semester(External)	50

Objective:

- To provide students with a sound understanding of the use of marine navigation.
- To familiarise the students with communication systems commonly encountered in marine engineering applications

UNIT I

Introduction-Principles of Navigation, basic map and globe related terminology, tools employed by mariners, types of navigation, phases of navigation, navigation terms and conventions. The earth, distance and direction on the earth, coordinates, finding latitude and longitude ,the navigational triangle, the time sight, navigation organizations, governments role, types of organizations-The International Maritime Organization(IMO), The National Imagery and Mapping Agency, The Radio Technical Commission for Maritime Services (RTCM) etc.

UNIT II Inputs of step, Ramp, Sinusoid, Pulse and Impulse, Exponential Function and their responses, Error Detector, Controller output elements.Torque Proportional to error. Electron tubes, transistors; principles of electronic circuits; amplifiers, oscillators, rectifier, tuned circuits – amplifiers, oscillators, transmission and reception.

UNIT III

Cathode Ray Oscilloscope, digital voltmeters, ammeter, ohmmeters and frequency meters, Multi-meters, Vacuum Tube voltmeter and signal Generators. MICROPROCESSORS-8085 Architecture, Programming, interfacing and Control of motors, Temperature/Speed control – Basics and Control mechanism of PLC.Introduction to control terms, Block diagrams for control systems, open loop and closed feedback control, comparison of closed and open loop.

UNIT IV

Communication as applicable to GMDSS (Global Maritime, Distress & Safety System), GPS(global positioning system), NAVSAT(navigational satellite), INMARSAT,LORAN-C, RADAR: direction finding, SONAR, Automatic Identification System (AIS),Search And Rescue Radar Transponder (SART), Echo Sounder, Emergency Position Indicating Radio Beacon (EPIRB).

UNIT V

Sonar Aids : Echo Sounder : Principle and working. Operational controls. Choice of site for echo sounder transducers. Errors causing display of faulty or unreliable sounding. Doppler Log : Description of the system. Errors and their remedies. Berthing aids : Brief description of systems using sound propagation and systems using radiowaves propagation.

REFERENCES:-

Electronic Communication, Robert L.Shrader, McGraw-Hill
Handbook for Marine Radio Communication, G.D.Less and W.G. Williamson, ISBN 1-85044-472.
Fundamentals of Digital Electronics and Microprocessors, Anokh Singh &A.K.Chhabra, S.Chand.
Marine Electronic equipments, C.D Joshy, CIFNET

OSE2306 COASTAL RESOURCES MANGEMENT

Name of the course	M.Tech Ocean and Coastal Safety Engineering
Name of subject	Coastal Resource Management
Subject code	OSE2306
Semester	3
duration	17 weeks
Lecture	3 hours/week
Tutorial	1 hour/week
Practical	Nil
Exam- Internal	50
Exam- End semester(External)	50

Objective:

- To provide students with a sound understanding of the use of coastal resources & their exploration.
- To familiarise the students with coastal management techniques in marine engineering applications

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-IINON-LIVING MARINE RESOURCES
Renewable vs. Non-Renewable Resources – Marine minerals – Placer deposits hydrocarbon deposits – Polymetallic nodules – Exploration and exploitation of natural minerals – Methyl/ Gas Hydrates – Sea Salt – Potential energy in the ocean – Salinity – Wave – Tides – Currents – OTEC

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-IVRESOURCE EXPLORATION AND EXPLOITATION
Marine geophysical methods – Sea floor resource exploitation – Exploitation of the oceans by human activities – overfishing – mining – ocean dumping – oil spills – coral reef bleaching – Marine archeology-optimal use of the land and water resources of coastal zone- ecological, cultural, historic, aesthetic values -CRZ-violation of CRZ-responsible fisheries in coastal zone.

