UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY CHENNAI : : CHENNAI 600 025

REGULATIONS - 2009

CURRICULUM I TO IV SEMESTERS (FULL TIME)

M. TECH. COASTAL MANAGEMENT

I SEMESTER

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA9104	Statistical method for Water Resources	3	1	0	4
2	CM9101	Oceanography	3	0	0	3
3	CM9102	Socio-economic Aspects in Coastal Management	3	0	0	3
4	CM9103	Integrated Coastal Management: Learning from Practice	2	0	2	3
5	CM9104	Coastal Marine Resources and Management	3	0	0	3
6	E1	Elective I	3	0	0	3
		TOTAL	17	1	2	**19**

II SEMESTER

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CM9121	Coastal Ocean Survey and Monitoring	3	0	2	4
2	CM9122	Coastal Engineering	3	0	0	3
3	CM9123	Marine Ecology and Toxicology	3	0	2	4
4	CM9124	Coastal Hazards and Management	3	0	0	3
5	E2	Elective II	3	0	0	3
6	E3	Elective III	3	0	0	3
		TOTAL	18	0	4	**20**

III SEMESTER

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CM9131	Satellite Oceanography	3	0	2	4
2	CM9132	Coastal Environmental Impact Assessment	3	0	0	3
3	CM9133	Practical Training (4 Weeks)	0	0	0	1
4	CM9134	Project Work Phase I	0	0	6	3
5	E4	Elective IV	3	0	0	3
		TOTAL	9	0	8	**14**

IV SEMESTER

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	CM9141	Project Work Phase II	0	0	30	15
		TOTAL	0	0	30	**15**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 68

UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY CHENNAI : : CHENNAI 600 025

REGULATIONS - 2009

CURRICULUM I TO VI SEMESTERS (PART TIME)

M. Tech. COASTAL MANAGEMENT

SEMESTER I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA9104	Statistical method for Water Resources	3	1	0	4
2	CM9102	Socio-economic Aspects in Coastal Management	3	0	0	3
3	CM9103	Integrated Coastal Management: Learning from Practice	2	0	2	3
		TOTAL	8	1	2	**10**

SEMESTER II

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CM9121	Coastal Ocean Survey and Monitoring	3	0	2	4
2	CM9122	Coastal Engineering	3	0	0	3
3	E1	Elective I	3	0	0	3
		TOTAL	9	0	2	**10**

SEMESTER III

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CM 9101	Oceanography	3	0	0	3
2	CM 9104	Coastal Marine Resources and Management	3	0	0	3
3	CM 9133	Practical Training (4 Weeks)	0	0	0	1
4	E2	Elective II	3	0	0	3
		TOTAL	9	0	0	**10**

SEMESTER IV

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CM9123	Marine Ecology and Toxicology	3	0	2	4
2	CM9124	Coastal Hazards and Management	3	0	0	3
3	E3	Elective III	3	0	0	3
		TOTAL	9	0	2	**10**

SEMESTER V

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CM9131	Satellite Oceanography	3	0	2	4
2	CM9132	Coastal Environmental Impact Assessment	3	0	0	3
3	CM9134	Project Work Phase I	0	0	6	3
4	E4	Elective IV	3	0	0	3
		TOTAL	9	0	8	**13**

SEMESTER VI

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	CM9141	Project Work Phase II	0	0	30	15
		TOTAL	0	0	30	**15**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 68

ELECTIVES FOR M.TECH. (COASTAL MANAGEMENT)

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CM9151	Global Climate Change	3	0	0	3
2	CM9152	Biogeochemistry of the Coastal Margins	3	0	0	3
3	CM9153	Coastal Biodiversity	3	0	0	3
4	CM9154	Coastal Aquaculture and Engineering	3	0	0	3
5	CM9155	Air-Sea Interactions	3	0	0	3
6	CM9156	Coastal Resource Economics	3	0	0	3
7	CM9157	Corrosion Engineering	3	0	0	3

8	CM9158	GIS and Visual Basic Customization	2	0	2	3
9	CM9159	Numerical Modeling for Coastal Processes	2	0	2	3
10	AG9163	Environmental Hydrogeology	3	0	0	3
11	AG9166	Environmental Geochemistry	3	0	0	3
12	RS9155	Space Geodesy	2	0	2	3
13	RS9151	Microwave Remote Sensing	3	0	0	3

MA 9104 STATISTICAL METHODS FOR WATER RESOURCES L T P C

3 1 0 4

OBJECTIVE:

- To provide the students the concept and an understanding of statistics, probability and random processes, needed for mathematical modeling of water resources phenomena.

UNIT I EMPIRICAL STATISTICS 9+3

Types of Sampling – Description of discrete and continuous data – Measures of Central tendency and Dispersion for grouped and ungrouped data – Measures of position – Box and Whisker plot.

UNIT II ESTIMATION THEORY 9+3

Unbiased Estimators – Methods of Moments – Maximum Likelihood Estimation – Curves fitting by Principle of least squares – Regression Lines.

UNIT III TESTING OF HYPOTHESIS 9+3

Sampling distributions – Type I and Type II errors – Tests based on Normal, t, χ^2 and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 9+3

Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT V MULTIVARIATE ANALYSIS TECHNIQUES 9+3

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

TOTAL (L:45 +T:15): 60 PERIODS

REFERENCES:

1 Douglas C., Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, 3rd Edition, Wiley India, 2007.
2. R.A.Johnson and D.W.Wicheren, Applied Multivariate Statistical Analysis, 5th Edition, Pearson Educations Asia, 2002.
3. Prem S. Mann, Introductory Statistics, 5th Edition, John Wiley and Sons. INC Asia 2005
4. J.E. Freund Mathematical Statistics, 5th Edition Prentice Hall of India, 2001.
5. R.E. Walpole, R.H. Myers, S.L. Myers, and K.Ye, Probability and Statistics for Engineers and Scientists, 8th Edition , Asia, 2007.

CM9101 OCEANOGRAPHY **L T P C**
3 0 0 3

OBJECTIVE:

- To provide an overview of the fundamental principles of ocean science and technology.
- To provide the background needed to undertake coastal oceanographic investigations and sets them in context by incorporating case studies and sample problems based on local and global examples.

