Course syllabus

Department of Civil Engineering, Indian Institute of Technology Madras

CE5971 - Aerosol Science and Technology

Credit Distribution: C:9 L:3 T:0 P:0 E:0 O:6 TH:9

Course Type: Theory

Description: To introduce students to a) the basic processes and underlying mechanisms by which atmospheric aerosol particles affect the climate, ecosystem health, and quality of life. b) the fundamental understanding to the relevant topics of practical application of aerosol science in climate change and ecosystem health, and c) understanding of the basic physical, chemical, and biological principles that underline the behavior of atmospheric aerosols and the advanced instruments used to measure them.

Course Content: Properties of gases and uniform particle motion: Kinetic theory of gases, measurement of velocity, flow, pressure, etc.; Stokes's law; various definitions of aerosol diameter; correction factors; settling velocity of particles in High Reynold's Number; Sources of atmospheric aerosols particles: Primary and Secondary sources; new particle formation, Organic and Inorganic aerosol particles, source of biological aerosol particles. Particle size, shape, density; morphological features; Physical properties of aerosols: Various diameters, number, surface, volume, mass size distribution; Brownian motion and diffusion; Chemical properties of aerosols: Source dependent chemical composition of atmospheric aerosols; Biological properties of aerosols: Various sources and characteristic properties of atmospheric bioaerosols, transport, transformation, and atmospheric aging of the aerosol particles; Climate and ecosystem health impact of atmospheric aerosols: Direct and indirect effects; aerosol " cloud " precipitation interaction, cloud formation theory; Kahler equation; effect of size vs. chemistry for cloud formation, cloud condensation nuclei, ice nuclei; deposition of particles in human respiratory system; implication of various properties of aerosol on human and ecosystem health. Aerosol Thermodynamics: Thermodynamic principles, aerosol liquid water content, Kelvin effect, aerosol thermodynamic models; Advanced instrumentation used for atmospheric aerosol studies: Size distribution measurements (SMPS), condensation particle counters (CPC), Cloud Condensation Nuclei Counter (CCNC), Ice Nuclei Counter (INC), Aerosol Mass Spectrometer (AMS), Ultra Violet Aerodynamic Particle Sizer (UV-APS), various impactors; measurements and impact of optical properties. Calibration techniques for high end aerosol equipment: CCN calibration, AMS calibration, particle generation system for calibration. Hands on aerosol instrumentation/tutorial.

Text Books

- Aerosol Technology: Properties, Behavior, and Measurement of Airborne Particles. William C. Hinds. Wiley Publications, 1996, Second Edition.
- Atmospheric Chemistry and Physics; from air pollution to climate change. Seinfeld, S. N., and Pandis, J. H., Wiley-Interscience, 2008, Second Edition

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Reference Books

- Aerosol Measurement: Principles, Techniques, and Applications. Willeke and Baron. Wiley Publications, 2011, Third Edition.
- Atmospheric Chemistry: Fundamentals and Experimental Techniques. Pitts and Pitts. Wiley Publications, 1985, Second Edition.

Prerequisite: NIL