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

References:
Beer, T., Environmental Oceanography: Second Edition (Marine Science Series), CRC Press, 1997.
Kennish, M.J., Pollution Impacts on Marine Biotic CommUNITies, CRC Press, New York, 1998.
Alongi, D.M., Coastal Ecosystem Processes, CRC Press, New York, 1998.
Eisma, D., Intertidal deposits, River Mouths, Tidal flats and Coastal Lagoons, CRC Press, New York, 1998.

OSE2307 COASTAL HAZARDS AND MANAGEMENT

Name of the course	M.Tech - Ocean and Coastal Safety Engineering
Name of subject	Coastal Hazards and Management
Subject code	OSE2307
Semester	03
Duration	17 WEEKS
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

OBJECTIVE:

• To provide students understanding of the materials and processes associated with the major natural geo-hazards: floods, earthquakes, volcanic activity, landslides, and coastal hazards
• To be able to discuss the ability to predict and manage these hazards based on case studies to demonstrate the intensity and management options for all the natural hazards under consideration.

UNIT I

Coastal Hazards; Causes of coastal hazards including geological, meteorological, oceanographic, and human-induced factors. Modes of occurrence of various coastal hazards like storm surges and erosion, locations and their origins and mitigation measures; Hurricanes, cyclones and typhoons; Most powerful storms on earth - different names; Storm surges and flooding in the Bay of Bengal, Bangladesh and New Orleans.

UNIT II

Historical records of tsunamis; Tsunamis in a global context, implications for different continents; Natural versus man-made hazards; Cyclones, coastal erosion, tsunami, flood, storm surges, sea level rise and others; Impacts of these on natural and human environment; Susceptibility of the world's coastal populations to tsunamis and solutions; Rip currents - characteristics and mitigation measures; Hydrodynamic characteristics of tsunamis and storm surges; Tsunami early warning systems; Construction of tsunami walls, levees etc. and mitigation effects.

UNIT III

Global sea level rise and responses; Global warming induced sea level rise; Disaster risk management in an age of climate change.Case studies of coastal disasters; Coastal management approaches for sea level related hazards; Causes of coast vulnerability to hazards; Cases in southeast Asia; Coastal hazard, vulnerabilities and resilience; Hazard prevention & control.

UNIT IV

Marine pollution, coastal salinities, water pollution, water quality; Classes of water pollutants, pollutant trace elements in water, arsenic, cadmium, lead, mercury and other inorganic chemicals in water; Acidity, alkalinity, salinity, sewage and water pollution; Ground water rise, causes of rising ground water; Oil spills and coastal disasters - prevention, control and recovery methods; Case study of disasters such as the BP oil spill in the Gulf of Mexico.

UNIT V

Cases of hazards in Indian coasts and applicable disaster management techniques; Vulnerability assessment in coastal disaster management - island risk management pertaining to cyclone, sea level rise and trends of coastal disaster management; Coastal early warning system; CommUNITy based disaster management system; Ethical dimensions and competing values; Growth management - tools, plans, principles; Mitigation - definition, approaches, types and examples; Coastal hazards management framework; Hazard mitigation planning.

References:

Norbert P. Psuty and Douglas D. Ofiara.(2002). Coastal Hazard Management.Rutgers university press.421 p.

John Heinz H. (2000). The Hidden coasts of coastal hazards- Implication for Risk Assessment and mitigation. Island Press.209 p

Beatley, T., David, J.B. and Anna, K.S. An Introduction to Coastal Zone Management, Island Press, Washington D.C., 2002.

Bryant, E., Natural Hazards, Cambridge University Press, New York, 2006.

Burby, R.J., ed., Cooperating With Nature: Confronting Natural Hazards With Land-Use Planning for Sustainable CommUNITies, Joseph Henry Press, Washington D.C. 1998.

Godschalk, D.R., et al., , Natural Hazard Mitigation: Recasting Disaster Policy and Planning, Island Press, Washington D.C,1999.