UNIT – I PHYSICAL OCEANOGRAPHY 9

Properties of Seawater – Coastal landforms – Ocean dynamics and upwelling Oceanographic instruments and methods – heat budget – General ocean circulation – Regional oceanography – waves, tides, sea level

UNIT – II CHEMICAL OCEANOGRAPHY 9

Descriptive Chemical Oceanography – Chemical composition of seawater – Thermodynamics – Carbonate system – Silicate Weathering – Redox equilibria – Biogeochemical cycles – Air-sea interactions – Trace metal geochemistry – Organic geochemistry – Tracers in the ocean – Minerals from the Sea

UNIT – III BIOLOGICAL OCEANOGRAPHY 9

Marine ecosystems –Phytoplankton diversity - Photosynthesis and primary productivity – Limiting nutrients in seawater – Harmful algal blooms – Global primary productivity – Zooplankton – Diel vertical migration – Seasonal vertical migration – Zooplankton and Secondary production – Nekton – Marine microbes

UNIT – IV GEOLOGICAL OCEANOGRAPHY 9

Structure of Earth's interior – Evolution of the Ocean-floor and plate-tectonic history – Geophysical techniques – Features of the seafloor – Stratigraphy – Geochronology – Continental drift – Sea level rise – Terrigenous and Biogenic sediments – Marine microfossils – Paleoceanography and global climate

UNIT – V ENVIRONMENTAL OCEANOGRAPHY 9

Definitions and development of the DPSIR framework – Drivers and Pressures – State and Impacts – Drivers – Response(s) and Discussion – Case Studies from Indian Coastline – Case Study from Cruise - Ocean Data View

TOTAL: 45 PERIODS

REFERENCES:

1. Garrison, T., Oceanography: An Invitation to Marine Science, 5th Edition, Brooks, 2007.
2. Gross, M.G. Principles of Oceanography, 7th Edition, Prentice-Hall, 1995.
3. Gross, M.G., Oceanography: A View of the Earth, 3rd Edition Prentice Hall
4. Thurman, H.V. Pinnet, P.R. 2006 Invitation to Oceanography, 1997.
5. Beer, T. Environmental Oceanography, 2nd Edition, 1997.

CM9102 SOCIO-ECONOMIC ASPECTS IN COASTAL MANAGEMENTL T P C
3 0 0 3

OBJECTIVE:

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

UNIT I ICM AND THE SOCIAL SCIENCES 9

Background to ICM – Sustainability and Sustainable ICM – ICM and Social Nature – Competing Claims and Visions of the Coast – ICM and Interdisciplinarity

UNIT II STAKEHOLDERS, SOCIETY AND SOCIAL CHANGE 9

Identifying Different Stakeholders – Social Categories (caste, class, gender, ethnicity) Social Organizations – Social Structure – Social Change on the Tamil Nadu Coast

UNIT III LIVELIHOODS AND CULTURE 9

Livelihoods along the Coast – Local Knowledge – Sustainable Livelihoods – Vulnerability and Resilience – Changing Livelihood Dynamics

UNIT IV INSTITUTIONS, PROPERTY AND LAW 9

Understanding Institutions – Property Rights and Coastal Management – Competing Property Rights and Resource Claims – Statutory and Customary Law – Institutional Change and Coastal Management

UNIT V POLICY AND GOVERNANCE 9

Existing Policies Governing the Coast – Good Governance – Making Sense of Policies –Reconciling Conflicting Agendas – Future of ICM

TOTAL: 45 PERIODS

REFERENCES:

1. Ostrom, E., Crafting Institutions for Self-Governing Irrigation Systems, Institute for Contemporary Studies Press, 1992.
2. Visser, L. (ed.), Challenging Coasts: Transdisciplinary Excursions into Integrated Coastal Zone Development, Amsterdam University Press, 2004.
3. Bavinck, M., Marine Resource Management: Conflict and Regulation in the Fisheries of the Coromandal Coast, Sage Publications, 2001.
4. 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.
5. Cicin-Sain, B and Knecht, R.W., Integrated Coastal and Ocean Management: Concepts and Practices, Washington DC, Island Press, 1998.

CM 9103	INTEGRATED COASTAL MANAGEMENT: LEARNING FROM PRACTICE	L	T	P	C
		2	0	2	3

OBJECTIVE:

- To be able to "see" 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.

UNIT I BASICS OF ICM 5+6

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 ICM FRAMEWORK AND PROCESSES 9+6

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 PRACTICE ORIENTED LEARNING 6+6

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 INTEGRATING DISCIPLINARY PERSPECTIVES 5+6

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

UNIT V REGIONAL AND GLOBAL COASTAL LAW AND POLICIES 5+6

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

TOTAL (L: 30 + P: 30): 60 PERIODS

REFERENCES:

1. Cicin-Sain, B and Knecht, R.W., Integrated Coastal and Ocean Management: Concepts and Practices. Washington, DC, Island Press, 1998.
2. Clark, J.R. Coastal Zone Management Handbook, CRC Press Environmental Studies 1995.
3. Holder, S., Bearley, T., Brower, D.J. and. Schwab, A.K., An Introduction to Coastal Zone Management, 2nd edition. Island Press, Washington, DC, 2002.
4. 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
5. Training (ICZOMAT) Project. The University of Newcastle upon Tyne, Newcastle upon Tyne, U.K. 2003.
6. 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.
7. Ramesh, R. and Purvaja, R., E-learning module on ICZM for UNESCO-IHE, The Netherlands, 2006.

CM 9104	COASTAL MARINE RESOURCES AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

UNIT I COASTAL AND MARINE RESOURCES 9

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 9

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 9

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 9

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

UNIT V COASTAL AND MARINE RESOURCE MANAGEMENT 9

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

TOTAL: 45 PERIODS

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 Estuarine Risk Assessment, Lewis Publishers, Washington D.C. 2002.

CM 9121	COASTAL OCEAN SURVEY AND MONITORING	L	T	P	C
		3	0	2	4

OBJECTIVE:

- To introduce the students to the practical issues involved in a coastal survey based on ongoing cooperative research programs at various survey locations and instrumentation
- Whilst in the past this project was primarily of a nautical charting focus, for oceanographic, environmental, geologic or coastal engineering purposes.

UNIT I BASICS OF COASTAL SURVEYING 7

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 PRINCIPLES OF POSITIONING 10+6

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 DEPTH DETERMINATION AND SEAFLOOR FEATURE DETECTION 10+6

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 WATER LEVELS AND FLOW MEASUREMENTS 9+6

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 BIOLOGICAL/ CHEMICAL INDICATORS OF COASTAL POLLUTION 9+12

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

TOTAL (L: 45 + P: 30): 75 PERIODS

REFERENCES:

1. Ask, T., Handbook of Marine Surveying, Sheridan House, 2007.
2. Ghilani, C.D. and Wolf, P.R., Elementary Surveying: An Introduction to Geomatics, Published by Prentice Hall, 2008.
3. Kennish, M.J., Practical Handbook of Marine Science, CRC Press, 2001.
4. Brekhovskikh, L.M. and Lysanov, Y.P., Fundamentals of Ocean Acoustics, Springer, 2003.
5. Dean, R.G. and Dalrymple, R.A., Coastal Processes with Engineering Applications. Cambridge University Press, 2002.

