CBCS SCHEME

USN | | | | | | | | | | |

18MT34

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Control Systems

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define the following terminologies used in control systems i) plant ii) process iii) command input iv) Reference input v) Disturbance. **(05 Marks)**

b. Find the transfer function $x_1(s)/F(s)$ for the mechanical system shown in Fig Q1(b)

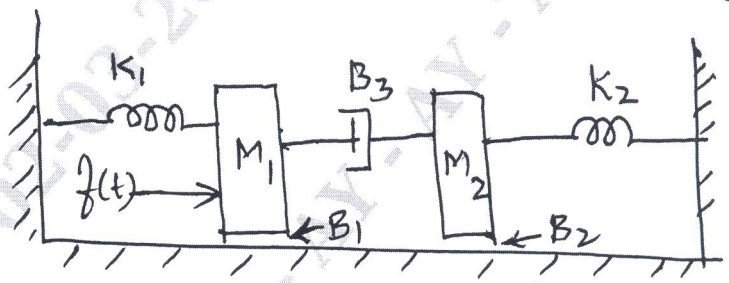

Fig Q1(b) **(07 Marks)**

c. For the mechanical system shown in Fig Q1(c), draw electrical network based on Torque – voltage analogy.

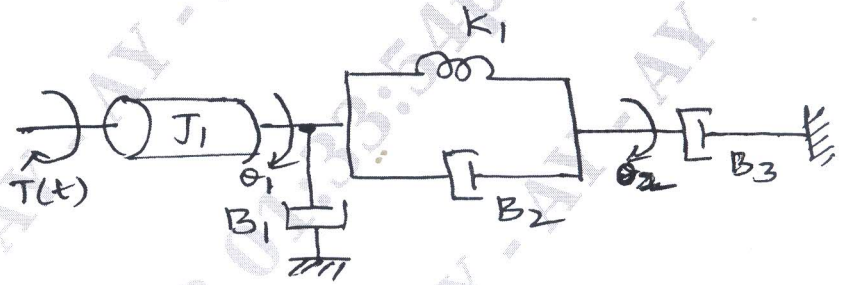

Fig Q1(c) **(08 Marks)**

OR

2 a. List out block diagram reduction technique rules? Draw necessary diagrams and equations. **(10 Marks)**

b. For the mechanical system shown in Fig Q2(b) i) Draw mechanical network ii) Obtain equations of notation iii) Draw an electrical network based on force current analogy.

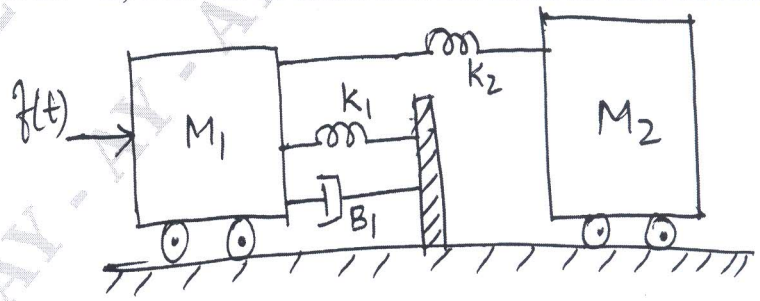

Fig Q2(b) **(10 Marks)**

Module-2

3 a. Find C(S)/R(S) by Mason's gain formula, for the signal flow graph shown in Fig Q3(a).