NC Division of Emergency Management, Hazard Mitigation Section, Risk Assessment and Planning Branch, Keeping Natural Hazards From Becoming

SE2308 MARINE SURVEYS AND MONITORING

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Marine Survey and Monitoring
Subject code	OSE2308
Semester	03
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To introduce the students to different aspects involved in a coastal survey and measurement systems, survey locations, survey parameters and standards, data acquisition, storage and processing.

UNIT I FUNDAMENTALS AND DATA HANDLING

Brief history – Importance – Fields of application of coastal surveying– Fundamental concepts – Survey Planning, Data collection, Data Processing, Data Analysis, Data Quality control, Data Products – Presentation

UNIT IISURVEY METHODS

The Earth – The Ellipsoid – The Local Sphere – The Geoid Datum – Types of Datum – Horizontal Datum – Vertical Datum – Datum Transformation – Coordinate Systems – Principles of Cartography – Projections – Genemonic – Conic – Cylindrical and Universal Transverse Mercator projection – Positioning Methods – Horizontal Control Methods – Vertical Control Methods – Instruments used – Topographic surveying applied to hydrography – Coastline delineation and – Coastal and Harbor Surveys

UNIT III ACOUSTIC SYSTEMS

Fundamentals of acoustic wave propagation in ocean waters – Sound velocity computation – Attenuation – Refraction and reflection – Frequency – Band width – Pulse length – Acoustic Instrument operation – Data recording and processing – Sidescan – Practical use of Sidescan – Plotting and measurements from Sonar records – MultibeamEchosounders – Feature detection and Sea floor classification

UNIT IV TIDES AND CURRENTS

Principles of Tides and Water Levels – Astronomical Tide Producing Forces – Tidal Characteristics – Non-tidal water level variations – Tide and water level Datum – Harmonic Analysis and Tide Prediction – Principles of Tidal Currents – Measurements and Prediction of Currents

UNIT V POLLUTION MONITORING

Methods for the assessment of coastal and marine pollution – Biological productivity and pollution monitoring – Water quality parameters: physical/ chemical/ biological properties, sampling techniques and problems – Nutrients, sewage and anoxia – Impacts of heavy metals – Pathways of radioactivity – Data storage and processing – Water quality standards

REFERENCES:

Ask, T., Handbook of Marine Surveying, Sheridan House, 2007.
Ghilani, C.D. and Wolf, P.R., Elementary Surveying: An Introduction to Geomatics, Prentice Hall, 2008.
Kennish, M.J., Practical Handbook of Marine Science, CRC Press, 2001.
Brekhovskikh, L.M. and Lysanov, Y.P., Fundamentals of Ocean Acoustics, Springer, 2003.
Dean, R.G. and Dalrymple, R.A., Coastal Processes with Engineering Applications. Cambridge

OSE2309 INTEGRATED COASTAL ZONE MANAGEMENT

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Integrated Coastal Zone Management
Subject code	OSE2309
Semester	03
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To understand the features and components of the natural, engineering and human aspects of the coast, the functions of components and relationship between them; To integrate the interpretation and analysis of the identified coastal issues to determine appropriate approaches to manage the humans and the coastal environment; To familiarize with the rules and regulations associated with coastal operations.

UNIT 1 COASTAL ZONE

Introduction to Coastal Zone – The need for ICM – Fundamental concepts – Interactions between coastal and ocean uses and conflicts – Definitions used in ICM – Glossary of terms in ICM.

