Code No: 134AM **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, December - 2018
CONTROL SYSTEMS
(Common to EEE, ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) Explain how feedback effects overall gain of the system. [2]
b) State and explain Mason's gain formula. [3]
c) What is meant by characteristic equation? [2]
d) What are the standard test signals? [3]
e) What are the limitations of Routh's stability? [2]
f) What are frequency domain specifications? [3]
g) Explain Lag compensation. [2]
h) What is the difference between polar plot and Nyquist plot? [3]
i) What are the properties of state transition matrix? [2]
j) What is meant by state in control system? [3]

PART – B

(50 Marks)

2. Derive an expression for the transfer function of an armature controlled DC servo motor. [10]

OR

3.a) Obtain the transfer function for the following mechanical translational system figure 1.

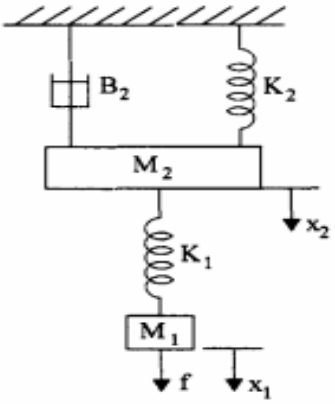

Figure 1

b) Obtain the transfer function for the following mechanical translational system figure 2.

[5+5]

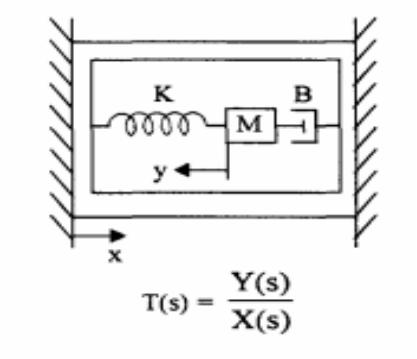

Figure 2

4.a) Write the equations for time domain specifications of a standard second order system with unit step input.

b) Explain the effect of Proportional control action on the performance of a second order system. [5+5]

OR

5. Consider the system shown in the Figure 3. With switch K open, determine the damping factor and the natural frequency of the system. If a unit ramp input is applied to the system, find the steady state output. Take K_A =5. The damping factor is to be increased to 0.7 by including a derivative output compensation. Find the value of k_t to achieve this. Find the value of undamped natural frequency and the steady state error due to a unit ramp input. [10]

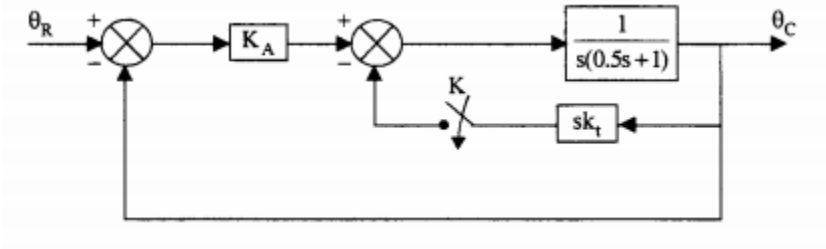

Figure 3

6. A unity feedback system has an open loop function G (s) = $\frac{k}{s(s^2+3s+10)}$ make a rough sketch of root locus plot by determining the following (a) Centroid, number and angle of asymptotes (b) angle of departure of root loci from the poles (c) Breakaway points if any. [10]

OR

7. Sketch the Bode plot for the following transfer function and determine the system gain K for which the magnitude plot crosses the 0 db line at ω = 15 rad/sec. [10]

$$G(s) = \frac{K}{s\,(s+1)(1+0.1s)(1+0.01s)}$$

8.a) Draw the complete Nyquist plot for the following open loop transfer function G(s) H(s) = $\frac{2(s+0.25)}{s^2\,(s+1)(s+0.5)}$. If the system is unstable, how many poles of the closed loop system are in the right half of s-plane?

b) Draw the electrical circuit diagram that represents the Lead-Lag compensator and explain in detail. [5+5]

OR

9.a) Consider the following polar plot shown in Figure 4. If now a pole at origin and a pole at s = - $\frac{1}{T_2}$ are added, sketch the polar plot.

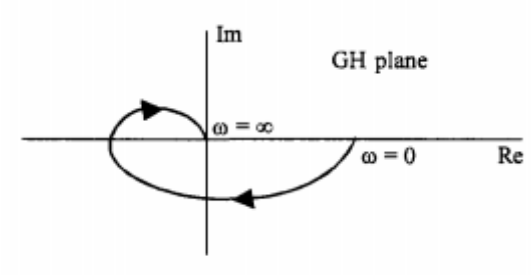

Figure: 4

b) Design a lag lead compensator for the unity feedback system with, G(s) = $\frac{K}{s(s+1)(s+2)}$ and satisfying the specifications, K_v = 10 sec^{-1}, φ_{pm} = 50° and B.W > 2 rad/sec. [5+5]

10.a) Explain various methods of evaluation of state transition matrix.

b) Obtain the transfer function for linear time invariant system and also draw the state model. [5+5]

OR

11. Determine the state and output equations in vector matrix form for the system whose transfer function is given by G (s) = $\frac{s+2}{s(s^2+4s+3)}$. [10]

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