DEPARTMENT: Environmental Health

COURSE NUMBER: EH 515     SEMESTER & YEAR: Spring 2015

CREDIT HOURS: 2

COURSE TITLE: Air Quality in the Urban Environment: A Survey of Research Methods and Recent Findings

INSTRUCTOR NAME
Jeremy A. Sarnat, ScD
Rachel Golan, PhD (Guest instructor)

INSTRUCTOR CONTACT INFORMATION
e-mail: jsarnat@emory.edu
Phone: 404-712-9725
Office: Claudia Nance Rollins Bldg. Room 2029

OFFICE HOURS
By appointment

COURSE DESCRIPTION
The link between the air we breathe and human health affects millions globally, placing urban air quality as a leading contributor to the global burden of disease. This course examines ways to characterize urban air pollution as well as its public health implications based on recent clinical, epidemiological and toxicological research. The course will be highly interactive and will provide instruction on conducting basic, applied air quality research in academic, governmental and grassroots settings.

EVALUATION
Your grade in this class will be based upon:

- Midterm (25%). This will be a take home exam on material covered during the first half the class. As part of this midterm, we will construct Gaussian Plume models that will be used to answer parts of the midterm.

- Exceptional Events Analysis (25%). Students will select an historical event or natural occurrence for a given location and prepare a detailed analysis examining the effect of this event/occurrence on urban pollutant concentrations (e.g., the Atlanta Olympics on traffic-related pollutant levels). This will be a group project with the aim of familiarizing yourself with accessing existing air quality databases and applying many of the concepts covered in the course with actual air quality data.

- Class participation and Pollutant log (10%). Many of the sessions will use topical journal articles to frame the class material. Students will be asked to review these articles in class. You will also be asked to prepare a log sheet of pollutant levels for a location of your choice to be presented in class.

- Final (40%). The in-class final exam will be cumulative.

ACADEMIC HONOR CODE
The RSPH requires that all material submitted by a student in fulfilling his or her academic course of study must be the original work of the student.
LEARNING OBJECTIVES OR COMPETENCIES OF THE COURSE
After completing this course, students should be able to:

- Identify the key urban air pollutants based on their physical and chemical properties and their impact on human health and the environment.
- Identify the major sources of urban air pollution, their trends, fate and transport in the atmosphere.
- Perform basic air pollution calculations to estimate ambient concentrations of pollutants.
- Interpret and utilize online databases of air pollution monitoring information.
- Understand the role of meteorological factors and photochemistry in the formation and dispersion of urban air pollution.
- Display familiarity with methods for measuring urban air pollution including direct sampling and modeling techniques.
- Demonstrate knowledge of the role of air pollution exposure assessment in promoting environmental health

LEARNING OBJECTIVES OR COMPETENCIES FOR THE DEPARTMENT OR PROGRAM TO WHICH THE COURSE CONTRIBUTES

- Demonstrate knowledge of general environmental science principles, and apply them to human health
- Identify and understand appropriate approaches for quantifying environmental exposures and their impacts on human health such as the use of environmental sampling, biomarkers and risk assessment techniques
- Understand and use key environmental health tools including quantitative data analysis, geographical information systems and multi-media models
Session 1  Course introduction – January 13, 2015
Topics  • Definition of air pollution
• Air pollution episodes in history
• Scales of pollution: global, regional, urban
• US vs. global air quality trends and challenges
• Evolution of air quality research
• Accessing air quality data

Session 2  The atmospheric system – January 20, 2015
Topics  • Laws governing atmospheric behavior: IGL, Henry’s Law, Raoult’s Law
• System of Units, conversions
• Background vs. polluted state
• Urban air pollutants of concern
Readings  Godish, Chapter 1

Session 3  Introduction to atmospheric chemistry: gases – January 27, 2015
Topics  • Formation, fate and transport of nitrogen and sulfur oxides, ozone, volatile organics; photochemistry
• Formation, fate and transport of particulate matter; size and chemistry dispersion; particle mass balance
Readings  Godish, Chapter 2.3 & 2.4

Session 4  Introduction to atmospheric chemistry: particulate matter - February 3, 2015
Topics  • Formation, fate and transport of nitrogen and sulfur oxides, ozone, volatile organics; photochemistry
• Formation, fate and transport of particulate matter; size and chemistry dispersion; particle mass balance
Readings  Godish, Chapter 2.3 & 2.4

Session 5  Meteorology and air quality – February 10, 2015
Topics  • Vertical/horizontal dispersion, atmospheric stability
• Mixing height, adiabatic lapse rate, inversions
• Radiative balance, global circulation
• Urban emissions/global impacts, urban plumes
Readings  Godish, Chapters 3.1 & 3.3

Session 6  Air pollution modeling – February 17, 2015
Topics  • Gaussian plume, derivation of Gaussian equation
• Regional models, Calpuff demonstration
• Remote sensing, use of satellite data
Readings  Godish, Chapter 7.3
7 Constructing a Gaussian Plume Model – February 24, 2015
- In class exercise on building and using a Gaussian Plume model

Readings TBA
Assignment Midterm Exam distributed → due in class March 17

8 Characterizing exposure to air pollution – March 3, 2015
Topics
- Methods, conducting air pollution exposure assessments
- Role of air pollution exposure assessment
- Quantifying measurement error
- How to design an exposure study
- Measuring ambient air quality levels

Readings Godish, Chapters 7.1 & 7.2

Spring Break – No Class – March 10, 2015

9 Quantifying air pollution health effects – March 17, 2015
Topics
- Epidemiologic methods, strengths, limitations
- Recent findings
- Class exercise: Designing an air pollution epidemiologic study

Godish, Chapters 5.1 & 5.2; 5.4 & 5.5

10 Pathways and Mechanism of Air Pollution Insult - March 24, 2015
Topics
- Systemic review of respiratory, reproductive, cardiovascular and neurological responses associated with exposure to urban air pollution
- Discussion of biological pathways and plausibility
- Brook et al. 2010 “Particulate Matter Air Pollution and Cardiovascular Disease: An Update to the Scientific Statement from the American Heart Association.”

11 Air pollution control – March 31, 2015
Topics
- Technical control methods for gaseous and particulate pollutants
- Mobile source emissions control technologies

Readings Godish, Chapter 8.2.1 – 8.4.8, 9 & 10

12 Indoor air quality – April 7, 2015
Topics
- Indoor pollutants of concern
- Indoor air as an urban risk factor, sick building syndrome
- Effect of ventilation
- Box models

Readings Godish, Chapter 11

13 Exceptional Events Analysis Class Presentations – April 14, 2015
- In class group presentations

14 Final Examination – April 21, 2015
- In class