ME 437 PARTICLE TRANSPORT PROJECT Fall 2004

Part 1: Brownian Diffusion in Laminar Duct Flows

a) Point Source: Consider a laminar flow between two parallel plates. Assume that a point source located at different locations emit particles in the size range of 0.01 to 100 micron. Simulate the motion of particles under the action of Brownian force in the presence and absence of gravity. Assume that the mean air velocity is V= 0.1 m/s, the channel is width is h=2 cm, with a length of about 20 cm or longer, and particle-to-air density ratio is S=2000. Use an ensemble of N=50 to 200 trajectories and evaluate the mean, variance and other statistics for particle position. Verify your results for dispersion for the source near the duct centerline by comparison with the exact solution. Discuss the importance of gravity and Brownian forces for different size particles. Also evaluate the deposition rate of panicles for point sources which are very near the wall (about a=1 mm). (Use FLUENT as well as your own program and compare the results.)

b) Uniform Inlet Concentration: For a uniform inlet concentration of particles in size range of 0.01 to 100 micron, evaluated the deposition rate for laminar flows between two parallel plates. Plot the results in term of Schmidt number. (Use FLUENT as well as your own program and compare the results with those obtained from the diffusion analysis.)

Part 2: Particle Detachment

Develop a computer program for evaluating the critical velocity needed to remove particles in the size range of 0.1 to 100 micron from a flat surface in a laminar and turbulent duct flow. Assume that the duct is two mm wide and use JKR, DMT and Maguis-Pollock models for two materials of your choice.

Part 3: Applications

Select an industrial/environmental example and perform a two or three-dimensional analysis of the flow and particle transport analysis.

Report and Due Dates: The reports should include hard copies and electronic copies of the program, figures, and discussion of the results. The due dates for Parts 1 and 2 are October 13, and November 10, 2004 and for Part 3 is December 1, 2004.