Mech. Engg. Dept.
IIT Delhi

MEL818 Multiphase Flows

2nd semester 2006-2007

Major Test

03 May 2007. 15:30-17:30 Marks 40

1. A near-spherical ash particle of diameter 2 μm. is moving in an electrostatic precipitator. For typical parameters, compare the relative magnitudes of the electrostatic drift velocity, gravitational settling velocity and any other velocities of relevance. What is the importance of Cunningham correction? [5]

2. In a pneumatic piping system, powdered material is transported with air supplied by a screw compressor. After a few years, the through-flow of solids is to be increased by 25 %. Under what conditions can this system meet the new requirement? [5]

3. During the coal-unloading operation at NCPS Dadri, dust was being blown along the sides the rail track. With neat sketches, explain the mechanics of this entrainment. The dispersion of this dust in the presence of a light breeze is to be modeled. Sketch the domain and write the equations, boundary conditions and initial conditions that you will use. Justify the domain size, choice of equations and boundary and initial conditions. [10]

4. With a neat sketch explain the particle dynamics and the physical features of the multi-phase flow in a circulating fluidized bed. For numerical modeling, indicate the computational domain that should be taken and the equations that should be used. All features of the flow need to be resolved. [10]

5. A dust-laden air flow contains particles up to 100 μm. with log-normal size distribution. The flow takes place in a duct as shown in the sketch. At plane 'A', the dust loading is uniform. The flow passes over the wedge. At the Reynolds number, vortex shedding is expected. How long should be the domain downstream of the wedge for accurate numerical simulations? Which equations should be used? From first-principles, make sketches of the flow pattern and the dust concentration profiles in the duct. [10]