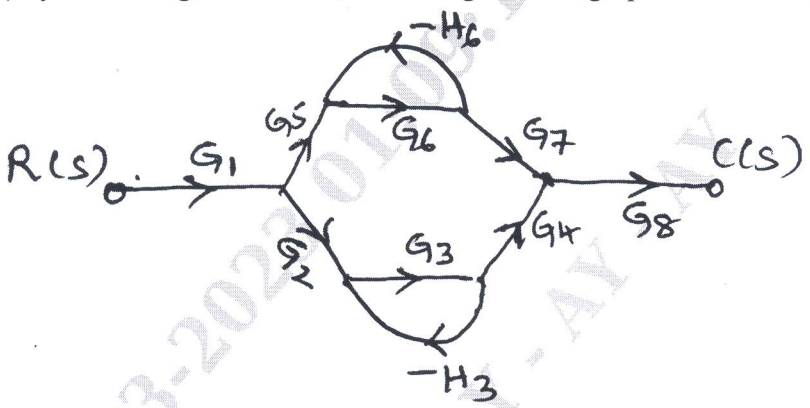

Fig Q3(a) **(10 Marks)**

b. Derive an expression of unit response of a second order system for underdamped case. **(10 Marks)**

OR

4 a. Define any five time response specifications of under damped second order system. Draw necessary response output graph. **(08 Marks)**

b. The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{K}{S(ST+1)}$.

i) By chart factor the amplifier gain 'K' should be multiplied so that damping ratio is increased from 0.2 to 0.8.

ii) By what factor the time constant T should be multiplied so that the damping ratio is reduced from 0.6 to 0.3. **(12 Marks)**

Module-3

5 a. Define the following i) Stable system ii) Unstable system iii) marginally stable system. **(06 Marks)**

b. Find the range of values of 'K' so that system with the following characteristics equations will be stable $F(s) = s(s^2 + s + 1)(s + 4) + K = 0$. **(08 Marks)**

c. Investigate the stability of a closed loop system whose characteristics equation in given by $s^5 + 3s^4 + 7s^3 + 20s^2 + 6s + 15 = 0$. **(06 Marks)**

OR

6 a. What are the advantages of frequency domain approach? **(06 Marks)**

b. For unity feedback system $G(s) = \frac{K}{s(1+0.4s)(1+0.25s)}$, find the range of 'K' marginal value of 'K' and frequency of sustained oscillations. **(07 Marks)**

c. The characteristic equation of a system is given by $s^4 + ks^3 + 2s^2 + (k + 1)s + 10 = 0$. Determine: i) the range of 'K', so that the system is stable and ii) the value of K so that system is marginally stable. **(07 Marks)**

Module-4

7 a. Explain the method of calculation the breakaway points and centroid. **(06 Marks)**

b. Sketch the complete root locus of system having

$$G(s)\,H(s) = \frac{K}{s(s+1)(s+2)(s+3)}.$$ **(14 Marks)**

OR

8 a. Explain the concept of gain margin and phase margin, and how these values help in studying relative stability. **(06 Marks)**

b. For a unity feedback system $G(s) = \frac{800(s+2)}{s^2(s+10)(s+40)}$, sketch the bode plot and comment on stability. **(14 Marks)**

Module-5

9 a. List the advantages of state space techniques and properties of state transition matrices. **(10 Marks)**

b. Obtain an appropriate state model for a system represented by an electric circuit as shown in Fig Q9(b)

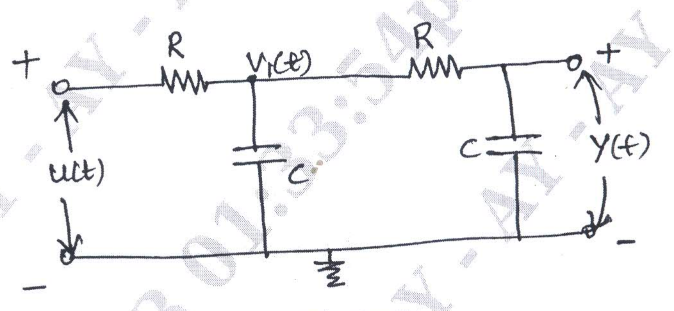

Fig Q9(b) **(10 Marks)**

OR

10 a. Explain the concept of state and state variables. **(04 Marks)**

b. Find the state transition matrix for a system whose system matrix is given by

$$A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$$ **(08 Marks)**

c. Represent the differential equation given below in a state model

$$\frac{d^3y}{dt^3} + \frac{3d^2y}{dt^2} + \frac{6dy}{dt} + 7y(t) = 2u(t).$$ **(08 Marks)**

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