

Annexure – A
Curriculum and Syllabus of M.Tech–Integrated Coastal Zone Management
FIRST SEMESTER

No	Course code	Course Title	Hrs/ week	Credits				Marks		
				L	T	P	C	INTL	EXTL	Total
1	CZM3101	Hydrodynamics and Coastal Oceanography	4	3	1	0	4	50	50	100
2	CZM3102	GIS and Remote Sensing	4	3	1	0	4	50	50	100
3	CZM3103	Statistical and modelling techniques	4	3	1	0	4	50	50	100
4	CZM3104	Principles of town and country planning	4	3	1	0	4	50	50	100
5	CZM3105	Coastal aquaculture Engineering	4	3	1	0	4	50	50	100
6	CZM3106	Coastal Resource Survey	4	3	1	0	2	100	--	100
7	CZM3108	Coastal Engineering Lab	4	0	0	2	2	100	--	100
		Total	26	15	5	6	24	450	250	700

Curriculum and Syllabus of M.Tech–Integrated Coastal Zone Management
SECOND SEMESTER

No	Course code	Course Title	Hrs/ week	Credits				Marks		
				L	T	P	C	INTL	EXTL	Total
1	CZM3201	Legal Mechanism of Coastal Zone Management	4	3	1	0	4	50	50	100
2	CZM3202	Environmental and Social Impact Assessment	4	3	1	0	4	50	50	100
3	CZM3203	Coastal Hazards and Disaster Management	4	3	1	0	4	50	50	100
4	CZM3204	Coastal Resource Management	4	3	1	0	4	50	50	100
5	CZM3205	Research Methodology	4	0	0	2	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	26	16	6	2	24	400	300	700

Curriculum and Syllabus of M.Tech–Integrated Coastal Zone Management
THIRD SEMESTER

No	Course code	Course Title	Hrs/ week	Credits				Marks		
				L	T	P	C	INTL	EXTL	Total
1	CZM3301	Project Phase I	4	0	0	4	6	100	--	100
2	CZM3302	Industrial Training	4	0	0	4	2	100	--	100
3	CZM3303	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	11	16	400	100	500

Curriculum and Syllabus of M.Tech–Integrated Coastal Zone Management
FOURTH SEMESTER

No	Course code	Course Title	Hrs/ week	Credits				Marks		
				L	T	P	C	INTL	EXTL	Total
1	CZM3401	Project Phase II	24	0	0	24	12	70	30	100
		Total	24	0	0	24	12	70	30	100

LIST OF ELCTIVES

Course No	Subject Name	L	T	P	C
Second semester					
CZM3206	Coastal ecosystem	3	1	0	3
CZM3207	Monitoring techniques-scientific techniques of analysis, surveying, instrumentation	3	1	0	3
CZM3208	Ocean Structures	3	1	0	3
CZM3209	Marine Corrosion and Prevention	3	1	0	3
CZM3210	Maritime Laws and Regulations	3	1	0	3
Third semester					
CZM3304	Marine Survey and Monitoring	3	1	0	3
CZM3305	Decision support and Management techniques	3	1	0	3
CZM3306	Pollution and Marine Environment	3	1	0	3
CZM3307	Marine Navigation and Communication Systems	3	1	0	3
CZM3308	Mining and Dredging	3	1	0	3
CZM330	Ocean Dynamics and Modeling	3	1	0	3
CZM3310	Fire Engineering And Explosion Control	3	1	0	3
CZM3311	Ocean Energy	3	1	0	3
CZM3312	Computational Fluid Dynamics	3	1	0	3

SEMESTER I

CZM 3101 HYDRODYNAMICS AND COASTAL OCEANOGRAPHY

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Hydrodynamics And Coastal Oceanography
Subject code	CZM 3101
Semester	01
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Concepts of computational fluid dynamics - Newton's laws, fundamentals of fluid dynamics: conservation laws of mass, momentum, and energy; derivation of equation of continuity of volume, - in viscid and viscous flows; boundary layers; vorticity dynamics; irrotational and potential flow. Equation of motion; pressure gradient, gravity and Coriolis forces; equations of continuity, inertial motion. Geostrophic equation and geostrophic flow. Currents with and without friction; Wind driven circulation, Ekman's solution, Sverdrup's solution, Munk's solution

Unit-II

Diffusion - stability and double diffusion. Criteria for static stability, dynamic stability. Introduction to classical hydrodynamics and continuum mechanics. Navier Stokes equations. Techniques for solution of Navier-Stokes equations on various scales of oceanic motion; potential theory, dynamics modeling and viscous and rotational processes.