CM 9122	COASTAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To provide an overview of the analysis and design procedures used in the field of coastal engineering.
- To introduce the processes of including coastal and estuarine circulation, coastal and shelf waves, surf zone hydrodynamics, sediment transport, hurricane-induced storm surge and inundation, beach nourishment etc
- To enable students apply these engineering principles to solve the problems in this environment such as shoreline erosion, natural flooding hazards, water quality deterioration and coastal habitat evanescence.

UNIT I INTRODUCTION TO COASTAL ENGINEERING 6

Introduction - wind and waves – Sea and Swell - Introduction to small amplitude wave theory – use of wave tables- Mechanics of water waves – Linear (Airy) wave theory.

UNIT II WAVE PROPERTIES AND ANALYSIS 7

Introduction to non-linear waves and their properties – Waves in shallow waters – Wave Refraction, Diffraction and Shoaling – Hindseast wave generation models, wave shoaling; wave refraction; wave breaking; wave diffraction random and 3D waves- Short term wave analysis – wave spectra and its utilities - Long term wave analysis- Statistics analysis of grouped wave data.

UNIT III COASTAL SEDIMENT TRANSPORT 10

Dynamic beach profile; cross-shore transport; along shore transport (Littoral transport), sediment movement

UNIT IV COASTAL DEFENSE 11

Field measurement; models, groins, sea walls, offshore breakwaters, artificial nourishment - planning of coast protection works - Design of shore defense structures –Case studies.

UNIT V MODELING IN COASTAL ENGINEERING 11

Physical modeling in Coastal Engineering – Limitations and advantages – Role of physical modeling in coastal engineering – Numerical modeling – Modeling aspects – limitations – Case studies using public domain models

TOTAL: 45 PERIODS

REFERENCES:

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

CM 9123	MARINE ECOLOGY AND TOXICOLOGY	L	T	P	C
		3	0	2	4

OBJECTIVE:

- To provide an understanding of the interactions of living and non-living components of tropical marine environments and how these shape/form different ecosystems
- To introduce the basic ecological principles to explain the interdependencies of species, populations, communities and ecosystems.
- To introduce the various methods and tools that determines the toxicity of various pollutants and the ultimate fate of pollutants in marine organisms

UNIT I LIFE ON EARTH 9

Big Bang Theory and Origin of Universe – Origin of Life on earth – Mass Extinctions –Charles Darwin's Galapagos Islands – Principles of Evolution – Evidence of Evolution – Mechanisms of Evolution – Types of Evolution – Speciation and Types

UNIT II GENERAL ECOLOGY 9+6

Fundamentals of Ecology – Basic Ecological principles – Energy and Nutrient Relations Thermodynamics – Population distribution, dynamics and growth – Competition, predation, mutualism – Food web, trophic transfer

UNIT III COASTAL AND ISLAND ECOLOGY 9

Estuaries and Saltwater Marshes – Adaptations of Estuarine and Saltwater Organisms – Seagrass Ecosystem – Mangrove Ecosystem – Barrier Islands, Biogeography – Coral Reefs and Atolls – Open Ocean – Marine Benthos and Tidal Communities – Human Impact on the Marine Environment

UNIT IV MARINE ECOTOXICOLOGY 9+12

General principles and overview of toxicology – Aquatic toxicology testing methods – Chemical uptake, transformation, elimination, and accumulation – Marine and estuarine invertebrate toxicity tests

UNIT V TOXICITY TESTS 9+12

Bioassays and biomarkers – Multispecies test systems – Biodegradation – Factors influencing bioaccumulation and trophic transfer – Sub-lethal effects – Acute and chronic lethal effects – Risk assessment of contaminants on communities and ecosystems

TOTAL: (L: 45 + P: 30): 60 PERIODS

REFERENCES:

1. Barnes, R.S.K. and Hughes, R.N.. Introduction to Marine Ecology, 3rd ed., Blackwell Publishing, 1999.
2. Wright, D.A., Welbourne, P. Environmental Toxicology, Cambridge University Press, 2002.
3. Kaiser, M.J., Attrill, M.J., Jennings, S., Thomas, D.N., Barnes, D.K.A., Brierly, A.S., Polunin, N.V. Raffaelli, D.G., Williams, P.J. 2006. Marine Ecology: Processes, Systems, and Impacts, Oxford University Press
4. Jonathan B. 1977, The Ocean Environment, H. W. Wilson Publishing Co., Michigan.
5. Nybakken, J.W. 1997, Marine Biology: An Ecological Approach, 4th ed., Addison Wesley Longman, Inc.
6. Odum, E.P., and Barrett G.W., Fundamentals of Ecology. 5th Edition, Thomson Brooks/Cole,2005.

CM 9124	COASTAL HAZARDS AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To provide students understanding of the materials and processes associated with the major natural geohazards: 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 INTRODUCTION 9

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

UNIT II COASTAL HAZARD 9

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 9

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 CASE STUDIES 9

Examples – Case Studies – Lessons Learnt – Preparing for the Future

UNIT V COASTAL HAZARD MANAGEMENT 9

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

TOTAL: 45 PERIODS

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 Disasters: A Mitigation Planning Guidebook for Local Governments, 2003. (http://www.dem.dcc.state.nc.us/mitigation/planning_publications.htm)

CM 9131	SATELLITE OCEANOGRAPHY	L	T	P	C
		3	0	2	4

OBJECTIVE:

- To describe the physical principles of remote sensing including: orbits, electromagnetic radiation, diffraction, electro-optical, and microwave systems will be taught.
- To provide the oceanographic applications of satellite remote sensing through field surveys and hands-on training of GIS and remote sensing tools in coastal environment

UNIT I REMOTE SENSING 7

History and Principles of Remote Sensing – Spectral Characteristics – Analysis & interpretation – Sensors and Platforms – Applications

UNIT II IMAGE PROCESSING 7+6

Data formats – Image resolution – Analogue image processing – Digital image processing: Feature extraction, radiometric, geometric and atmospheric corrections – Spectral and multi spectral enhancement techniques – Spatial processing – Classification

UNIT III GEOGRAPHIC INFORMATION SYSTEMS 9+6

Introduction – Essential Elements of a GIS – Data Acquisition and Data Input – Data Management – Data Quality

