INDIAN INSTITUTE OF TECHNOLOGY KANPUR
DEPARTMENT OFMECHANICAL ENGINEERING

ME685A - ASSIGNMENT III

16h September 2020

1. In the model of a parachutist descending vertically downwards in air, the governing equation based on Newton's second law of motion is obtained as

$$\frac{du}{dt} + Au^2 = 8; \quad t > 0; \quad u(t=0) = 0$$

   For A=2, integrate this equation numerically and obtain the solution u_i at discrete time instants t_i. When do you stop integration? Discuss the choice of the time step by first identifying the characteristic timescale. Examine the possibility of an analytical solution. Compare the analytical and the numerical.

2. Express the time integration process in the form of a sequential algorithm for velocity at discrete time instants. The algorithm may be programmed in Fortran, C/C++, Matlab or even in Excel. Compare the solutions obtained (at given time instants) for the choice of three time steps = 0.02, 0.005, and 0.001.

3. In a follow-up problem, the parachute is closed initially while the parachutist starts the jump. It opens later at time t=5. Hence, A=0 for $t \leq 5$ and $A = 2$ for $t > 5$. Develop a solution for the velocity variation with time over $0 < t < 10$. Assess the solution obtained on three time steps of decreasing magnitude as in Question 2.