CE 412 HYDRAULIC ENGINEERING II

Elective Course

Spring 2009

Instructor: *Name:* Cem B. Avcı

Office Hours: M 6

Course Data: Hours: M 5, T 56

Room: M 2181, M 3100

Course Description (Catalog):

CE412 Hydraulic Engineering II **(3+0+0)3**

The course is designed to introduce the concept of ground water flow hydrology and contamination as an extension of the mandatory fluid mechanics and hydraulics taught in the junior year of the civil engineering curriculum. Ground water flow as well as contaminant transport in the subsurface media are presented at an introductory level as well as presentation of real life case studies.

Prerequisite: CE 312 Hydraulic Engineering

Course Objectives (Learning Outcomes):

To introduce the concept of ground water flow hydrology and contamination as an extension of the mandatory fluid mechanics and hydraulics taught

To provide students with exposure to the systematic methods for solving engineering problems in groundwater engineering.

To discuss the basic theoretical principles underlying modern approaches of the real life case study problems.

To build the necessary theoretical background for modeling of advanced groundwater flow and contaminant transport courses.

Textbook:

Freeze R.A, Cherry J.A., ***"Groundwater"***, Prentice-Hall, 1979, GB1003.2F73

Reference Books:

Bear J, ***"Dynamics of Fluids in Porous Media"***, Elseiver, 1972, 76-168264

Curricular Context

This elective course provides to basic theoretical concepts of groundwater flow hydrology and contaminant remediation techniques of real life examples. It constructs the links between mathematical implementations of flow equations and engineering applications.

Laboratory and Computer Usage:

Students are provided with public domain software that simulates ground water and contaminant flow. The program is used as part of the final assignment for the course.

Class Policies:

Midterm exams: Two exams, each 30% of the course grade.

Final exam: Comprehensive exam at the end of the semester, 40% of the course grade.

Contribution of the Course to Program Outcomes:

(a) An ability to apply knowledge of mathematics, science and engineering

(c) An ability to design a system, component, or process to meet desired needs such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(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

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	Topics	Reading Assignments	Suggested Problems	Objectives
1	Introduction	Chapter 1		Present course outline, explain the importance of ground water as a source of water supply and the domain of ground water hydrology within the hydraulic domain
2	Overview of subjects and case studies	Handouts		Case study presentation including contemporary and real life problems relate to ground water exploitation and remediation problems in industrial facilities
3	Groundwater : Hydrologic Cycle, Resources, Contamination	Chapter 1		Explain ground water and the hydrologic cycle, ground water as a resource, contamination and geotechnical problems
4	Properties & Principles : Darcy's Law, Hydraulic Head and Fluid Potential, Hydraulic Conductivity	Chapter 2	1.1-1.6, Handouts	Establish the principles governing the ground water flow motion and the various geological unit classification within which ground water flow is investigated
5	Properties & Principles : Heterogeneity, Unsaturated Flow, Aquifers-Aquitards, Steady State – Transient Flow, Equations of Groundwater	Chapter 2	1.7-1.12, Handouts	Define the variables associated with the ground water flow occurrences and develop equations of ground water flow
6	Flow Nets: Hydraulic head distribution and Streamlines	Chapter 5	5.1,5.2,5.3,5.4	Discuss the process of hydraulic head distribution and streamline construction. Boundary conditions development for ground water flow
7	Groundwater Resources : Exploration of Aquifers, Ideal Aquifer Pumping TAKE HOME 1	Chapter 8	8.1-8.9	Develop methodology for problem definition for pumping tests and review available analytical solutions
8	Groundwater Resources : Pumping Tests, Aquifer Property Predictions	Chapter 8	8.10-8.16	Develop methodology for problem definition for pumping tests and review available analytical solutions
9	Groundwater Contamination : Water, Soil Quality Standards, Transport Process	Chapter 9	9.4-9.11	Review principles of ground water contamination and governing contaminant transport equation. Discuss dispersion, advection and retardation process
10	Ground Water Risk Analysis	Chapter 9	Handouts	Explain role of risk assessment in ground water contamination evaluation and cleanup process
11	Groundwater Contaminations : Case Studies, Remediation Technologies : Principles TAKE HOME 2	Handouts	Selected journal papers	Describe various remediation technologies available for ground water unsaturated and saturated media
12	Remediation Technologies : Physical Systems : Case Studies	Handouts	Selected journal papers	Use of ground water flow principles in containment barrier design
13	Remediation Technologies : Physical Systems : Case Studies	Handouts	Selected journal papers	Use of ground water flow principles in soil vapor and ground water flow extraction remediation techniques