Code No: 134AM

R16

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year II Semester Examinations, December - 2019

CONTROL SYSTEMS

(Common to EEE, ECE, EIE, ETM)

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

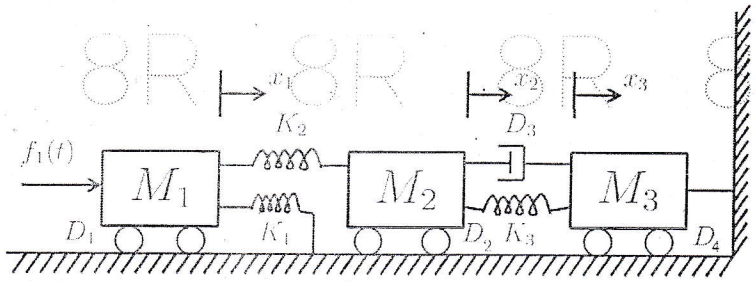
Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A **(25 Marks)**

1.a) What are the different types of control system? [2]
b) What is the difference between AC servo motor and D.C servo motor? [3]
c) What is the difference between type and order of a system? [2]
d) What is the need of PID controller? [3]
e) What is the necessary condition that the characteristic equation of a feedback system satisfies the BIBO stability? [2]
f) What are the advantages of frequency domain analysis? [3]
g) State the Nyquist criterion. [2]
h) What is the effect on polar plot if a pole is added to the transfer function? [3]
i) What is state? [2]
j) What are the advantages of state variable techniques? [3]

PART-B **(50 Marks)**

2.a) Contrast differences between open loop and closed loop control systems.
b) Develop the differential equations governing the mechanical system as shown in below figure. Also find the transfer function $\frac{x_1(S)}{F(S)}$. [5+5]



OR

3. Describe the construction and operating principle of synchro transmitter with neat diagrams. [10]

4.a) Derive the time domain specifications of second order system with unit step input.
b) A unity feedback system has a forward path transfer function $G(s) = \frac{8}{s(s+2)}$. Find the value of damping ratio, undamped natural frequency of the system, percentage over shoot, peak time and settling time. [5+5]

OR

5.a) Derive the response of second order system with unit step response.

b) For a negative feedback control system $G(s) = \frac{8}{s(0.4s+1)}$ and $H(s) = \frac{7}{s+2}$. Using generalized error series determine the steady state error of the system when the input applied is $r(t) = 1+2t+5t^2$. [5+5]

6.a) Determine the number of roots of a given polynomial with real parts between zero and -1, $7s^2 + 4s^4 + 10s^3 + 2s^2 + 3s + 6 = 0$

b) Define and derive the breakaway point on the root locus. [5+5]

OR

7. Sketch the Bode plot and determine the Gain margin and phase margin. For the open transfer function is given, $G(s) == \frac{8}{s(1+0.3s)(1+0.1s)}$. [10]

8.a) Describe the procedure for developing the polar plot.

b) A unity feedback control system has an open loop transfer function given by $G(s)\,H(s) = \frac{10}{s(s+3)(s+6)}$. Draw Nyquist diagram and determine stability. [5+5]

OR

9. Consider the open loop transfer function with unit feedback system,

$$G(s) = \frac{k}{s(s+3)(0.4s+1)}.$$

Design the lead-lag compensator so that:

a) Velocity error constant K_v is 5 sec^{-1}

b) Phase margin not greater than 30^0

c) Gain margin not greater than 10 db. [10]

10.a) Obtain the state space representation of an n^{th} order differential equation.

b) A second order linear system is described by

$\dot{x}_1 = -2x_1 + 4x_2 + u$

$\dot{x}_2 = -x_1 - 2x_2 + u$

and $y = x_1 + x_2$.

Find the transfer function and also calculate the zero input response of $x_{1(0)} = 1$ and $x_{2(0)} = -1$. [5+5]

OR

11. The state variable formulation of a system is given by

$$[\dot{x}] = \begin{bmatrix} -3 & 2 \\ -1 & 0 \end{bmatrix} [x] + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \text{ and } y = \begin{bmatrix} 1 & 0 \end{bmatrix} [x].$$

Find the following:

a) Transfer function of the system

b) State transaction matrix and

c) State equation for a unit step input under zero initial condition. [10]

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