ME 637 PARTICLE TRANSPORT, DEPOSITION AND REMOVAL-II
Spring 2009

INSTRUCTOR: G. Ahmadi, Room 102 CAMP (268-2322)
Office Hours: TT 1:00 - 3:30 p.m.

TEXT: None

COURSE WEB SITE: http://www.clarkson.edu/projects/crcd/

Course Objectives

1. To provide a fundamentals of particle transport and deposition in turbulent flows.
2. To familiarize the students with the computational modeling of dilute two-phase flows.
3. To familiarize the students with the industrial applications of dilute multiphase flows.
4. To familiarize the students with the modern experimental techniques in aerosol transport analysis.
5. To familiarize the students with the industrial applications of aerosols.

Course Learning Outcomes

Objective 1:
• Students will be able to solve aerosol transport and deposition in turbulent flows.

Objective 2:
• Students will be able to formulate and analyze charged particle transport and deposition.

Objective 3:
• Students will be able to perform computational fluid dynamics and particle trajectory analysis in turbulent flows.
• Students will demonstrate using the FLUENT Code for solving particle transport in turbulent flows.
• The student will be able to perform an experimental study of aerosol transport and deposition processes.

Objective 4:
• Students will become familiar with the industrial gas cleaning and separation processes.
• Students will become familiar with pollution transport and lung deposition

COURSE OUTLINE

REVIEW of VISCOUS FLOWS
• Navier-Stokes Equation
• Simple Flows
• Creeping Flows
Drag on Spherical Particles

**REVIEW OF COMPUTATIONAL FLUID MECHANICS**
- Finite Difference and Finite Volume Methods
- Introduction to Gambit and Unstructured Fluent Code

**REVIEW OF TURBULENCE MODELING**
- Algebraic Models
- Two-Equation Models
- Stress Transport Model
- Rate-Dependent Models
- PDF Models

**AEROSOLS**
- Review of Drag, Lift, Virtual Mass and Basset Forces, BBO Equation
- Review of Nonspherical Particles
- Review of Brownian Motions
- Review of Particle Deposition Mechanisms
- Aerosol Transport in Turbulent Flows
- Wall Deposition in Turbulent Flows
- Inertia Impaction
- Particle Charging Mechanisms
- Electrostatic Forces
- Thermophoretic Forces
- Aerosol Coagulation
- Coagulation by Turbulence and Shear Fields

**COLLOIDS**
- Introduction to Colloids
- Double Layer Forces
- Electrokinetic Phenomena

**SIMULATION METHODS**
- Sublayer Model of Turbulence
- Particle Deposition on Smooth and Rough Wall
- Sublayer Simulation of Charged Particle
- Approximate Simulation of Instantaneous Turbulent Flows
- DNS and Large Eddy Simulation of Turbulence (Dr. McLaughlin)
- Particle Transport and Deposition in Turbulent Flows (Dr. McLaughlin)
- Brownian Motion of Nano-particles in Turbulent Flows
- Nonspherical Particle Transport in Turbulent Flows

**EXPERIMENTAL TECHNIQUES**
- Turbulent Flow Measurement (Hot-Wire, PIV, Laser-Doppler) (Dr. Glauser, Dr. Hiroshi, Syracuse University)
- Particle Concentration and Velocity Measurements (Phase-Doppler, PIV) (Dr. Taylor)
- Particle Production (Dr. Goia)
- Aerosol Sampling Techniques and Aerosol Instrumentation (Dr. Dhaniyala)
- Advanced Surface Cleaning Techniques (laser, cryogenic, ultrasonic) (Dr. Cetinkaya)

APPLICATIONS
- Microcontamination Control and Clean Room Operation (Dr. Cetinkaya)
- Xerography (Dr. Fan, Xerox)
- Indoor Air Quality (Dr. Zhang, Syracuse University)
- Computational Methods for Indoor Air (Dr. Dang, Syracuse University)
- Lung Deposition and Inhalation Drug Delivery (Dr. Tu, RMIT University, Australia)
- Filtration Processes and Gas Cleaning
- Combustors and Boilers
- Spray formation

EVALUATION METHOD:
- Exam 1 (March 9, CAMP 175, 11:00-12:30) 25%
- Final Exam (Final Exam week) 35%
- Computational Projects and Lab 30%
- Homework 10%

COURSE DESCRIPTION

REFERENCES