DEPARTMENT OF ENGINEERING

UNIVERSITY OF CAMBRIDGE

Module 5R18:

Environmental Fluid Mechanics and Air Pollution

Leader: Professor Nedunchezhian Swaminathan

Timing: Michaelmas Term

Prerequisites: No prior knowledge assumed. 4A12 and 4A13 of Part IIB Tripos are useful companion courses.

Structure: 8 two-hour afternoon classes, one per week.

Mode of Assessment: Coursework

AIMS

This course applies environmental fluid mechanics to enable engineers to predict and assess the climate and air quality impacts of engineering systems such as transport and power generation. The approaches developed are readily extended to model the impacts of these systems to building, estuarine, river and oceanographic applications. A strong background in and understanding of vector calculus, differential equations, fluid dynamics, ability to cut across these topics and apply them to other topics such as pollutant dispersion, aerosols, etc., is essential, if this course is taken for assessment.

SYLLABUS

1. Transport mechanisms: contaminant dispersion by advection and diffusion; turbulent jets; Buoyant plumes; aerosols

2. Thermal structure, chemical composition and general circulation of the atmosphere; the greenhouse effect; radiative balance

3. Anthropogenic emissions; atmospheric chemistry; air quality; climate change

4. Aerosol sources; fundamentals of aerosol dynamics; role of aerosols on radiative forcing and environmental flows

COURSEWORK

Each of the four topic areas above will be assessed be assessed by a problem-set. Some problems may be open-ended to provoke original thinking from students.

OBJECTIVES

Upon completion of this module the student should be able to:

- model and predict the fate and concentration of pollutants released into the environment from a wide range of different sources;
- understand certain aspects of the fluid mechanics and chemistry of the atmosphere at scales from ~1 μm to ~10,000 km;
- quantify the climate and air quality impacts of engineering systems, with knowledge of limitations and uncertainties in the methods used.
- understand fundamentals governing aerosol dynamics and simple applications

ASSESSMENT

Each of the four problem-sets will be equally weighted.