Unit-III

Waves and ocean circulation, classification of water waves - two dimensional wave equation and wave characteristics - wave theories - small amplitude waves - finite amplitude waves - theories of wave generation - water particle kinematics - wave energy, power - shallow water wave transformation - reflection, refraction, diffraction, breaking of waves, wind-generated waves, wave statistics and spectral analysis, edge waves- coastal trapped waves - Kelvin & Rossby waves, wave hindcasting and forecasting, wave forecasting methods. Ocean circulation- vertical circulation - upwelling and sinking- large-scale (gyres) oceanic circulation, thermohaline circulation - balanced and unbalanced flows - turbulent flows - jets, vortices and eddies

Unit-IV

Coastal processes, factors influencing coastal processes, Coastal water level fluctuations - storm surge, tides, seiches, seasonal and long-term fluctuations, Surf scaling factors. Land and sea breeze. Tides and tidal currents, role of the oceans in climate change. Impact of physical processes on marine ecology in small and large spatial scales - impacts of the physical environment on production at all trophic levels - coastal oceanographic data collection

Unit-V

Coastal Geomorphology, sea coasts and shorelines, shoreline features, beaches, behavior of beach, wave action on beach sediments, movement of beach material, beach stability, effect of man on the beach. Long shore currents - rip currents, types of sediment transport, equation governing sediment transport, long-shore sediment transport, cross-shore sediment transport, sediment transport calculations, sediment budgeting. Mudbanks. Estuaries and its classification. Sediment cells, coastal zone management, environmental characteristics and conditions. Oceanographic aspects in coastal zone protection, impact assessment for coastal environment, coastal zone of India, EEZ and its importance, law of the sea. Various coastal protective measures

References:

1. Mani, J. S. (2012). Coastal Hydrodynamics, PHI Learning Pvt. Ltd.
2. Beach processes and coastal hydrodynamics, [John Stanley Fisher](#), [Robert Dolan](#) Dowden, Hutchinson & Ross, 1977
3. Ippen A. T. (1982) Estuary and Coastline Hydrodynamics. Iowa State University Press.
4. Massel, S.R. (1989). Hydrodynamics of Coastal Zones, [Elsevier Oceanography Series](#)
5. Introduction to Nearshore Hydrodynamics [Ib A. Svendsen](#) World Scientific, 2006
6. Sarpkaya, T. and Isaacson, M., Mechanics of Wave Forces on Offshore Structures, Van Nostrand Reinhold Co., New York, 1981

CZM 3102 REMOTE SENSING AND GIS

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Remote Sensing And GIS
Subject code	CZM 3102
Semester	01
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Remote Sensing - History and basic principles of Remote Sensing, Electromagnetic Radiation and Electromagnetic Spectrum, Energy Source and its Characteristics. Energy interaction with atmosphere and earth materials. Platforms and sensors, Resolutions. Types of satellites (LANDSAT, SPOT, IRS, NOAA, SEASAT, RADARSAT, QUICKBIRD etc), Basic elements of image interpretation (Tone, Texture, shape, size, Association, Pattern, Shadows, Topographic location)

Unit-II

Image Interpretation And Image Processing - Introduction, Types of Pictorial Data Products, Interpretation of Satellite Imagery. Image preprocessing (Geometric correction, Radiometric correction, Atmospheric correction), Image registration, Digital image processing (Image enhancement, Image fusion) Image classification (supervised classification, unsupervised classification)

Unit-III

Geographic Information System -History of GIS, Fundamentals of GIS, Components of GIS (Data, Hardware, software, Method, People), Spatial and non spatial data, Data input and editing, Data output. Data structure, Data source, Data acquisition, Geo-referencing of GIS data. GIS data management.

Unit-IV

Co-ordinate Systems and GIS Analysis- Maps, Different types of maps, Scale, Projections and Co-ordinate systems, Different types of projections (Conical, Planar, Cylindrical projections), comparison of raster and vector structures, Raster and vector analysis – Reclassification, Buffering, Overlay.

Unit-V

Remote Sensing and GIS Application for Coastal Environment - Coastal geomorphology, Mapping of Coral reef, Mangroves, Shoreline changes,. Coastal land use and land cover mapping. Active microwave remote sensing, Sea surface topography from radar altimetry, SAR imagery and application. Current Sensors and platforms.

References:

1. Lillesand, T.M. and Kieffer R.W., Remote Sensing and Image Interpretation. John Wiley & Sons, Inc., U.S.A, 2000.
2. Burrough, P.A and McDonnell R.A., Principles of Geographic Information Systems. Oxford Press, U.K, 1998.
3. Green, E.P., Mumby, P.J., Edwards, A.J. and Clark, C.D., Remote Sensing Handbook for Tropical Coastal Management – Coastal Management Sourcebooks (Ed.) Edwards A.J., UNESCO Publishing, France, 2000.
4. Robinson, I.S., Satellite Oceanography. John Wiley and Sons, 1985.

CZM 3103 STATISTICAL AND MODELLING TECHNIQUES

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Statistical And Modelling Techniques
Subject code	CZM 3103
Semester	01
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I: Basic Statistics

Scope of Statistics, types of data, measures of central tendency – mean, median, mode, quartiles, deciles and percentiles. Measures of dispersion-absolute and relative measures – range, quartile deviation, mean deviation, standard deviation and variance. Measures of Skewness and Kurtosis.

Unit-II: Probability and Probability Distributions

Elementary ideas on probability, Random variables and probability distributions – mean and variance. Theoretical distributions - Binomial, Poisson and Normal Distributions – fitting of the distributions.

Unit-III: Correlation and Regression

Bivariate linear correlation – Scatter diagram, pearson's correlation coefficient, rank correlation. Partial and multiple correlations.coefficient of determination, correlation matrix.

Linear Regression – simple and multiple – fitting linear regression equations using least square method. Standard error of the estimate.Properties of correlation and regression coefficients, applications of correlation and regression analysis.

