Indian Institute of Technology, Kanpur.

Even semester, 2019 - 2020.

AE 322 Aircraft Control Systems

Assignment 1

Due in class on 30/1/2020 **Answer all questions** **Marks - 15**

1. Consider the system model as the following differential equation.

$$\dddot{y} + 6\ddot{y} + 11\dot{y} + 6y = 0$$

   (a) Obtain the state-space representation.

   (b) Find the characteristic polynomial.

   (c) Extract its eigenvalues using *eig()* command in MATLAB.

   (d) Check and corroborate its stability using Routh-Hurwitz criterion.

   (e) Comment on the response of the system when perturbed from its equilibrium.

(5marks)

2. Form the Routh table to check the stability of the systems governed by the following characteristic polynomials.

   (a) $s^3 + 8s^2 + 22s + 20$.

   (b) $s^4 + 2s^3 + 3s^2 + 4s + 5$.

   (c) $s^3 + 2s^2 + s + 2$.

   (d) $s^5 + 2s^4 + 24s^3 + 48s^2 - 25s - 50$.

   (e) $s^4 + 3s^3 + 3s^2 + 2s + 1$.

(5 marks)

3. Write the linearized governing equations and the initial conditions for a pendulum and an inverted pendulum. The length and the mass of the pendulum are your roll number's last two non-zero integers respectively. Use 4^{th} order Runge-Kutta method to simulate the pendulum and the inverted pendulum. Comment on the results. **(5 marks)**