UNIT II ENVIROMENTAL EVALUATION AND MANAGEMENT

Introduction – Pathway through the framework – Tools and techniques for ICM – ICM Processes – Stakeholder analysis – Environmental assessment – Problem tree analysis – Conflict resolution – Risk evaluation – Cost Benefit Analysis – Traditional management

UNIT III CASE STUDIES

Case studies (including field work) – Resource survey – Transect walks – learning through observation – Observing in practice – Participatory observation – Focus group discussions – Group ordering – Interpreting observations

UNIT IV SOCIAL AND NATURAL ASPECTS

Social science insights – Natural science insights – Horizontal integration – Vertical integration – Problem and objective analysis – Monitoring and evaluating management

UNIT V RULES AND REGULATIONS

Law of the Sea [UNCLOS] – Ocean Governance – Coastal regulation zones including small islands – Environmental policies – Spatial planning – Administrative and legal situations,

REFERENCES:

Cicin-Sain, B and Knecht, R.W., Integrated Coastal and Ocean Management: Concepts and Practices. Washington, DC, Island Press, 1998.

Clark, J.R. Coastal Zone Management Handbook, CRC Press Environmental Studies 1995.

Holder, S., Bearley, T., Brower, D.J. and. Schwab, A.K., An Introduction to Coastal Zone Management, 2nd edition.Island Press, Washington, DC, 2002.

Le Tissier, M.D.A., Ireland, M., Hills, J.M., McGregor, J.A., Ramesh, R. and Hazra, S. (eds).A Trainers' Manual for Integrated Coastal Management Capacity Development. Integrated Coastal Zone Management and Training (ICZOMAT) Project.The University of Newcastle upon Tyne, Newcastle upon Tyne, U.K. 2003.

Le Tissier, M.D.A., S. Coulthard, D. Rath and H.A.Y. Whyte (eds), Integrated Coastal Management – From post-graduate to professional Coastal Manager– a teaching manual. www.coastalprofs.eu, 2008.

Ramesh, R. and Purvaja, R., E-learning module on ICZM for UNESCO-IHE, The Netherlands, 2006.

Disasters: A Mitigation Planning Guidebook for Local Governments, 2003.

OSE2310 OCEAN DYNAMICS AND MODELING

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Ocean Dynamics and Modeling
Subject code	OSE2310
Semester	03
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To provide the students the knowledge of various modeling concepts and methods .

UNIT I

Introduction - modeling issues – numerical computing – accuracy – rate of convergence – efficiency; computational environment - governing equations – approximations and representations- parameterization - boundary conditions - physical and numerical modeling.

UNIT II

Finite difference methods – advection equations -computation errors - Implicit and explicit finite difference schemes- leap-frog scheme, Euler's scheme, Von Neumann method, Trapezoidal Implicit schemes - stability criteria- computational instability.

UNIT III

Concepts of ocean models - numerical modeling of ocean processes- Cox's model of Indian Ocean – POM, ROMS models. Model validation - data assimilation and calibration of models – nowcast, forecast and prediction- forecasting ENSO.

UNIT IV

Physics of ocean modeling, Lagrangian and Eularian approaches in modeling, diagnosticmodels, prognostic models, model domain, model initialization and model forcing, subgrid scale parameters

UNIT V

Indian Ocean boundary conditions, model forcing conditions over Indian ocean, status of operation models in Indian Ocean.

REFERENCES:

Numerical modeling of ocean circulation – Robert N. Miller - Cambridge University Press
Numerical methods for ocean circulation – Pond S. and Bryan - AGU Publications
Circulation models of lakes and inland seas – T.J. Simons - Ottawa : Department of Fisheries and Oceans, 1980.,RC Press

OSE2311 FIRE ENGINEERING AND EXPLOSION CONTROL

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Fire Engineering And Explosion Control
Subject code	OSE2311
Semester	03
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

OURSE OBJECTIVES:

- To provide students with a sound understanding of firefighting and salvage operations

UNIT I

Fire properties of solid, liquid and gases - fire spread - toxicity of products of combustion - theory of combustion and explosion – vapour clouds – flash fire – jet fires – pool fires – unconfined vapour cloud explosion, shock waves - auto-ignition – boiling liquid expanding vapour explosion – case studies – Flixborough, Mexico disaster, Pasedena Texas, Piper Alpha, Peterborough and Bombay Victoria dock ship explosions.