Unit-IV: Sampling Techniques

Concepts of population and sample, methods of sampling – purposive and random, Sampling designs – simple random sampling, stratified sampling, systematic sampling, cluster sampling and two-stage sampling. Determination of sample size.

Unit-V : Statistical Inference

Concept of sampling distribution and standard error.Uses of standard error.Statistical Inference – estimation of parameters– point and interval estimation–confidence interval. Basic ideas on tests of hypothesis / significance – type I and type II errors – level of significance .Types of tests – one-tailed and two-tailed tests. Large sample tests for means, proportions and correlation coefficients. Tests for mean and variance based on student's t and F distributions. Chi-square tests for goodness of fit and independence. Analysis of Variance (ANOVA) – one-way and two-way classifications.Numerical Exercises on statistical &modelling techniques based on the above topics.

References:

1. Croxton, F.E.,Cowden,D.J. and Klein,S. Applied General Statistics, Prentice Hall.
2. Gupta,S.C. and Kapoor,V.K. (1978). Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
3. Nabendu Pal and SahadebSarkar(2013) .Statistics – Concepts and Applications. PHI Learning Private Limited, New Delhi.
4. Richard A.Johnson,Miller and Freunds (2007). Probability and Statistics for Engineers. Prentice Hall of India.
5. Zar,J.H. (1999). Biostatistical Analysis. Pearson Education.

CZM 3104 PRINCIPLES OF TOWN AND COUNTRY PLANNING

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Principles Of Town And Country Planning
Subject code	CZM 3104
Semester	01
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Introduction to town and country planning

History of town planning, pre historic (harappan and mohanjadaro) ancient Coastal cities (poompuhar,dwaraka,kodungallur) Pre independence town planning (Jaipur, Delhi), post-independence(Chandigarh).Eminent town planners and their contributions (pattrickgeddes,le Corbusier)Theory of urban planning-physical planning (spatial planning) components- land use planning. Factors determining the land uses, spatial pattern of urban land uses.

Unit-II

Environmental factors influencing town and country planning

Environmental factors influencing spatial pattern of land use: land forms-sand bars, water bodies (creeks) hills and vallies, drainage pattern-climate, geology, vegetation, soil. Economic base and employment.

Unit-III

Data collection and analysis

Introduction to planning standards Different land uses, existing land use and proposed land use, Various survey used for land use planning- data analysis and interpretation, zoning and zoning regulations socio-economic survey, map preparation.

Unit-IV

Infrastructure development and landscaping in coastal areas

Infrastructure in coastal areas: road, water ways, parks, open spaces. Landscaping of beaches, coastal tourism infrastructure, Basic amenities and recreational facilities. Energy-water supply, waste disposal

Unit-V

Preparation of master plan

Different kinds of master plans and their components. Procedure for preparation of master plans in coastal areas.

References:

1. Centre for research documentation and training, insttute of town planners, india,1996.UDPFI. Ministry of urban affairs and employment, Govt of india
2. Department of town and country planning, local self Govt Dept. Kerala state.2007
3. Development plan of cochin region, 1997
4. Fairbridge, R W 1960 the changing level of the sea. Scientific American vol 205,no 5 70-79
5. Benjamin p v 1988.geological soundness of indiscriminate land filling in cochin
6. Davies,JI,Geographical variation in coastal development. University of East Anglia.
7. Intergovernment panel in climatic change (IPCC) 1990.
8. Urban and regional planning by Peter hall.
9. Traffic Engineering and Transport planning by L R Kadiyal

CZM 3105 COASTAL AQUACULTURE ENGINEERING

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Coastal Aquaculture Engineering
Subject code	CZM 3105
Semester	01
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Coastal aquaculture development and management. Selection of cultivable species- Exotic species for aquaculture. Types of aquaculture farms - Freshwater - brackish water - coastal aquaculture farms. Site selection of coastal aquaculture farms. Tide fed farms and pump fed farms. Advantages and disadvantages. Design, layout and construction of aquaculture farms. Pond culture techniques – Cage and Pen culture systems.

Unit-II

Aquaculture systems- hydrology and morphology of soils-design of water supply and pond- intensive and recycling systems- farm construction- pond culture techniques-cage and pen culture systems construction - hatchery construction and operation-grow out systems-leading canal, pumping systems, main inlet, electrical distribution system, farm stead, approach road, peripheral dyke, diffuser tank, feeder canal dyke, inlets for culture ponds-aeration-biological filtration-Sterilization and disinfection.

Unit-III

Fluid Mechanics: definitions, Pumps: types of pumps. Classification of pumps: centrifugal, rotary, reciprocating, axial flow airlift and others. Water horse power: selection of a suitable pump for aquaculture. Numericals.

Unit IV

Farm machinery. Aquaculture in ponds, raceways, tanks and other structures. Recirculation aquaculture. Intensive culture systems and recycling systems. Types of aerators; surface aerators; paddle wheel aerators- diffuser aerators. Placement of aerators in aquaculture farms. Filtration: type of filters, mechanical, chemical and biological filters.

Unit V

Land leasing policies of maritime states, setting – up of a aquaculture farm in practice how to go about, purchase of land, registration, registration in MPEDA / BFDA for getting subsidy and technical guidance, getting electric connection and other practical considerations.

