Course: ***CIV_ENV 363, Environmental Engineering Applications I: Air & Land***

Credits: 1 Unit credit; contact hours: 3 hrs lecture

Instructor: Harish Rao, Ph.D., P.E., QEP

Text: C. David Cooper and F. C. Alley. 2011. Air Pollution Control – A Design Approach, 4th Edition. ISBN 1-57766-678-X.

RCRA Orientation Manual 2014 – Resource Conservation and Recovery Act, U.S. Environmental Protection Agency, Office of Resource Conservation and Recovery, Program Management, Communications, and Analysis Office, Solid Waste and Emergency Response (5306W) EPA630-F-11-003, October 2014. https://www.epa.gov/sites/production/files/2015-07/documents/rom.pdf

Other Mat'l: EPA Air Pollution Control Cost Manual, Sixth Edition, EPA/452/B-02-001, January 2002 (Canvas)

35IAC Subchapter f: Risk Based Cleanup Objectives, Parts 740 & 742 (IPCB Website)

Khan, F.I., Husain, T and Hejazi, R., "An overview and analysis of site remediation technologies." Journal of Environmental Management, 71 (2004) 95-112. (Canvas)

Description: Nature and control of air pollution. Sources, properties, effects, measurement, monitoring and control of major air pollutants. Engineering design of air pollution controls. Solid and hazardous waste management, legislative and regulatory approaches applicable to waste management and air pollution control.

Prereq: Junior standing Required;
Required: CEE260 and CEE 340 Recommended

Goals: The objectives of the course are to provide an overview of environmental engineering applications related to two media – primarily air and some land. The focus is on understanding the U.S. regulatory structure of the Clean Air Act, properties of air pollutants and design of air pollution control systems; study of hazardous and solid waste regulations, review of major technologies and risk-based approaches for site evaluation and remediation of contaminated sites. By the end of this course, the successful student will be able to do the following:

1. Define air pollution and understand the sources, types and effects of major air pollutants including greenhouse gases, and the Clean Air Act mandated regulatory approaches used for controlling air pollution, including CO_2 control for addressing global warming.
2. Understand properties of classes of air pollutants, units of concentration and conversion, dispersion modeling and fundamentals approaches to the engineering design of air pollution control systems.
3. Identify the characteristics of hazardous and nonhazardous waste. Understanding of regulatory programs (RCRA, CERCLA and state programs) for management of wastes and remediation of contaminated sites
4. Apply basic components in risk assessment and contaminant transport to evaluate risk-based approaches to managing and remediation of contaminated sites, with a basic understanding of major soil and groundwater remediation technologies.

Student outcomes:

a. an ability to apply knowledge of mathematics, science, and engineering (including chemistry, physics, geology & biology)
b. an ability to design and conduct experiments as well as to analyze and interpret data in more than one focus area
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Course Outline:

Week	Date	Topics and Assignment Due	Readings
1	W,F: Sep 21, 23	Air Pollution – Definitions, Sources and Effects, Concentration in gases and Measurements	C&A: Chap. 1
2	M,W,F: Sep 26, 28, 30	Types of air pollutants, Legislation and Regulation, Air Quality Trends, AQI	C&A: Chap. 1; USEPA web sites
3	M,W,F: Oct 3,5,7	Process design considerations, engineering economics, AQI; Introduction to particulate matter. Particulate Control and Design – Cyclones; **HW1**	C&A: Chap. 2, 3 & 4
4	M,W,F: Oct 10, 12, 14	Particulate Control and Design – ESPs, Scrubbers; **EXAM 1** Project Introduction: Design of Particulate Control System	C&A: Chap 5 & 7 Chap. 9
5	M,W,F: Oct 17, 19, 21	Particulate Control and Design– Fabric Filters;	C&A: Chap. 6
6	M,W,F: Oct 24, 26, 28	Properties of Gases/Vapors; Control technologies: Adsorption, Incineration, Absorption. Overview of SO2, NO_x and CO_2 Control. **HW2 due**	C&A: Chap. 10 and 12
7	M,W: Oct 31, Nov 2	Meteorology and Dispersion Modeling. Carbon dioxide control	C&A: Chap. 19, Chap. 20
	F: Nov 4	Review and Project Progress. **HW3 due**	Chap 9
8	M,W,F: Nov 7, 9, 11	Waste Issues – RCRA Definitions; Regulation for management and remediation of hazardous wastes and contaminated sites. **EXAM 2**	RCRA Manual: Chap. I, II & III
9	M,W,F: Nov 14, 16, 18	RCRA requirements for Generators, TSD facilities and Transporters. Universal wastes. Landfills and Land Disposal restrictions. Landfill liners. RCRA Corrective Action and CERCLA Cleanup. **HW4 Due**	RCRA Manual: Chap. II and III; Handout
10	M,W: Nov 21, 23,	Corrective action under CERCLA, RCRA and risk-based corrective action (RBCA) programs. Risk Assessment Process. **EXAM-3**	RCRA Manual: Chap. VI; Website
	F: Nov 25	Thanksgiving break – No Class	
11	M,W: Nov 28, 30	Illinois voluntary cleanup program (TACO) and Overview of Remediation technologies. Review	IPCB Website and Handout
	F: Dec 2	**Project Presentations**	
Final	Th: Dec 8 (9-11am)	**FINAL EXAM**.	

Grade Distribution:

Homework	20%
Midterm Exams (3)	30%
Final Exam	20%
Group Project	20%
Participation	10%

Contact Information:
Harish Rao, Adjunct Professor
harish.rao@northwestern.edu
Phone: 847-902-1518

Grader: None