UNIT IV OCEANOGRAPHIC APPLICATIONS OF SATELLITE REMOTE SENSING 10+6

Visible wavelength “Ocean Color” Sensors – Sea surface temperature from infrared scanning radiometers – Passive microwave radiometers – Satellite altimetry of sea surface topography – Active microwave sensing of sea surface roughness – Altimeter as a surface-roughness sensor – Synthetic aperture radar – Microwave Scatterometers – Future oceanographic satellite systems

UNIT V REMOTE SENSING APPLICATION TO COASTAL ENVIRONMENT 12+12

Introduction – Field Surveys – Water Column Correction Techniques – Methodologies for Defining Habitats – Mapping Coral Reefs, Macroalgae and Mangrove – Coastal Landuse/ land cover mapping – Coastal geology and geomorphology – Digital Elevation Models – CRZ mapping - Cost effectiveness of Remote Sensing for Coastal Management

TOTAL (L: 45 + P: 30): 75 PERIODS

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 3. (Ed.) Edwards A.J., UNESCO Publishing, France, 2000.
4. Robinson, I.S., Satellite Oceanography. John Wiley and Sons,1985.
5. Martin, S., An Introduction to Ocean Remote Sensing. Cambridge University

Press, 2004.

CM 9132	COASTAL ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

UNIT I INTRODUCTION 9

Environmental Impact Assessment (EIA) – Environmental Impact Statement (EIS) – Environmental Risk Assessment (ERA) – Legal and Regulatory aspects in India – Types and limitations of EIA – Terms of Reference in EIA – Issues in EIA – National – Cross-sectoral – Social and cultural

UNIT II COMPONENTS AND METHODS 9

Methods for Impact Identification – Matrices, Networks and Checklists – Prediction and assessment of Impacts on Air, Noise, Water, Soil, Biological and Cultural environments –Public participation in environmental decision making – Decision Methods for Evaluation of Alternatives – Mitigation measures – Environmental Monitoring Plan

UNIT III QUALITY CONTROL AND INSTITUTIONAL ARRANGEMENTS 9

Trends in EIA practice and evaluation criteria – Capacity building for quality assurance – Expert system in EIA – use of regulations and AQM – QAQC -Roles, scope and contributions of public involvement – Indigenous involvement in decision-making processes – NGO's roles and responsibilities in EIA – Constitution and law

UNIT IV EIA ESSENTIAL SECTORS AND ISSUES 9

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

UNIT V CASE STUDIES 9

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

TOTAL: 45 PERIODS

REFERENCES:

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York,1996.
2. Petts, J., Handbook of Environmental Impact Assessment, Vol. I and II, Blackwell Science, London,1999.
3. The World Bank Group, Environmental Assessment Source Book, Vol. I, II and III, The World Bank, Washington,1991.
4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley Interscience, New Jersey,2003.
5. Wood, C., Environmental Impact Assessment/ A Comparative Review, Prentice Hall, Pearson Education Limited, 1995.
6. Glasson, J., Introduction to Environmental Impact Assessment: Principles and Procedures, Process, Practice and Prospects, UCL Press, 1999.
7. Calow, P., Handbook of Environmental Impact Assessment, Blackwell Science, 1999.

CM 9151	GLOBAL CLIMATE CHANGE	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

UNIT I INTRODUCTION 7

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

UNIT II OCEAN-ATMOSPHERE INTERACTIONS 10

Role of the oceans in climate -Introduction to ocean-atmosphere interactions – Global radiation balance – Heat and fluids in the atmosphere – Air masses and weather systems – Ocean-atmosphere coupling and ocean surface circulation

UNIT III OCEAN CURRENTS AND CIRCULATION 10

Ocean currents – Thermohaline circulation and deep water masses – Ocean heat budgets and water mass mixing – Sea ice – Air-sea interactions – Solubility and physics of air-sea gas exchange- Observations: Ocean Climate Change and Sea Level

UNIT IV CLIMATE SYSTEMS 9

Predictability and chaos in climate systems – Milankovitch Cycles - North Atlantic Oscillation – El Nino/Southern Oscillation – Tropical climatology-Observations: Changes in snow, Ice and Frozen Ground

UNIT V IMPACTS, ADAPTATION VULNERABILITY AND MITIGATION 9

Assessment of observed changes and responses in natural and managed system- Freshwater resources and their management- Ecosystems, their properties, goods and services- Coastal systems and low-lying areas – Industry, settlement and society- Human health – Small Islands- Inter relationships between adaptation and mitigation

TOTAL: 45 PERIODS

REFERENCES:

1. Wells, N., The Atmosphere and Ocean, a Physical introduction. Wiley, Chichester, 1997.
2. Houghton, J., Global Warming: The Complete Briefing. 3rd Edition. Cambridge University Press, 2004.
3. Barry, R.G. and Chorley, R.J., Atmosphere, Weather and Climate, 8th edition. Routledge, London, 2003.

4. IPCC Fourth Assessment Report, Climate Change, Working Group I, II, III and IV, Cambridge University Press, 2007.

CM 9152		L	T	P	C
	BIOGEOCHEMISTRY OF THE COASTAL MARGINS	**3**	**0**	**0**	**3**

OBJECTIVE:

- To introduce the basic concepts and approaches in biogeochemistry including carbonate systems and redox equilibria, stability constants and weathering
- To help students develop skilled multidisciplinary approach to problem solving by using Gran Plots and mass balance models
- To identify and quantify the impact of various human activities on the carbon, nitrogen and silica cycles and the overall biogeochemistry of coastal habitats

UNIT I CHEMICAL BACKGROUND 9

Units and terminology – Equilibrium thermodynamics – Equilibrium constants – Measurements of disequilibrium – Activity-Concentration relationships – Activities of ionic species – Complex formation – Apparent equilibrium constants

UNIT II CARBONATE SYSTEMS AND pH CONTROL 9

Carbonic acid system – Alkalinity and titration curves – Gran Plots – Calcium carbonate solubility – Surface water in carbonate terrain

UNIT III REDOX EQUILIBRIA AND REDOX CONDITIONS 9

Standard Hydrogen electrode and thermodynamic conventions – Definition of pe and Eh by redox pairs – Measurement of Eh – pe -pH and Eh-pH diagrams – Systems - Fe-O-H_2O – Fe-O-H_2O-CO_2 – Photosynthesis-respiration and decay – Redox buffering – Lakes and Oceans

UNIT IV STABILITY RELATIONSHIPS, SILICATE EQUILIBRIA AND WEATHERING 9

Solubility equilibria – Solubility of magnesium silicates – Gibbsite – Alumina silicates – Incongruent solution and stability diagrams – Weathering – Soil formation – Mass balance approach – Mineral weathering reactions – Clay minerals – Case Studies

UNIT V COASTAL BIOGEOCHEMICAL DYNAMICS 9

Human perturbation of the global carbon cycle – N and C cycles – Radiocarbon dating – Oxygen isotopes

TOTAL: 45 PERIODS

REFERENCES:

1. Drever, J.I. The Geochemistry of Natural Waters: Surface and groundwater Environments, 3rd Edition, Prentice Hall, 1997.
2. Berner, E.K. and Berner, R.A. Global Water Cycle: Geochemistry and Environment, 1st Edition, Prentice Hall, 1998.
3. Broecker, W.S. and Peng T.H. Tracers In The Sea, Eldigio Press, 1982.