References:

1. Bose , S. N. Ghosh , Chih Ted Yang and A. Mitra. Coastal Aquaculture Engineering. Oxford-IBH, 2009.
2. Egna, H.S. and Boyd, C.E. Dynamics of Pond Aquaculture. CRC Press. New York, USA, 1997.
3. Lawson, T.B. Fundamentals of Aquacultural Engineering. CBS Publishers & Distributors. New Delhi, 1997
4. Lucas, J.S. and Southgate P.C. Aquaculture – Farming aquatic animals and plants. Fishing News Books, Blackwell Publishing Ltd. Oxford, UK, 2003.
5. Odd-Ivar Lekang . Aquaculture Engineering. Wiley - Blackwell Publishing Ltd. Oxford, UK , 2013.
6. Pillai, TVR & M.N. Kutty Aquaculture: Principles and Practices, 2nd Edition. Wiley- Blackwell Publishing Ltd. Oxford, UK, 2005.
7. Wheaton., Fredrick Warner: Aquacultural Engineering. Krieger Publishing Company, Florida , USA, 1993.

CZM 3106 COASTAL RESOURCE SURVEY

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Coastal Resource Survey
Subject code	CZM3106
Semester	01
duration	17 weeks
Lecture	Nil
Tutorial	Nil
Practical	04 hours/week
Exam- Internal	100
Exam- External	--

OBJECTIVES: • To introduce the students to the practical issues involved in a coastal survey based on ongoing cooperative research programs at various survey locations and associated instrumentation •

Coastal surveying at larger scales with precise instrumentation is also introduced. Triangulation stations - Positioning Methods - Horizontal Control Methods - Vertical Control Methods - Instruments used - Topographic surveying applied to hydrography- Global Positioning systems (GPS) - establishing control points - Intensification of control - Precise spirit leveling - Trigonometric leveling - Use of modern electronic surveying instruments - Total station -Coastal hydrographic surveying - LIDAR surveying for Digital Elevation Models (DEM) - Delineation of coastline and demarcation - Plotting and measurements from Sonar records - Harmonic Analysis and Tide Prediction - Principles of Tidal Currents - Measurements and Prediction of Currents

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CZM 3107 COASTAL ENGINEERING LAB

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	COASTAL ENGINEERING LAB
Subject code	CZM3107
Semester	01
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 theoretical aspects covered during the semester. Develop engineering skills to perform various activities covered in the course.

Strain Gauges, displacement transducers, pressure gauges, wave gauges, 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

CZM 3201 LEGAL PRINCIPLES OF COASTAL ZONE MANAGEMENT

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Legal Principles Of Coastal Zone Management
Subject code	CZM 3201
Semester	02
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Meaning and definition of coastal zone and integrated coastal zone management. Sources of International law relating to integrated coastal zone management- Customary principles of International law- International bilateral and multinational treaties – General principles of law recognized by civilized nations- recommendations and decisions of international organizations like UN, UNESCO, OECD and UNEP- Function of law in coastal zone management- Enforceability of international coastal zone management law.

Unit-II

International environmental treaties bearing on coastal zone development (basic features only)- principles adopted in Stockholm Conference 1972-UNCED 1992 – Agenda 21 Chapter 17- UNCLOS 3 part 12- UNESCO Convention on world cultural heritage – Bonn Convention – Ramsar Convention- MARPOL 73/78: SOLAS 1974 and Environmental conventions under IMO.

Unit-III

International treaties bearing on conservation of fisheries and jurisdiction over international waters- UNCLOS 3 provisions on conservation of living resources- coastal state jurisdiction over internal waters; territorial waters, contiguous zone, exclusive economic zone and continental shelf. UN fish stock agreement- FAO Code of conduct for responsible fisheries- convention on migratory species (basic features only) - regional and sub regional co-operation and plan of actions (IPOAS).

Unit-IV

Indian law bearing on protection of coastal zone environment – The Environmental Protection Act 1986 – coastal regulations notifications 2011 - Mandatory Environment Impact assessment for coastal zone development projects- legal protection of wet lands and paddy fields- Land use controls in coastal areas.

Unit-V

Indian laws bearing on fisheries (basic features only)- National deep ocean fisheries policy 2004- National Aquaculture Authority Act 2005- Merchant shipping (Regulation of Fishing Vessels Act 2001) –Indian Fisheries Act 1876- State Marine fisheries regulations act- T.C fisheries act- state fisheries policy.

References:

1. Report on Kerala laws bearing on environment
2. Relevant statutes and international conventions
3. FAO report on integrated coastal zone management
4. UNESCO principles on coastal zone development

CZM 3202 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Environmental And Social Impact Assessment
Subject code	CZM 3202
Semester	02
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Implications of global change for natural ecosystems and sustainable development –conflicting spatial, temporal and organizational issues - pressures on eco systems - influence natural resource availability and sustainability. Capacity developments to assess, model and predict - change in natural systems under human activity - consequences for human welfare -livelihood issues of communities, in the context of scenarios of future human activity and environmental change

Unit-II

Risks and vulnerabilities -Risk and Vulnerability Uncertainties - Risk Uncertainty as a Barrier to Decision Making- recognition and effective responses on the part of the urban planning and policy community - barriers to adaptation - Obstacles to Urban Adaptation .The Challenge of Adaptation Costs: Balancing Risks and Costs - Cost–Benefit Analysis, Adaptation and Action Plans - emerging techniques and technologies for mitigation and adaptation to the impacts of climate change - Climate Change Communication - Risk and Vulnerability Assessments - Policies and Legislation - strategies

Unit-III

Environmental Impact Assessment: Introduction, methodology of environmental impact assessment, environmental impact assessment processes, tools and frame works used in environmental impact assessments, assessing impacts and setting priorities, Cost benefit analysis: Introduction, methodology, The concept of value, Introduction, moral value and the economic systems, concepts of welfare, moral values for natural world, Generally applicable techniques of valuing environmental impacts -changes in productivity, cost of illness, cost effectiveness analysis, replacement and relocation costs, opportunity cost etc.