UNIT II

Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E – types of fire extinguishers – fire stoppers – hydrant pipes – hoses – monitors – fire watchers – layout of stand pipes – firestation-fire alarms and sirens – maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills – notice-first aid for burns.

UNIT III

Sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards – alarm and detection systems. Other suppression systems – CO2 system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. Portable extinguishers – flammable liquids – tank farms – indices of inflammability-fire fighting systems.

UNIT IV

Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design - exists – width calculations - fire certificates – fire safety requirements for high rise buildings –snookers.

UNIT V

Principles of explosion-detonation and blast waves-explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases, plant for generation of inert gasrupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO2) and halons-hazards in LPG, ammonia (NH3), sulphur dioxide (SO2), chlorine (CL2) etc.

REFERENCES

Gupta, R.S., “Hand Book of Fire Technology” Orient Longman, Bombay 1977.
“Accident Prevention manual for industrial operations” N.S.C., Chicago, 1982.
Dinko Tuhtar, “Fire and explosion protection” U.S.A.: John Wiley & Sons Inc
Fire fighters hazardous materials reference book Fire Prevention in Factories”, an Nostrand
Rein Hold, New York, 1991.
“Fire Prevention and fire fighting”, Loss prevention Association, India. Relevant Indian Acts and rules, Government of India.

OSE2312 OCEAN ENERGY

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Ocean Energy
Subject code	OSE2312
Semester	03
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

OURSE OBJECTIVES:

- To provide students with a sound understanding of Ocean Renewable Resources and its uses

UNIT I

Introduction to the ocean environment o Ocean circulation and stratification-Ocean habitat- Ocean economy - Ocean surface waves - Wave measurement - Linear wave theory - Wave spectrum - Wave energy resource- Ocean tidal currents - Current measurement - Current turbulence - Current energy resource - Site selection and characterization for ocean energy systems

UNIT II

Wave energy systems - Types of wave energy converters - Linear wave-structure interactions - Frequency domain analysis - Hydrodynamic coefficients and their computation - Time domain analysis - Phase control - Arrays - Model testing techniques - Marine current turbines - Types of marine current turbines - Hydrodynamic models (BEM, Lifting line, IBEM) - Hydrofoil data and analysis - Cavitation and strength - Design criteria - Multiple turbine interaction -Other types of energy systems - Ocean Thermal Energy Conversion (OTEC) - Energy from salinity gradient

UNIT III

Power take-off systems o Air turbines- Water turbines - High pressure hydraulic systems - Electrical generation - Energy storage - Mooring and anchoring systems - Farm layout - Offshore electrical grid and connection systems - Operation and maintenance of ocean energy devices - Offshore operations - Maritime safety issues

UNIT IV

Economic analysis - Cost - Financing mechanisms - Economic evaluation - Life-cycle assessment - Policy issues - Socio-economic impact - Licensing & permitting - Environmental impact assessment

UNIT V

Resource characterization - Site selection - Conceptual system development - Licensing procedure - Environmental impact - Economic analysis

REFRENCES

"Marine Renewable Energy: Resource Characterization and Physical Effects" Zhaoqing Yang, Andrea Copping, Springer
"Fundamentals of Ocean Renewable Energy: Generating Electricity from the Sea" Simon P. Neill, M Reza Hashemi, Academic Press
"Wave and Tidal Energy" Deborah Greaves, Gregorio Iglesias, Wiley Online Books,
"Handbook of Ocean Wave Energy" edited by Arthur Pecher, Jens Peter Kofoed, Springer
"Ocean Wave Energy Conversion: Resource, Technologies and Performance" Aurelien Babarit, ISTE Press - Elsevier

OSE2313 COMPUTATIONAL FLUID DYNAMICS

Name of the course	M.Tech in Ocean and Coastal Safety Engineering
Name of subject	Computational Fluid Dynamics
Subject code	OSE2313
Semester	03
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

OBJECTIVE: To provide an overview of various numerical techniques and hydrodynamic computations with code development and mathematical formulations

UNIT I

Fundamentals of fluid Mechanics and dynamics-purpose and philosophy, governing equations of fluid dynamics-models of flow-continuity equation-momentum equation-energy equation, equations of viscous flow(navier-stokes equation). Mathematical behaviour of partial differential equation-hyperbolic equations-parabolic equations-elliptic equations. CFD techniques-Lax Wendroff-pressure correction-simple algorithm.