4. Morel, F.M.M. and Hering, J.G. Principles and Applications of Aquatic Chemistry, Wiley-Interscience, 1993.
5. Stumm, W. and Morgan, J. Aquatic Chemistry, John Wiley & Sons, 1996.
6. Libes, S.M. An Introduction to Marine Biogeochemistry. John Wiley and Sons, Inc., N.Y., 1992.

CM 9153	COASTAL BIODIVERSITY	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

UNIT I CLASSIFICATION OF COASTS 9

Seas and oceans – Classification – EEZ – Continental area – Coastal zone – Coral reefs – Mangroves – Wetlands – Importance – Food, transportation, recreation – Reef Structure, Types, and Formation – Mangrove distribution

UNIT II BIOLOGY OF COASTAL ECOSYSTEMS 9

Taxonomy and genetics – Temporal and regional variation – Morphology – Temporal and regional variations – Physiology and biochemistry – Factors affecting various growth parameters – Types of reproduction, seed propagation, dispersal and establishment studies in mangroves

UNIT III ECOLOGICAL FACTORS AFFECTING COASTAL BIODIVERSITY 6

Ecological and environmental conditions affecting coastal ecosystems – Tides, temperature, rainfall, salinity – Sediment characteristics

UNIT IV ROLE OF BIODIVERSITY IN CONSERVATION 9

Marine, coastal biodiversity – Inter-relationships between ecosystems – Methods of assessing biodiversity – Importance of assessing species diversity and status - IUCN conservation status of species – Status book

UNIT V DEGRADATION OF COASTAL ECOSYSTEMS AND CONSERVATION 12

Importance of mangroves and coral reefs – Reefs as Dynamic Systems – Natural calamities – Hurricanes, storms, floods, coastal erosion and other natural disturbances – Fouling and boring organisms, animal grazing and human pressure – Conservation and management strategies – Restoration technology – People's participatory approach – Joint Forest Management – Management strategies and methods – Role of Institutions – Global policies – Conservation strategies in different countries

TOTAL: 45 PERIODS

REFERENCES:

1. Global Threats to Coral Reefs – Chapter 1: Global Threats to Coral Reefs:

Coral Bleaching, Global Climate Change, Disease, Predator Plagues, and Invasive Species.(PDF): Status of Coral Reefs of the World: – Vol. 1, 2004.
2. Moore, H.B. Marine Ecology. Wiley Interscience, 1958.
3. Raffaelli, D.G. and Hawkins, S.J. Intertidal Ecology. 2nd Edition, Springer, 1996.
4. Doody, J.P. Coastal Conservation and Management: An Ecological Perspective. Springer, 2000.

CM 9154	COASTAL AQUACULTURE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the various aquaculture systems and technology development including the history of aquaculture, general principles, infrastructural facilities and human resources, survey and location of suitable sites, selection of suitable culturable species, layout and design of farms, construction and management.
- To teach suitable technologies and grow-out systems for culturable marine finfish and shellfish including ornamental fishes.
- To introduce finfish/ shellfish nutrition and health management, water quality management in various coastal aquaculture systems, post harvest technology, processing, economics and marketing, coastal aquaculture engineering, aquaculture extension, coastal aquaculture guidelines
- Case studies and entrepreneurship including the prospects of coastal aquaculture will be covered

UNIT I COASTAL AQUACULTURE 9

History of aquaculture – Global coastal aquaculture development and management – General Principles - Infrastructural facilities and Human resources – Survey and location of suitable sites – Site selection for aquaculture using remote sensing - Selection of culturable species – Exotic species for aquaculture.

UNIT II LAYOUT/DESIGN AND CONSTRUCTION OF AQUACULTURE FARMS 9

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 – 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 – Sterilisation and disinfection.

UNIT III AQUACULTURE TECHNOLOGIES 9

Fin fish and shellfish seed production technology – Fry rearing technology – Grow-out technology - Nutrition and health care – Ornamental fish culture technology - Integrated farming systems – Harvesting methods - Post harvest technology and processing – Economics and Marketing.

UNIT IV ENVIRONMENTAL ISSUES IN AQUACULTURE 9

Water quality and aquaculture production – pH, Alkalinity, Hardness, Salinity – Temperature, Dissolved Oxygen, Turbidity, Suspended solid particles, Dissolved gases, Nutrients, Hydrogen sulphide, Heavy metals and pesticides – Soil Organic Carbon- Acid sulphate soil – Phytoplankton, Zooplankton - Influence / impact of water quality on aquaculture and management

UNIT V AQUACULTURE ENGINEERING AND POLICIES FOR AQUACULTURE **9**

Role of Engineers in Aquaculture – Aquaculture policy – Coastal Aquaculture Authority guidelines – Case studies (Finfish, Shellfish, Seaweed culture) - Sources of finance and Insurance coverage – Aquaculture extension and entrepreneurship – Prospects of coastal aquaculture

TOTAL: 45 PERIODS

REFERENCES:

1. Egna, H.S. and Boyd,C.E. Dynamics of Pond Aquaculture. CRC Press. New York, USA, 1997.
2. Lucas, J.S. and Southgate P.C. Aquaculture – Farming aquatic animals and plants. Fishing News Books, Blackwell Publishing Ltd. Oxford, UK, 2003.
3. Lawson, T.B. Fundamentals of Aquacultural Engineering. CBS Publishers & Distributors. New Delhi, 1997.
4. Stickney, R.R. and McVey, J.P. Responsible marine aquaculture. CAB Publishing, New York, USA, 2002.
5. Thomas, P.C. Current and Emerging Trends in Aquaculture. Daya Publishing House, New Delhi, 1998.