Unit-IV

Economic and ecological approaches: - Introduction, total economic value, economic valuation techniques, ecological evaluation environmental valuation technique, , Ecosystem services, The Equity Triangle to Social justice: For Access to, and Sustainable use of Coastal Resources - Economic Development (Tourism) - Livelihood/ Fishing – Environmental Protection/ Conservation.Beaches: beautification activities – sanitation activities. Economic measurement of environmental impacts-generally applicable, selectively applicable and potentially applicable techniques.

Unit-V

Vulnerability of systems and hazards to society - hazards to humans from coupled human–ecosystem change, carrying capacities - vulnerability issues, risk of degrading the sustainability of goods and services. Dynamics of interaction between inhabitants of coastal zone and outsiders – traditional fishing rights and exploitation of fishery by mechanized boats – poverty, lack of drinking water – poor housing – rehabilitation of fishermen folk near coastal zone areas.

References:

1. Menon, M., S. Rodriguez, A. Sridhar. 2007. Coastal Zone Management Notification '07 – Better or bitter fare? Economic and Political Weekly. September 22-28 (2007), Vol. XLII (38), pp 3838-3840.
2. Sorensen, J. “The international proliferation of integrated coastal zone management efforts”, Ocean and Coastal Management, 21, 1-3 PP45-80, 1993 [3] UNEP /GPA. “The State of the Marine Environment: Trends and Processes” UNEP /GPA, The Hague, 2006
3. A. Ramachandran, B. Enserinkb, A.N. Balchand Coastal regulation zone rules in coastal panchayats (villages) of Kerala. Journal of Ocean & Coastal Management 48 (2005) 632–653
4. Report of the committee chaired by Prof.M.S.Swaminathan to review the CRZ notification 1991(February 2005)
5. George G. Report on coastal zone management of India, Report by school of industrial fisheries,Cochin University of Science & Technology, Cochin, India. 2002

CZM 3203 COASTAL HAZARDS AND DISASTER MANAGEMENT

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Coastal Hazards And Disaster Management
Subject code	CZM 3203
Semester	02
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Introduction - The Nature of the Coast: Rocky Shores, Sandy Shores and Barrier Islands, Estuarine Ecosystems, Coral Reefs.

Unit-II

What is a Coastal Hazard? – Natural vs. Man-made hazard - Cyclones, Coastal Erosion, Tsunami, Flood, Storm surges, Sea Level Rise and Others – Impacts on Natural and Human environment

Unit-III

The Human Coast - Governance of the Coast: Institutions, Policy and Jurisdictions – Technological Hazards - Biological and Anthropogenic Coastal Hazards – Hazards and Disasters; Definition, Causes, Effects, Differences and their relationship to each other

Unit-IV

The southwest coast of India – possibilities of tsunamis and tidal waves – Lessons Learnt – Preparing for the Future.

Unit-V

Coastal Hazard Management: Ethical Dimensions - Competing Values - Growth Management: tools, plans, principles – Mitigation: Definition, approaches, types and examples – Coastal Hazards Management Framework - Hazard Mitigation Planning

References:

1. Beatley, T., David, J.B. and Anna, K.S. An Introduction to Coastal Zone Management, Island Press, Washington D.C., 2002.
2. Bryant, E., Natural Hazards, Cambridge University Press, New York, 2006.
3. Burby, R.J., ed., Cooperating With Nature: Confronting Natural Hazards With Land-Use Planning for Sustainable Communities, Joseph Henry Press, Washington D.C. 1998.
4. Godschalk, D.R., et al., Natural Hazard Mitigation: Recasting Disaster Policy and Planning, Island Press, Washington D.C, 1999.
5. NC Division of Emergency Management, Hazard Mitigation Section, Risk Assessment and Planning Branch, Keeping Natural Hazards From Becoming
6. Disasters: A Mitigation Planning Guidebook for Local Governments, 2003. (http://www.dem.dcc.state.nc.us/mitigation/planning_publications.htm)

CZM 3204 COASTAL RESOURCES MANGEMENT

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Coastal Resources Management
Subject code	CZM 3203
Semester	02
Duration	17 weeks
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

COASTAL AND MARINE RESOURCES

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

Unit-II

NON-LIVING MARINE RESOURCES

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-IV

RESOURCE 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:

1. Beer, T., Environmental Oceanography: Second Edition (Marine Science Series), CRC Press, 1997.
2. Kennish, M.J., Pollution Impacts on Marine Biotic Communities, CRC Press, New York, 1998.
3. Alongi, D.M., Coastal Ecosystem Processes, CRC Press, New York, 1998.
4. Eisma, D., Intertidal deposits, River Mouths, Tidal flats and Coastal Lagoons, CRC Press, New York, 1998.
5. Newman, M.C., Roberts Jr. M.H. and Male, R.C. (Eds.), Coastal and

CZM 3205 RESEARCH METHODOLOGY

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Research Methodology
Subject code	CZM3205
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
- 7.P K Majumdar Research Methods in Social Science, Viva Books Pvt Ltd, New Delhi, 2005
- 8.Norman Blaikie Analysing Quantitative Data, SAGE Publications, London, 2003

SEMESTER III

CZM3301 PROJECT PHASE I

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Design Project
Subject code	CZM3301
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.

