ENE 426 Particulate Air Pollutants: Properties/Behavior/Measurement — 3 Units

USC | SONNY ASTANI DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

ABET Course Syllabus

Course Information, Textbook and Supplementary Materials

Course Description: Particulate air pollutants, their measurement and instrumentation methods, and their effects on the environment and human health; optical properties and visibility degradation.

Required for: BSCE Environmental, and BSENE

Prerequisite: ENE 200
Co-Requisite: None

Required Textbook: Properties, Behavior, and Measurement of Airborne Particles, 2nd Edition- William C. Hinds, 2000

Reference: None

Topics Covered	Learning Outcomes
Basic Properties of Particulate Pollutants	• Introduction to Particulate Air Pollution • Relevance: PM and Health Effects • Aerosol concentrations and sizes • Aerosol effect on visibility and climate change
Particle Mechanics	• Particle motion (uniform and curvilinear) • Stokes regime flow • Particles in an External Field • Relaxation time, particle mobility and stopping distance • Design of Instruments based on particle mechanics: impactors, virtual impactors, cyclones
Particle Statistics	• Particle Size distributions • Frequency functions • Normal and Log Normal distributions • Aerosol distribution means and standard deviations calculations
Brownian Motion and Diffusion	• The primary transport mechanism for smaller (ultrafine, <0.1 um) particles • Fick's law • Brownian displacement and Fick's 2nd law of diffusion • Deposition by diffusion • Diffusion batteries and denuders • Turbulent diffusion
Thermophoresis	• Thermophoretic velocity • Thermal precipitators

Topics Covered	Learning Outcomes
Particle Coagulation	• Thermal coagulation- due to Brownian motion • Kinematic agglomeration- due to external forces (i.e. gravity, electrostatic, aerodynamic effects) • Sintering • Monodisperse and Polydisperse Coagulation • Kinematic coagulation • Turbulent coagulation

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Topics Covered	Learning Outcomes
Measurement of Aerosol Concentration	• Isokinetic Sampling • Error estimates in concentration due to anisokinetic sampling • Design of sampling campaigns
Respiratory Deposition	• Respiratory deposition vs. particle size • Estimates of inhaled dose • Particle deposition mechanisms in respiratory track • Respirable Mass Sampling • Deposition of gases inside respiratory tract
Particle Condensation and Evaporation	• Saturation vapor pressure • Semivolatile aerosols • Particle formation by condensation • Nucleation • Evaporation
Electrical Properties of Aerosols	• Particle charge and Coulombic force • Particle electrical mobility • Aerosol Charging Mechanisms • Electrostatic Precipitators • Aerosol characterization instruments based on electrical mobility
Optical Properties of Aerosols	• Light scattering and absorption by particles • Particle extinction coefficient • Light extinction, visibility and visual range • Optical particle measurement methods
Particle Filtration	• Particle filters • Filtration mechanisms • Single fiber efficiency calculations • Filter design • Electrostatic filtration

Lecture and Lab Schedule

Lecture		Lab	
Sessions per Week	Duration per Session	Sessions per Week	Duration per Session
3	1 hour	n/a	

Relation of Course Objectives to Program Outcomes

The Civil Engineering program is designed to teach beyond the technical content of the curriculum and prepare the students to utilize what they learn in a professional setting.

This course contributes to the program outcomes as outlined in the adjacent table

This course does not contribute to Program Outcomes a-k

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