CM 9155	AIR-SEA INTERACTIONS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- Examines the interaction of the atmosphere and ocean on time scales from minutes to months, with emphasis on effects within the near-surface boundary layers in both the air and water
- To identify the magnitude and influence of atmosphere on coastal waters and the influence of the sea surface on atmospheric phenomena.
- To provide an understanding of i) atmospheric radiation, ii) thermodynamics and iii) upper ocean dynamics
- To introduce concepts of basic meteorology for application, air-sea interactions, air-sea-land interaction including storm surges, ENSO and ITCZ and tropical climate dynamics

UNIT I METEOROLOGY 9

Introductory Meteorology- Structure and composition of the atmosphere – Vertical distribution of temperature in the atmosphere – Solar Radiation, insolation, outgoing radiation – Atmospheric heat budget, lapse rate, formation – Classification of clouds

UNIT II CIRCULATION AND FORCE 9

Atmospheric flow characteristics – Distribution of pressure and wind – Atmospheric general circulation – Types of forces: Pressure gradient force, gravitational force – Coriolis force, frictional force – Geostrophic wind and gradient wind – Surface pressure and wind characteristics during southwest and northeast monsoon

UNIT III OCEAN DYNAMICS 9

Upper ocean dynamics – Oceanic heat budget – Factors influencing heat budget terms – Radiative and turbulent fluxes – Bulk method for computation of fluxes – Dominant forces for ocean dynamics – Equation of motion

UNIT IV TURBULENCE AND HEAT TRANSFER 9

Air-Sea Interface Dynamics – Turbulence – Turbulent flow over the sea, Mathematical tools of turbulence – Transfer laws – Momentum and heat transfer across the interface

UNIT V TROPICAL CLIMATE DYNAMICS 9

Air-Sea interaction systems – ITCZ – Tropical cyclone-formation, classification and structure, Storm surges, El-Nino Southern Oscillation (ENSO) – Prediction of air-sea interaction systems- Storm surge prediction – Case study

TOTAL: 45 PERIODS

REFERENCES:

1. Gill A. E. Atmosphere-Ocean Dynamics, Academic Press, 1982.
2. Hess S.L. Introduction to Theoretical Meteorology, Robert E. Kreiger Publishing Co. Inc, 1959.
3. Pettersen S. Introduction to Meteorology, McGraw-Hill Book Co. New York, 1958.
4. Pickard G.L. and W. J. Emery, Descriptive Physical Oceanography,

Pergamon Press, New York, 1990.
5. Stull R. B. An Introduction to Boundary Layer Meteorology, Kluwer Academic Publishers, 1988.

CM 9156	COASTAL RESOURCE ECONOMICS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- The course introduces the basic, critical appreciation of economics as applied to natural and coastal resources management
- Specific goals include comprehension of the economics of sustainability, non-market valuation, economic policy instruments and international trade and the environment

UNIT I OVERVIEW OF COASTAL RESOURCE ECONOMICS 7

An introduction to Ecological Economics and coastal zone ecosystems' values – Interaction between Economy, Ecology and Fisheries – Property Rights and Enforcement in fisheries – Marine Reserves – Economic Valuation of Recreation spots – Use and non-use values of conserving endangered species – Assessment of Loss of Ecological diversity – Uncertainties – Environmental accounting – Environmental indicators

UNIT II ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL PROTECTION 9

Regulatory versus Economic Instruments – Charges and Subsidies – Non Compliance fees, bonds and deposit refunds – Tradable permits – Pigovian and Pollution Taxes – Polluter pays Principle – Evaluation of Instruments – Choice of instruments for Environmental policy

UNIT III ECONOMICS OF COASTAL RESOURCE EXPLOITATION 12

Resource Taxonomy – Resource Flows – Natural Resources (Renewable and non renewable) – Resource Scarcity and Economic Growth – Capital theory – Production costs and environmental costs – Market Structure and Optimal Extraction Policy – Uncertainty and Rate of Resource extraction – Efficient Utilization – Inter temporal Graphical Model: Rate of Time Preference, Utilitarianism and discounting, Optimal Allocation Rule, Marginal User Cost, Scarcity Rent

UNIT IV BENEFIT-COST ANALYSIS AND VALUATION TECHNIQUES OF COASTAL RESOURCES 11

Principles of cost benefit analysis – Methods of Profitability analysis: Net Present Value, Benefit-Cost Ratio, Internal rate of return, Pay back period, Opportunity costs – Market and non-market valuation techniques – Abatement Cost methods – Behaviour Linkage Methods – Economic value v/s. Environmental Value and Issues of non-human value – Costs of Sustainability

UNIT V TRADE AND ENVIRONMENT 6

Stakeholders – Ecological and Social Concerns – Impact of trade on coastal resources and of coastal environment agreements – Economic analysis of Pollution Prevention options – Lending Agencies – Case studies

TOTAL: 45 PERIODS

REFERENCES:

1. Hanley, N., Shogren, J.F. and White, B., Environmental Economics – In Theory and Practice, Macmillan India Ltd, New Delhi, 1999.
2. Perman, R., Ma, Y. and McGilvray, J. Natural Resources and Environmental economics, Second edition, Addison Wesley Longman Ltd., Singapore, 1997.
3. Bowers, J. Sustainability and Environmental Economics, Addison Wesley Longman Ltd., Singapore, 1997.
4. Kolstad, C.D. Environmental Economics, Oxford University Press, New York, 2000.

CM 9157	CORROSION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- The course will be an overview of the various aspects of corrosion and the result of interaction between metals by chemical or electrochemical reaction with the environments
- Studies on gradual destruction and decay of materials by chemical or biological agents are included
- The potency and consequences of corrosion which destroys economy, depletes resources, plants, equipments and other components are highlighted
- The explanation of different forms of corrosion, rates of corrosion and mechanisms of corrosion are provided in corrosion engineering

UNIT I CORROSION 9

General, electrochemical corrosion of metals, galvanic cells, corrosion rates (kinetics), types of corrosion with properties and phenomenon, oxidation metals.

UNIT II CORROSION TESTING 9

Importance, classification materials and specimens, surface preparation, measuring and weighing, exposure techniques, duration, planned interval tests.

UNIT III CORROSION PREVENTION 9

Material selection, modification of metal, alternate of environment, design, cathodic and anodic protection, coatings (metallic, inorganic, non metallic and organic)

UNIT IV CORROSION IN SELECTED ENVIRONMENTS 9

Atmospheric Corrosion, Corrosion in Automobiles, Corrosion in Soils, Corrosion of Steel in Concrete, Corrosion in Water, Microbiologically Induced Corrosion, Corrosion in the Body

UNIT V CORROSION IN INDUSTRIES 9

Corrosion in the Petroleum Industry, Corrosion in the Aircraft Industry, Corrosion in the Microelectronics Industry

TOTAL: 45 PERIODS

REFERENCES:

1. Jones, D.A. Principles and Prevention of Corrosion, 2nd Edition, Macmillan Publishing Co., 1995.
2. Balasubramanian, M.R., Krishnamoorthy, S. and Murugesan, V., Engineering Chemistry, Allied Publisher Limited., Chennai, 1993.
3. Sadasivam, V. Modern Engineering Chemistry - A Simplified Approach, Kamakya Publications, Chennai, 1999.
4. Kuriakose, J.C. and Rajaram J. Chemistry in Engineering and Technology, Vol. I and II, Tata McGraw-Hill Publications Co. Ltd., New Delhi, 1996.