CZM3302 INDUSTRIAL TRAINING

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Industrial Training
Subject code	CZM3302
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.

CZM 3303 SEMINAR

Name of the course	M.Tech in Integrated Coastal Zone Management
Name of subject	Seminar
Subject code	CZM3303
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

CZM 3401 PROJECT WORK

Name of the course	M.Tech in Integrated Coastal Zone Management
Name of subject	Project Work
Subject code	CZM 3401
Semester	03
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

CZM3206 COASTAL ECOSYSTEMS

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Coastal Ecosystems
Subject code	CZM3206
Semester	02
Duration	17 WEEKS
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Introduction to various coastal ecosystems: Ecological roles of mangroves, coral reefs, seagrasses, rocky shore, sandy shore. Coastal resources.

Unit-II

Developmental activities: Habitat destruction - ecological issues – multiples uses of coastal zone – urban settlement – industrial development – waste disposal – shore protection - and their impacts on coastal ecosystems – pollution, biodiversity loss. Restoration activities – coastal aquaculture – Coastal tourism – beach resorts – parks.

Unit-III

Coastal Ecosystem modeling: Various models applied in coastal ecosystem modelling and its dynamics.

Unit-IV

Ecosystem services: Definition. Key concepts – ecosystems, biodiversity and resilience. Categories of ecosystem services. Valuing ecosystem services. Issues in measuring ecosystem services. Environmental accounting. Eco Tender. Ecosystem services and natural resource management.

Unit-V

Coastal Zone Management & Coastal Regulation Zone Act: Integrated Coastal Zone Management (ICZM), its need and benefits, principles and objectives. ICZMP. development and implementation of management programs, wise use of the land and water resources of the coastal zone - ecological, cultural, historic, esthetic values, need for compatible economic development, Coastal Zone Management Act and Related Legislation - CRZ notification of India – amendments - Coastal Regulation Zone Act of state governments - National Coastal Zone Management Authority.

References:

1. Menon, M., S. Rodriguez and A. Sridhar, 2007. Coastal Zone Management Notification '07 – Better or bitter fare? Economic and Political Weekly. September 22-28 (2007), Vol. XLII (38), pp 3838-3840.
2. Sorensen, J. “The international proliferation of integrated coastal zone management efforts”, Ocean and Coastal Management, 21, 1-3 PP45-80, 1993 [3] UNEP /GPA. “The State of the Marine Environment: Trends and Processes” UNEP /GPA, The Hague, 2006.
3. Ramachandran, A., B. Enserink and A.N. Balchand, 2005. Coastal regulation zone rules in coastal panchayats (villages) of Kerala. Journal of Ocean & Coastal Management 48 (2005) 632–653.
4. Report of the committee chaired by Prof. M.S. Swaminathan to review the CRZ notification 1991 (February 2005).
5. George G., 2002. Report on coastal zone management of India, Report by School of Industrial Fisheries, Cochin University of Science & Technology, Cochin, India. 2002.
6. Ajith Joseph K., Balchand A.N., 2000. The application of coastal regulatory zones in coastal management—appraisal of Indian Experience. Journal of Ocean and Coastal Management 2000; 43:515–26.
7. Marale, S. M., R. K. Mishra, 2011. Status of Coastal Habitats and its Management in India. International Journal of Environmental Protection IJEP Vol.1 No.1 2011 PP.31-45.
8. The Natural Resources of Kerala, WWF Thiruvananthapuram, 1997, Page 122.
9. Tomy, P.J., 1996. The Kerala coast causes of its ruin and methods for revival. KAU.

CZM 3207 MONITORING TECHNIQUES - SCIENTIFIC METHODS OF ANALYSIS, SURVEYING, INSTRUMENTATION

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Monitoring Techniques - Scientific Methods Of Analysis, Surveying, Instrumentation
Subject code	CZM3207
Semester	02
Duration	17 WEEKS
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Scientific methods of analysis- measurement units of environmental parameters- qualitative and quantitative methods – Statistics, environmental modeling - geographical information systems - data collection and data banks; applications in coastal zones – quality standards – fixed and moving standards – standard fixing procedure – judgment and decision making based on standards - importance of meta data. Environmental Impact Assessment concepts and requirements of environmental impact assessment, - Morphological Impact Assessment - methodology of planning and carrying out an environmental audit - use of environmental management systems.