UNIT II

Basics of numerical methods-finite difference method- Finite difference methods; different means for formulating finite difference equation; Taylor series expansion, integration over element, local function method; treatment of boundary conditions; boundary layer treatment; variable property; interface and free surface treatment; accuracy of f.d. method

UNIT III

Finite Volume Technique: Finite volume methods; different types of finite volume grids; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem. boundary element method-finite volume methods.

UNIT IV

Finite Element Methods: Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications. Methods of Solution:Solution of finite difference equations; iterative methods; matrix inversion methods;ADI method; operator splitting; fast Fourier transform.

UNIT V

Discretization of partial differential equation, transformations and grids, simple numerical techniques, applications to ocean engineering. Introduction to parallel machines and high performance computing.

REFERENCES:

Anderson D, Computational fluid Dynamics, McGraw Hill International Editions, 1995.
Anderson, John David, and J. Wendt. Computational fluid dynamics. Vol. 206. New York: McGraw-Hill, 1995.
Anderson, Dale, John C. Tannehill, and Richard H. Pletcher. Computational fluid mechanics and heat transfer,2016., Taylor and Francis
Pletcher, Richard H., John C. Tannehill, and Dale Anderson. Computational fluid mechanics and heat transfer, 2012., CRC Press

OSE2314 REMOTE SENSING & GEOGRAPHICAL INFORMATION SYSTEMS

Name of the course	M.Tech in Coastal and Harbour Engineering
Name of subject	Remote Sensing & Geographical Information Systems
Subject code	CHE2202
Semester	02
duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Objective: To introduce the students to the basic concepts and principles of various components of remote sensing; To provide an exposure to GIS and its practical applications in coastal engineering.

UNIT I INTRODUCTION TO GIS

Introduction to GIS; Basics of ArcGIS; Geographic Coordinates Systems; Data creation (including georeferencing images and on screen digitization), metadata; Addition of attributes; Geometrical calculations (e.g. calculation of area, perimeters);

UNIT II SPATIAL AND SURFACE ANALYSIS

Spatial analysis; Surface analysis (including interpolation, slope, etc); Identification of sea level prone areas by using Digital Elevation Model; Cartographic principles for making maps; Open source GIS softwares; Basic Remote Sensing.

UNIT III REMOTE SENSING

Remote sensing: Introduction, principles of remote sensing, EMR interaction with atmosphere and earth material – platforms – Airborne, space borne – satellites Ocean sat. Optical sensors and thermal sensors – Thermal detectors, thermal radiometer – thermal infrared Satellites - types and sensors…. scanner.

UNIT IV DATA HANDLING

Microwave sensors – Active and passive sensors – RADAR, LIDAR Data transmission and storage: Information system, transmission path loss – encoding and decoding – storage and retrieval, thematic mapper.

UNIT V DATA BASE MANAGEMENT SYSTEM

Data management systems: DBMS, Knowledge based system – geographic data bases

REFERENCES

Lilesand T.M. and Kiefer R.W., Re,ote Sensing and Image Interpretation, John Wiley and Sons Inc New York, 1999
James B Campbell, Introduction to Remote Sensing, Taylor and Francis, London 2011
Pradip Kumar Guha, Remote sensing for the beginners, East West Pres Pvt. Ltd., 2003
Franks S. Marzanic, Remote Sensing of atmosphere and ocean fro space: Models, Instruments and Techniques, Kulwer Academic Pub. 2002