CBCS SCHEME

USN | | | | | | | | | | 18EC43

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
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 control system and explain closed loop control system with an example. **(06 Marks)**

b. Explain the requirements of a good control system. **(04 Marks)**

c. Find the force voltage analogous electrical network for the given translational mechanical system shown in Fig.Q1(c).

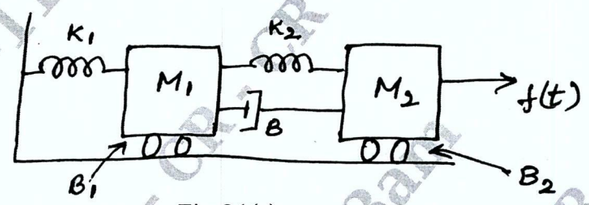

Fig.Q1(c) **(10 Marks)**

OR

2 a. Distinguish between open loop and closed loop control system. **(06 Marks)**

b. Explain the effect of negative feedback in control systems. **(04 Marks)**

c. Find the transfer function $\theta_1(s)/T(s)$ for the rotational mechanical system shown in Fig.Q2(c).

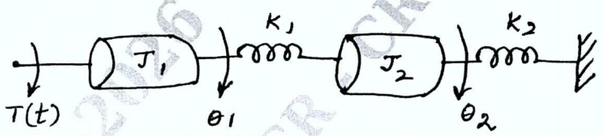

Fig.Q2(c) **(10 Marks)**

Module-2

3 a. Define Transfer function. List the properties of transfer function. **(04 Marks)**

b. Derive the expression for transfer function of a closed loop transfer function. **(06 Marks)**

c. Find the transfer function C(s)/R(s) for the block diagram given in Fig.Q3(c).

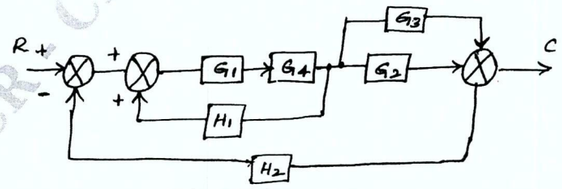

Fig.Q3(c) **(10 Marks)**

OR

4 a. Explain any four rules of block diagram reduction. **(06 Marks)**

b. Define signal flow graph and explain Mason's gain formula. **(04 Marks)**

c. Find the transfer function for the signal flow graph shown in Fig.Q4(c) using Masons Gain formula.

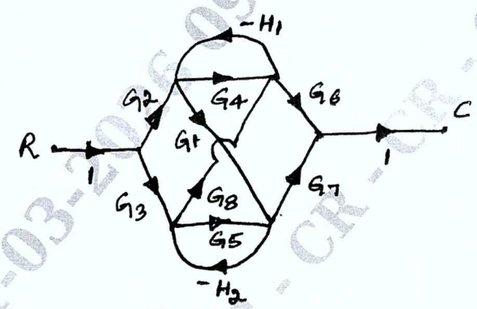

Fig.Q4(c) **(10 Marks)**

Module-3

5 a. List the standard test inputs used in control system with their Laplace transform. **(04 Marks)**

b. Derive the step input response of a first order system. **(08 Marks)**

c. A unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$.

Determine the gain K so that the system will have damping ratio of 0.5. For this value of K determine the settling time, peak overshoot and time to peak overshoot for a unit step input. **(08 Marks)**

OR

6 a. Derive the expression for C(t) of an under damped second order system for a unit step input. **(10 Marks)**

b. The open loop transfer function of a servo system with unity feedback is $G(s) = \frac{10}{s(0.1s+1)}$.

Evaluate the static error constants and obtain the steady state error of the system when subjected to an input of $r(t) = A_0 + A_1 t + \frac{A_2}{2} t^2$. **(10 Marks)**

Module-4

7 a. Explain Routh-Hurwitz criterion for stability of the system and what are its limitations. **(04 Marks)**

b. Find the range of K so that system with characteristics $s^4 + 20s^3 + 15s^2 + 2s + K = 0$ is stable. Also find frequency of oscillation at marginal value of K. **(08 Marks)**

c. Plot the Root Locus for a unity feedback system with $G(s) = \frac{K}{s(s+4)(s+5)}$. **(08 Marks)**

OR

8 a. For a unity feedback with $G(s)=\frac{100}{s(s+5)}$.

Determine :
i) Resonance peak
ii) Resonant frequency. **(06 Marks)**

b. Sketch the Bode plot for open loop transfer $G(s)H(s)=\frac{80}{s(s+2)(s+20)}$. Determine GM PM W_{gc} and W_{pc}. Comment on stability. **(14 Marks)**

Module-5

9 a. Explain Nyquist stability criterion. **(04 Marks)**

b. Find stability and range of K for a system with $G(s)H(s)=\frac{K}{s(s+2)(s+10)}$. **(10 Marks)**

c. Explain Lag-Lead compensator network. **(06 Marks)**

OR

10 a. What are the advantages of state space analysis? **(04 Marks)**

b. Obtain the stale equations for the electrical network shown in Fig.Q10(b).

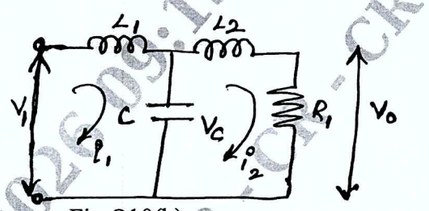

Fig.Q10(b) **(10 Marks)**

c. Obtain the transfer function of a state model if :

$$A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}\quad B=\begin{bmatrix}0\\0\\1\end{bmatrix}\quad C=[1\ \ 0\ \ 0]\quad D=[0].$$

(06 Marks)

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