Unit-II

Surveying – methodology – monitoring – goals – planning field work – sampling techniques including rural appraisal techniques – primary and secondary data - data processing – inventory studies – sampling and storage protocols – analytical techniques – selection of environmental parameter – frequency – spatial distribution – urban and rural scenarios – socio-cultural and economic aspects –appraisal techniques. Surveyors technical skills – to collect and collate data: – Geodetic – Hydrographic, – Cadastral – integration of Cadastre and Land Registry -Spatial Data Infrastructures - assessment, interpretation and management

Unit-III

Instrumentation – in-situ measuring devices – remotely controlled devices – GPS - DGPS - shoreline mapping – Beach elevation and profiles - Physical parameters and instruments – oceanographic instruments -chemical procedures – instrumentation and devices – biological approach – ecosystem study – counting techniques – size and groups – biodiversity index – geological / geophysical methods and instruments.

Unit-IV

Marine Instrumentation - Types of marine instrumentation; in-situ and remote sensing instruments; operating platforms-fixed, ship, platform and buoy based; output formats; telemetry. Measurement of temperature, salinity, sound velocity, wave height, wave period, tidal height, tidal period and ocean depth etc. 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 Surveying equipment: echosounder, multibeam sonar, sub-bottom profiler, side scan sonar, boomers, sparkers, magnetometers, positioning and tracking equipment. 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

Coastal and ocean data sources and Institutions –tide tables and admiralty charts – Websites providing coastal and ocean data - NOAA, COADS, MEDS, NCAR, NODC, INCOIS, NHO, SAC, NRSC

References:

1. Anthony J. Richardson, Elizabeth S. Ampt, Arnim H. Meyburg . Survey Methods for Transport Planning
2. Peter Newsted, Sid Huff & Malcolm Munro ; Survey Instruments in IS. MISQ Discovery, Dec., 1998
3. ShanALi Surveying instruments
4. Stephen A. Dyer, Wiley Survey of Instrumentation and Measurement, John Wiley & Sons, 07-Apr-2004 - Technology & Engineering

CZM 3208 OCEAN STRUCTURES

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Ocean Structures
Subject code	CZM3208
Semester	02
Duration	17 WEEKS
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

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 sea bed 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:

1. Ben C.Gerwick, Jr., Construction of Marine and Offshore Structures, CRC Press, New York
2. Reddy, D.V.andArockiasamy, M., Editors, Offshore Structures, Vol.I and II, Krieger Publishing Company, Florida, 1991
3. PerBruun, Port Engineering, Volume I and II, Gulf Publishing Company, 1989

CZM 3209 MARINE CORROSION AND PREVENTION

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Marine Corrosion And Prevention
Subject code	CZM3209
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 Alkyd – 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 – Anodic & cathodic protection – forms of metallic coatings – anodizing – phosphating.

REFERENCES

1. Lavery, H.I., "Shipboard operations" Institute of Marine Engineers Publication
2. Schweitzer, ,, Fundamentals of Corrosion", 1st Ed. Taylor & Francis, Indian Reprint 2012 (Yesdee Publishing Pvt. Ltd.)
3. M.E.P., "Corrosion For Marine & Offshore Engineers ", Marine Engineering Practice, Vol.02, Part 11, IMarEST, London
4. Francis Laurence LaQue , " Marine corrosion: causes and prevention", 1st Ed., Wiley, 1975
5. Claire Hellio, Diego M. Yebra, Pinturas Hempel 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.

CZM3210 MARITIME LAWS AND REGULATIONS

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Maritime Laws And Regulations
Subject code	CZM3210
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 XI). Prevention and containment of pollution of the sea by oil (Part XII), Wreck and Salvage (Part XIII).

REFERENCES:

D.W.Nixon, Marine and Coastal Law: Cases and Materials.,Praeger Publishers, 1994
Brown, J.R. Admiralty 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

ELECTIVES SEMESTER III

CZM3304 MARINE SURVEYS AND MONITORING

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Marine Surveys And Monitoring
Subject code	CZM3304
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

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 II

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 – Genomonic – 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

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 – Multibeam Echosounders – Feature detection and Sea floor classification

UNIT IV

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

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

CZM 3305 DECISION SUPPORT AND MANAGEMENT TECHNIQUES

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Decision Support And Management Techniques
Subject code	CZM3305
Semester	03
Duration	17 WEEKS
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Management: - introduction, tasks, social responsibilities, planning, fundamentals of decision making, organizing and control of functions, management information systems - critical understanding of the contribution of economic, legal, socio-cultural, planning, management and environmental factors relevant to CZM.

Unit II

Current coastal zone management philosophies (in the UK, EU and world-wide) and their practical applications, Sustainable Development; - Stress Effects on Coasts and Seas; Economics and Human Influences on the Coastal Zone - Resolving Conflicting Interests - Sustainable Tourism - Spatial Planning and GIS;

Unit-III

Group and communication skills: definition of a group, physiological functions of groups, group goals, type of groups, social influences, communication in groups - direction of communication, communication networks effective group activity. Use of Information and Communication Technology for community awareness and education of the concepts of ICZM

Unit-IV

Multi-criteria appraisal: Introduction, multi-criteria in decision making, elements of multi criteria analysis, Evaluation. Participatory rural appraisal technique – basic philosophy, participation and empowerment, tools and techniques of participatory rural appraisal.

Unit V

Design methods for strategic decision making: Introduction, forecasting methods Application- financial and caring forecasting, cash flow forecasting analysis of cost behavior and cost prediction, interest rate forecasting and technological forecasting.

