CE 414 COASTAL ENGINEERING

Elective Course

Spring 2009

Instructor: Emre Otay

Course Data: Hours: MMT 786, Rooms: M78 M2180, T6 M2130

Course Description (Catalog):

CE246 Strength of Materials **(3+0+0)3**

The coastal zone; wave classification; water waves; engineering properties of water waves; wave energy, transformation of waves, shoaling, refraction, diffraction; wave breaking; wave generation and prediction; tides, wave forces; design of breakwaters, seawalls, pile structures, and beach fills.

Prerequisite: CE 311 Fluid Mechanics

Course Objectives (learning outcomes):

(i) To develop an understanding of basic concepts in coastal engineering such as the linear wave theory, energy propagation in waves, shoaling, refraction, diffraction, and breaking.

(ii) To help the student develop an intuitive feeling about design concepts in coastal engineering based on wave spectra, prediction of waves in fetch limited seas, wave forces on piles and wall type structures.

(iii) To discuss basic principles of water wave mechanics regarding wave energy and momentum, and their effects on wave transformation.

(iv) To discuss various analysis tools used in the design of breakwaters using estimation of transmitted and reflected waves through wall type structures using energy concepts and wave diffraction diagrams.

(v) To learn numerical and graphical techniques for solving the wave dispersion equation and the group effect of water waves.

Textbook:

Dean & Dalrymple (1984) “Water wave mechanics for engineers and scientists”, Prentice Hall.

Reference Books:

US Army Corps of Engineers (1984) “Shore Protection Manual, v.1,2

Curricular Context

This elective course provides students an introductory knowledge on coastal engineering within the context of fluid mechanics and hydraulic engineering. It provides the foundations of water wave mechanics for both research oriented students but also for those who are interested in the design of coastal structures which are offered as part of the Department’s graduate program. Estimated design content is 20%.

Laboratory and Computer Usage:

Students are asked to develop computer programs to carry out the analysis of group waves and to numerically solve the wave dispersion equation.

Class Policies:

Two sets of Homework to be assigned . Midterm exams: Two exams, each 30% of the course grade.
Final exam or final project: Comprehensive exam at the end of the semester, 40% of the course grade. For those who prefer a project instead of a written exam are given a coastal engineering design project (40%).

Contribution of the Course to Program Outcomes:

(a) An ability to apply knowledge of mathematics, science and engineering
*(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(e) An ability to identify, formulate and solve engineering problems
(j) A knowledge of contemporary issues
(k) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice
(*) applicable only to those students who have taken final project instead of a written final exam.

Course Assessment:

Course will be assessed on the basis of the accomplishments regarding the course objectives and the contributions to the program outcomes. The evaluation will consist mainly of the responses from the students, who will provide their comments to various course related questions in the final week of the semester.

WEEK	TOPIC	**OBJECTIVES**
1	Introduction Coastal regions, waves, currents	Syllabus and administrative matters. Slide show. Coastal regions, basic definitions and concepts, wave classification
2	Fundamentals of idealized flows.Linear, small amplitude waves: the boundary value problem	Conservation of mass and momentum, rotation, velocity potential, Laplace equation, the Bernoulli equation. Formulation of the boundary value problem: the governing equation and the boundary conditions, linearization.
3	Solution of the wave BVP	Solution by separation of variables. The surface profile, wave dispersion, celerity, wave length, constancy of period, wave classification according to relative depth.
4	Wave kinematics. Wave induced pressure. Group velocity and the beat effect.	Velocities, accelerations, orbital motions of water particles. Dynamic pressure and its distribution, hydrostatic and total pressure. Superposition of waves, formation of a wave group, interpretation.
5	Wave generation by reflection Wave energy, energy flux and the transformation of waves, EXAM 1	Perfect reflection and standing waves , imperfect reflection and partial standing waves Potential energy, kinetic energy, energy flux, second interpretation of group velocity, shoaling of waves, example
6	Wave transformations	Conservation of waves equation, refraction, conservation of energy
7	Wave transformations	Wave breaking in shallow water, importance, difficulties in analysis, classification Wave transformations in channels of varying width and depth
8	Wave transformations	Diffraction, Huygen's principle, formulation of the BVP, Helmholtz equation Diffraction diagrams, tables, example
9	Wave generation and prediction	Wind wave generation, zero up-crossing method, the significant wave, probability distribution of wave heights, the wave spectrum
10	Wave Forces, EXAM 2	Non-breaking wave forces on piles and walls. Breaking and broken wave forces on walls
11	*SPRING BREAK*	
12	Wave Forces. Rubble mound breakwaters	Effects of wave approach angle and non-vertical wall, toe protection and foundations Armouring, types of cross sections, Hudson's equation, design considerations (crest width and elevation, layer thicknesses, placing and placing density.)
13	Closure depth, equilibrium beach profiles,	Hallermeier's closure depth formulation, Equilibrium Beach Profile concept
14	Beach nourishment design *SPRING BREAK*	Iintersecting, and non-intersecting profiles, beach nourishment design.