AIR POLLUTION AND ITS CONTROL TECHNOLOGIES

SYLLABUS

INTRODUCTION

This is an introductory course to air pollution and technologies for its control covering a wide range of topics. In this course, participants will learn effects of air pollutants on human beings, materials and the environment, what their sources are, and their physical and chemical behaviour in the atmosphere. As the course is intended for engineering students, special focus is placed on control technologies and future trends towards preventing air pollution.

OBJECTIVES

The main aim of the course is to provide students with a scientific and technical background in air pollution monitoring, pollution control technologies and environmental management. This OCW course is especially focused on industrial processes and plants. Students will also be introduced to the European legislative framework on air quality and to international conventions.

Specific objectives are listed below.

1. Gain understanding of the basic concepts of air pollution and its effects on human and ecosystem health
2. Explore how atmospheric chemical composition both drives and responds to changes in the earth system, including climate change.
3. Look at the major air pollutants, their sources, chemical transformations in the atmosphere and impacts
4. Articulate current air pollution policies applied in Europe for criteria pollutants
5. Know how to interpret meteorological data for atmospheric stability and air pollutant transport and dispersion
6. Get an insight into the fundamentals of some of the most widely used commercial and freely available air quality models

7. Present detailed information about the design characteristics of technology for particulate matter control, including electrostatic precipitators, fabric filters, cyclones, spray towers and Venturi washers.
8. Learn the concepts and strategies of control of gaseous pollutants, including adsorption, adsorption, condensation, oxidation-reduction and biofiltration.

SKILLS/ COMPETENCIES / LEARNING OUTCOMES

Upon completion of this OCW course students should be able to:

1. Characterize the elements of air pollution
2. Describe current air pollution issues at all scales (from local to global)
3. List the main air pollutants and their effects on human health, welfare and the environment
4. Quantify environmental engineering parameters with appropriate metrics and units, and be able to convert between units of measurement.
5. Discuss several types of air pollution problems and the chemistry and physics affecting them
6. Solve simple problems related to dispersion and air quality modeling
7. Develop a broad overview understanding of the strategies, regulations and policies to manage air pollution
8. Select methods for control, and prevention of air pollution to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
9. Analyze various unit operations and unit processes used in air treatment
10. Evaluate process design criteria for different air treatment technologies and perform basic calculations

PREREQUISITES

This course is intended for undergraduates and first year graduate students. It is a science-based course that requires comfort with mathematical calculations, physics and chemistry. Students who do not feel comfortable with these prerequisites will need to do outside self-study to progress satisfactorily through the course.

COURSE DESCRIPTION

This course provides an introduction to major aspects of air quality science and its control technology, including an overview of many current air pollution problems, from local to continental scales; a discussion of air pollutant characteristics, natural and anthropogenic sources, transport and transformations in the atmosphere; a presentation of the models that are used to predict dispersion and air pollutant concentrations; and finally a review of the strategies and key technologies for controlling emissions of gaseous pollutants and particulate matter. Participants will also learn to design air pollution control systems and to calculate treatment system efficiencies from design parameters. This OCW course also examines the complex regulatory and institutional framework controlling air quality management in Europe and explains current air quality management concepts.

COURSE PROGRAM AND CONTENT

The course is structured in four modules: Introduction to air pollution, Main atmospheric pollutants and transformations, transport and dispersion of air pollutants and, Industrial emission reduction. Each module will focus on the following contents:

1. Introduction to air pollution

    Concepts

    Scales of air pollution

    Primary and secondary pollutants

    The Earth's atmosphere: structure, composition and energy balance

2. Main atmospheric pollutants and transformations

    Carbon monoxide

    Sulfur dioxide

    Oxides of nitrogen

    Hydrocarbons

    Atmospheric aerosol

3. Transport and dispersion of air pollutants

    Atmospheric stability

    Stability and plume behavior

    Dispersion modeling

4. Industrial emission reduction

Introduction Concepts

Particulate matter control equipment

Gaseous pollutant control equipment

METHODOLOGY

Participants will be given reading material and a collection of exercises to practice various aspects of air pollution and its control technologies. At the end of each lecture they will be required to complete a self-assessment questionnaire in order to evaluate their level of knowledge and understanding in key areas (formative assessment).

All the materials (lectures notes, exercises, self-assessment questionnaires, bibliography and other resources) will be delivered at the beginning of the courses. Hence, participants can complete the activities at times convenient to them. However, it is recommended to do it progressively according to the schedule presented in the next section.

COURSE OUTLINE

Students should plan to spend 5 hours each week during 5 weeks to complete this course. The aforementioned four modules and the tasks associated should be completed according to schedule shown in Figure 1.

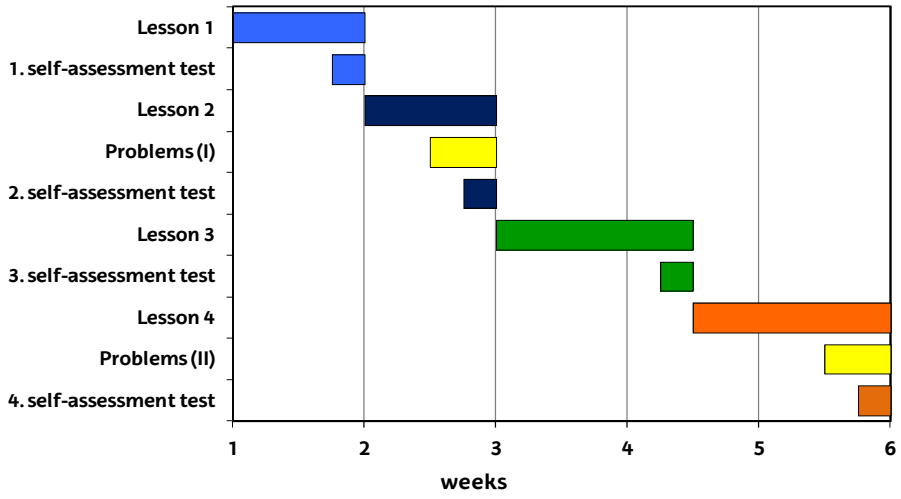

Figure 1. Gantt chart for the course 'Air pollution and its control technologies'