References:

1. Doody, J.P. Coastal Conservation and Management: An Ecological Perspective. Springer, 2000.
2. Stickney, R.R. and McVey, J.P. Responsible marine aquaculture. CAB Publishing, New York, USA, 2002.
3. Hanley, N., Shogren, J.F. and White, B., Environmental Economics – In Theory and Practice, Macmillan India Ltd, New Delhi, 1999.
4. Perman, R., Ma, Y. and McGilvray, J. Natural Resources and Environmental economics, Second edition, Addison Wesley Longman Ltd., Singapore, 1997.
5. Bowers, J. Sustainability and Environmental Economics, Addison Wesley Longman Ltd., Singapore, 1997.
6. Kolstad, C.D. Environmental Economics, Oxford University Press, New York, 2000.

CZM 3306 POLLUTION OF MARINE ENVIRONMENT

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Pollution Of Marine Environment
Subject code	CZM3306
Semester	03
Duration	17 WEEKS
Lecture	03 hours/week
Tutorial	01 hour/week
Practical	Nil
Exam- Internal	50
Exam- External	50

Unit-I

Marine Pollution: Definition, Pollutants and its classification. Organic wastes: BOD, COD, dilution factor, Fluctuations in DO, Consequences of organic discharges to estuaries with examples; Thames and Cochin estuary; Consequences of sludge dumping at sea. Sewage treatment: Primary, Secondary and Tertiary treatment processes. Solid waste pollution: Classification and disposal of solid wastes.

Unit-II

Industrial pollution: sources, nature and their treatment processes. Marine corrosion: Definition, corrosion reactions, classification of corrosion, factors affecting corrosion of metals in sea water and prevention of marine corrosion. The state of pollution of some seas in the world - The North sea, The Mediterranean sea and the Baltic sea.

Oil spills and cleanup: sources, major accidental spills, fate of spilled oil on the sea, consequences of oil spills and treatment of oil spills.

Pesticide pollution: inputs, fate in the sea, factors affecting the bioaccumulation of pesticides, DDT - the most wide spread pesticide, Impact of pesticides on the Environment, Mode of poisoning of pesticides, Methods to minimize pesticide pollution.

Unit-III

Conservative pollutants: Measures of contamination, toxicity, measurement of toxicity, acute and chronic exposure, Detoxification. Metal pollution in coastal waters (Hg, Pb, Cd, Cu, Zn and Fe).The present status of coastal pollution in India and future strategies.

Unit-IV

Radioactive Pollution: Sources, Classification and effects of radiation; Protection and control from radiation: Maximum permissible dose concept, dose limits, Disposal of radioactive wastes; Beneficial aspects of radiation and food safety.

Unit-V

Indicator organisms: Criteria for selection of indicator organism: Quantification of pollution load, basic pre-requisites, response to different pollution load and time integration capacity, Macro algae, crustaceans and molluscs as indicator organisms for monitoring of trace metal pollution; Harmful algal blooms : distribution, types of poisoning, effects and methods to minimize HABs in the sea. Monitoring strategies of marine pollution: Critical pathway approach and Mass balance approach. Standards in water quality: Assessment of pollution damage: the need, seriousness of damage, assessment of damage and methods and problems of measuring impact.

References:

1. A. M. Chakravarthy Biodegradation and detoxification of Environmental pollutants, CRC Press, 1928.
2. O. Kinne. 1984. Marine Ecology, Vol. V. Ocean Management 3&4, John Wiley & Sons.
3. Johnston R. (Ed.). 1976 Marine Pollution, Academic Press.
4. Patin. S.A. 1982 Pollution and Biological resources of the Oceans Butterworth & Co. Ltd.
5. Ruive M. (Ed.).1972. Marine Pollution and Fishing News Sea Life.
6. Venugopalan, V.K.: Pollution and Toxicology, CAS in Marine Biology, 1991.
7. Rita Colwell (Ed.) 1981. Biotechnology in Marine Sciences, Academic Press.
8. Prakesh P. Textbook of Marine Pollution.
9. Williams 1996. Introduction to marine Pollution Control. John Wiley
10. W.J. heya and E.R. Laws 1991. Handbook of pesticide toxicology V. I to III

CZM 3307 MARINE NAVIGATION AND COMMUNICATION SYSTEMS

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Marine Navigation And Communication Systems
Subject code	CZM3307
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 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.

UNIT II

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 III

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 IV

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 V

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).

REFERENCES:-

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

CZM3308 MINING AND DREDGING

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Mining And Dredging
Subject code	CZM3308
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 methods of mining and dredging in coastal and offshore regions.

UNIT I

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

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

UNIT III

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

UNIT IV

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

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 flow in pipelines.

REFERENCES:

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

CZM2309 OCEAN DYNAMICS AND MODELING

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Ocean Dynamics and Modeling
Subject code	CZM3309
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 Eulerian 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

CZM2310 FIRE ENGINEERING AND EXPLOSION CONTROL

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Fire Engineering And Explosion Control
Subject code	CZM2310
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, Pasadena 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.

CZM2311 OCEAN ENERGY

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Ocean Energy
Subject code	CZM2311
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

REFERENCES

“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

CZM2312 COMPUTATIONAL FLUID DYNAMICS

Name of the course	M.Tech Integrated Coastal Zone Management
Name of subject	Computational Fluid Dynamics
Subject code	CZM2312
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