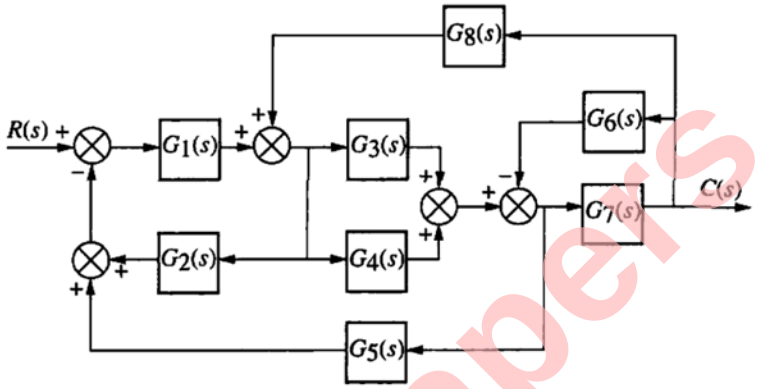
Q.P.Code: 013979

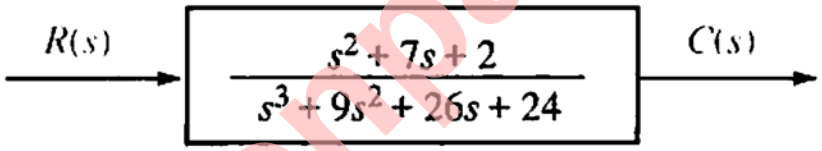
(3 Hours) **Total Marks : 80**

N.B. : (1) Attempt any **four** questions.
(2) Assumptions made should be **clearly** stated.
(3) Use log/semi – log paper is permited.

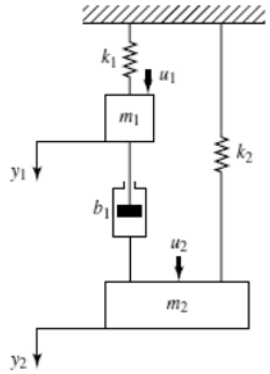
1. (a) Obtain the transfer function for the block diagram shown in figure below using block diagram reduction technique. 10



(b) Find state - space representation of the transfer function shown below. 10



2. (a) Obtain a state-space representation of the mechanical system shown in figure below, where u_1 and u_2 are the inputs and y_1 and y_2 are the outputs. 10

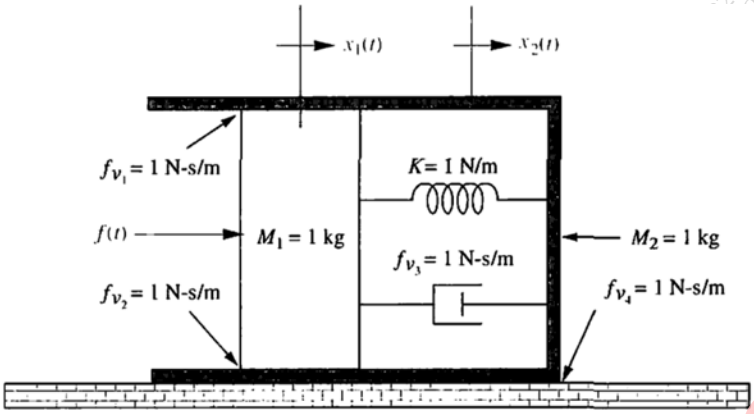


(b) [1] Explain state of dynamic system, state variable, state space, state equation and output equation involved in state space modeling 05
[2] Distinguish between modern control theory and conventional control theory 05

3. (a) [1] Explain Lyapunov stability theory. 05
[2] Explain the common nonlinearities in control systems. 05

(b) Find the transfer functions for the translational mechanical system shown in figure below. 10

TURN OVER



4. (a) For particular unity feedback system 10

$$G(s) = \frac{64(s+2)}{s(s+0.5)(s^2+3.2s+64)}.$$

Sketch the bode plot. Determine the gain margin, phase margin, gain crossover frequency and phase crossover frequency. Comment on stability.

(b) Write note on dynamic mathematical modeling of liquid level system having two tanks in series. 10

5. (a) For a unity feedback system the open loop transfer function is given by 10

$G(s) = \frac{k}{s(s+2)(s^2+6s+25)}$ Sketch the root locus and find the value of k at which system becomes unstable.

(b) The open loop transfer function of a unity feedback system is given by 10

$G(s) = \frac{k}{s(1+sT_1)(1+sT_2)}$. Apply Routh – Hurwitz criterion, determine the value of k in terms of T_1 and T_2 for the system to be stable.

6. (a) For a certain control system 10

$G(s)H(s) = \frac{K}{s(s+2)(s+10)}$ Sketch the Nyquist plot and hence calculate the range of values of K for stability.

(b) Determine the value of k such that the damping ratio ζ is 0.5. Then obtain the rise time t_r, peak time t_p, maximum overshoot M_p, and settling time t_s in the unit-step response. 10