Time: (3 Hours) **Total Marks – 80**

N.B.:- (1) Question No.**1** is compulsory.
(2) **Attempt** any **three** questions out of remaining **five** questions.
(3) Draw neat diagrams wherever it is necessary.

Q 1. Answer any four of the following questions. **20**

A) Compare Open loop and Closed loop control system. **5**

B) Explain the following rules with suitable examples; **5**

(i) Blocks in series

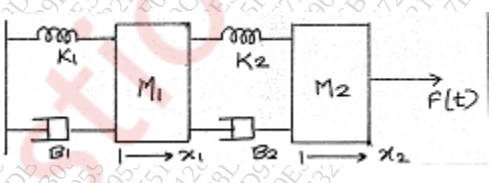
(ii) Blocks in parallel

C) Explain Routh-Hurwitz criteria of stability with suitable example. **5**

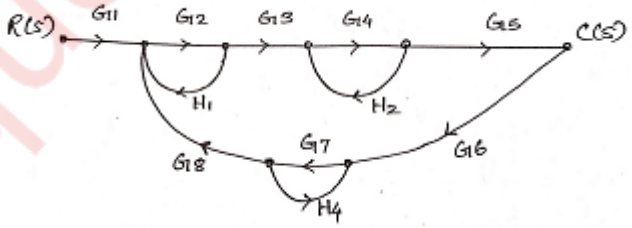
D) What are the advantages of using state space analysis over classical control approaches? **5**

E) What is Nyquist stability criteria? **5**

Q 2 a) Obtain the differential equations and transfer function describing the mechanical system shown in fig. and also draw its electric network. **10**



Q 2 b) Find the transfer function C(s)/R(s) for the signal-flow graph in figure. **10**



58387

Q 3 a) Write a short note on: Time response specifications. **10**

Q 3 b) The unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{S(S+10)}$ Determine gain K, so that the system will have a damping ratio of 0.5. for this value of K, determine, T_s, T_p an M_p for a unit step. **10**

Q 4 a) Define (i) State (ii) State variables (iii) State vector (iv) State space. How to obtain the state variable form from transfer function? **10**

Q 4 b) Obtain the state representation in phase variable form of the following transfer function. $\frac{C(s)}{R(s)} = \frac{12S^2+42S+158}{S^3+10S^2+56S+158}$ Also draw state space model. **10**

Q 5 a) Sketch the root locus of a unity feedback system having $G(s)H(s) = \frac{K}{S(S+4)(S+10)}$ given, also determine the value of K for $\xi = 0.5$. **10**

Q 5 b) Explain Angle and Magnitude condition. Also explain the steps to find intersection points of root locus with imaginary axis. **10**

Q 6 a) For the unity feedback control system $G(s) = \frac{10}{S(S+1)(S+5)}$ Sketch the bode plot. Also determine GM, PM, gain and phase crossover frequencies. **10**

Q 6 b) Discuss the stability of system using Nyquist plot for $G(s)H(s) = \frac{20}{S(S+4)(S-2)}$ **10**

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