CM 9158	GIS AND VISUAL BASIC CUSTOMIZATION	L	T	P	C
		2	0	2	3

OBJECTIVE:

- In this course, the students are introduced to Visual Basic (VB) programming through practice VB programs using MapObjects. In addition, students learn how to use the latest version of MapObjects ActiveX control developed by ESRI.
- Spatial selection, thematic mapping, overlays, map projections, and web-based GIS were explored thoroughly using a blend of software design discussions addressed and explored thoroughly using a blend of thought-provoking software design discussions, detailed examples, and carefully crafted exercises.
- This essential resource offers students the programming skills to create state-of-the-art GIS applications using MapObjects and Visual Basic.
- Developing GIS Solutions with MapOjects and Visual Basic teaches GIS programming in a complete hands-on environment to Visual Basic (VB) programming through practice utilizing MapObjects are the key aspects of this course

UNIT I INTRODUCTION TO SPATIAL DATA AND MAP MODELS 5+4

Spatial data elements & characteristics - Spatial patterns - Map scale - Map characteristics - Map projections - Grid system for mapping - Map symbols

UNIT II GIS DATA INPUT STORAGE AND EDITING 5+4

Input devices - Map preparation & digitization process - Methods of vector and raster input - Data storage – Editing - Edge matching - Rubber sheeting.

UNIT III GIS ANALYSIS 6+7

Analysis of spatial information - Logical, arithmetic, complex and statistical operators – Buffer – Overlay - 3D analysis

UNIT IV VISUAL BASIC PROGRAMMING 7+7

Visual basic applications - Creating and using controls, object & instances – Debugging - Responding to mouse events, file system, controls, processing files - Programming basics.

UNIT V MAP OBJECTS & CUSTOMIZATION 7+8

Map objects activex control - Managing map layers, toolbars, layer management, geometry, co-ordinates and identifying features - Rendering, collections, classes and advanced selection - Case studies for customization.

TOTAL (L: 30 + P: 30): 60 PERIODS

REFERENCES:

1. Demers, M.A. Fundamentals of Geographic Information System, 2nd edition John Wiley & Sons, 1999.
2. Hutchinson, S. and Daniel, L. Inside Arc view GIS, Onward Press, 2000.
3. Schneider, D.I. Introduction to programming using Visual Basic, 6th edition, Prentice Hall Publications, 2005.
4. Stevensen, O. Visual basic 6 the complete reference, Mcgraw Hill, 2006.
5. Hardsen, T. Geographic Information Systems, 2nd edition, John Wiley &

Sons, 1999.
6. Ralson, B.A. Developing GIS solutions with map objects & Visual Basic, Onward Press, 2002.

CM 9159	NUMERICAL MODELING FOR COASTAL PROCESSES	L	T	P	C
		2	0	2	3

OBJECTIVE:

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

UNIT I INTRODUCTION 4

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

UNIT II MODELING OF COASTAL PROCESSES 7+7

Equations governing processes in coastal environment: Inviscid & viscous flows, waves, coastal flow fields & estuarine flows, beach processes - Case studies of numerical solutions of equations governing coastal processes: Systems of linear algebraic equations; over-, even- and under- determined system of linear equations – Review of matrix algebra – Numerical solutions of matrix equations - Matrix Eigen value problem.

UNIT III EQUATIONS INVOLVED IN MODELING 7+7

Interpolation & Curve-fitting - Quadratic splines & Cubic splines – System of ordinary differential equations: Initial value - Boundary-value, Eigen value Problems - Numerical Solution to Systems of Equations

UNIT IV WATER QUALITY MODELS 6+7

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

UNIT V WATER QUALITY MODELING AND FEEDBACK 6+9

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

TOTAL (L: 30 + P: 30): 60 PERIODS

REFERENCES:

1. Chapra, S.C. and Canale, R.P. Numerical Methods for Engineers, Tata McGraw Hill Publishing Co. Ltd., 2006.
2. Smith, G.D. Numerical solution of Partial Differential equations, Clarendon Press, 1985.

3. Chapra, S.C. Surface Water Quality Modeling, McGraw Hill Companies, Inc. 1997.
4. Reeves, D., Chadwick, A. and Fleming, C. Coastal Engineering, Spon Press, 2004.
5. Dean, R.G. and Dalrymple, R.A. Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994.
6. Ippen, A.T. Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc. New York, 1978.

AG9163 ENVIRONMENTAL HYDROGEOLOGY **L T P C**

3 0 0 3

UNIT I INTRODUCTION **9**

Hydrological cycle - geological formations as aquifers - aquifer parameters - their estimation - groundwater flow and recharge - environmental impacts related to hydrogeology

UNIT II HYDROGEOLOGICAL IMPACTS **9**

Mass movements - land subsidence - causes - hydrocompaction – sink holes – natural compaction - groundwater problems in mines and slopes

UNIT III GEOLOGICAL ASPECTS OF WASTE DISPOSAL SITES **9**

Physiography - nature of rock types - structure - hydrogeological considerations - data required - formation fluid tests - transport mechanisms of polluted groundwater

UNIT IV GROUNDWATER CONTAMINATION **9**

Water quality standards – transport processes – sources of contamination – oil spills – deep well disposal site locations – sea water intrusion - hydrogeological systems and monitoring

UNIT V GROUNDWATER PROTECTION **9**

Groundwater contamination - methods of assessment - application of groundwater modelling - damage prevention - remediation of aquifers – bio remediation of contaminated aquifers

TOTAL: 45 PERIODS

REFERENCES :

1. Soliman, M.M et al . Environmental Hydrogeology, Lewis Publ., 1997
2. Freeze, R.A and Cherry, J.A Groundwater, Prentice Hall, 1979
3. Coates,D.R. Environmental Geology, John Wiley, 1981
4. Keller, E.A, Environmental Geology, Columbus, 1985
5. Marcel van der Perk, Soil and Water Contamination: From Molecular to Catchment, Scale, Taylor and Francis, 2006
6. Appelo, C.A.J. and D. Postma, Geochemistry, Groundwater and Pollution, Taylor & Francis; 2 edition,, 2005.

AG9166	ENVIRONMENTAL GEOCHEMISTRY	L	T	P	C
		3	0	0	3

UNIT I PRINCIPLES OF ENVIRONMENTAL GEOCHEMISTRY 9

The science of Geochemistry – Its objectives, its relationship to other geosciences and its methodology. The natural workings of the Earth: Natural distributions of chemicals in global and local environments. Geochemistry of the Earth: The birth of matter in our solar nebula, formation of the solar system and early geochemical history of the earth. The geochemical cycle – Distribution of elements in rocks

UNIT II THE CONTINENTAL ENVIRONMENT 9

Hydrologic cycle – Dissolution and precipitation of silica, aluminum and iron hydroxides - Geochemistry of surface and ground waters – Rivers, ground water and lakes. Complex formation and chelation. Metals and nonmetals. Radioactive isotopes and radioactive waste.

UNIT III MARINE ENVIRONMENT 9

Physical and chemical properties of open ocean seawater chemistry. Trace metals in sea waters. Types of metal distributions. Geochemistry of marine sediments. Marginal marine environments. Perturbations caused by humans: chemical distributions in anthropogenically "perturbed" systems.

UNIT IV ENVIRONMENTAL MINERALOGY 9

Basic mineralogy – Definition of a mineral – Types of minerals – Crystal chemistry – X – ray Crystallography. Basic silicate structures – zeolites – asbestos minerals – health effects of asbestos exposure. Mineral-microorganism interactions.

UNIT V GEOCHEMICAL EXPLORATION ENVIRONMENT 9

Introduction – Primary Dispersion pattern Secondary dispersion pattern. Background values – Geochemical anomaly – Geochemical sampling - Weathering – Soils.

TOTAL: 45 PERIODS

REFERENCES:

1. Arthur Brownlow, Geochemistry (Second edition), Pearson Education, INC., 1996.
2. Faure, G., Principles and applications of Geochemistry, Pearson Education, INC., 1998.
3. Nelson EBY, G., Principles of Environmental Geochemistry, Thomson Brooks/Cole, 2004.
4. Fraure, G, Principles of isotope geology, John Wiley, Second edition. 1986.

RS9155 SPACE GEODESY **L T P C**

2 0 2 3

OBJECTIVE:

- The objective of this course is to teach the fundamentals of space geodesy, the observation and processing of the GPS data for different applications.

UNIT I BASICS **6**

Definition – fundamentals of geodesy – Basic concepts – Historical perspectives – Development - Applications in space geodesy – Geoid and Ellipsoid - satellite orbital motion – keplerian motion – Keplar's law – perturbing forces – Geodetic satellites.

UNIT II DIFFERENT TECHNIQUES **6**

Determination of Direction By Photography – SECOR – electronic observation techniques- Doppler effect – positioning concept – development of TRANSIT satellites

UNIT III GLOBAL POSITIONING SYSTEM **6**

GPS – different segments – space, control and user segment – satellite configuration – GPS signal structure – orbit determination and orbit representation, Anti spoofing and selective availability – task of control segment – GPS receiver- main receiver component- example of GPS receiver.

UNIT IV GPS DATA PROCESSING **6**

GPS observables – code and carrier phase observation – linear combination and derived observables – concept of parameter estimation – data processing – software modules – solutions of cycle slips, ambiguities, RINEX format. Concepts of rapid static methods with GPS - semi kinematic and pure kinematic methods – basic constellation of satellite geometry and accuracy measures.

UNIT V APPLICATION OF SPACE GEODESY **6**

Geodetic control surveys, cadastral surveying, photogrammetry and remote sensing, engineering applications and monitoring – GIS. GLONASS satellite configuration comparison – satellite laser ranging & applications – concept of satellite altimetry.

FIELD WORK **30**

Study of different GPS – Static, Kinematic observations – Downloading and Processing the GPS data.

TOTAL (L: 30 + P: 30): 60 PERIODS

REFERENCES:

1. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004.
2. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer – Verlag, Berlin, 2003.
3. Seeber G.Satellite Geodesy, Walter De Gruyter, Berlin, 1998.
4. Ahmed ei-rabbany, Introduction to GPS, the global positioning system, Artech house publishers, 2002.
5. Mohinder s.Grewal, Lawrence R.Weill, Angus P.Andrews, Global positioning systems, Inertial Navigation and integration, Wiley-Interscience, 2000.
6. Bradford W.Parkinson, James J.Spilker, GPS: Theory & Applications progress in astronautics and aeronautics, American Institute of Aeronautics, 1996.
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RS9151	MICROWAVE REMOTE SENSING	L	T	P	C
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OBJECTIVE:

- To impart the knowledge of Microwave Remote sensing and its applications.

UNIT I FUNDAMENTALS AND RADIOMETRY 6

Introduction and early history, Basic concepts, plane waves, antenna systems, radiometry, microwave interactions with atmospheric constituents, Earth's surface and vegetation, Radiometric systems, Sensors, Data products and its applications.

UNIT II RADAR REMOTE SENSING 9

Radar Basics, Radar interaction with Earth surface and vegetation, Surface scattering theory. Radar equation , fading concept, Measurement and discrimination, Physical mechanisms and empirical models for scattering and emission, Geometry of Radar images, Radar return and image signature, Resolution concepts, SAR, Speckle in radar imagery, concept of roughness, geometry of targets, resonance, dielectric constant, surface and volume scattering, signal penetration and enhancement.

UNIT III AIRBORNE AND SPACEBORNE RADAR SYSTEMS 9

Airborne, Spaceborne, different platforms and sensors, Data products and selection procedure, SEASAT,SIRA,SIRB,ERS,JERS,RADARSAT missions, Doppler radar, JASON,TOPEX/POSEIDON, Aircraft: AirSAR, C/X SAR, E-SAR, STAR-1.

UNIT IV APPLICATION OF RADAR REMOTE SENSING 12

Applications in Agriculture, Forestry, Geology, Hydrology, ice studies, landuse mapping and ocean related studies, military and surveillance applications, search and rescue operations, ground and air target detection and tracking.

UNIT V SPECIAL TOPICS IN RADAR REMOTE SENSING 9

SAR interferometry-Basics- differential SAR interferometry, Radar polarimetry-Radargrammetry and applications-Altimeter and its applications, scatterometer and its applications.

TOTAL: 45 PERIODS

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3. Philippe Lacomme,Jean clande Marchais,Jean-Philippe Hardarge and Eric Normant, Air and spaceborne radar systems-An introduction, Elsevier publications 2001.
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