

CBCS SCHEME

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21EE52

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025 Control Systems

Time: 3 hrs.

Max. Marks: 100

**Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Semilog graph sheet required.**

Module-1

- 1 a. Define control system. Distinguish the types of control system with example. (08 Marks)
 b. For the mechanical system shown in Fig.Q1(b). Write the differential equations describing its behavior. Write the analogous electrical equations based on force-voltage analogy, and force-current analogy, and draw the corresponding networks. Also draw the mechanical

network and obtain the transfer function : $\frac{Y_1(s)}{F(s)}$.

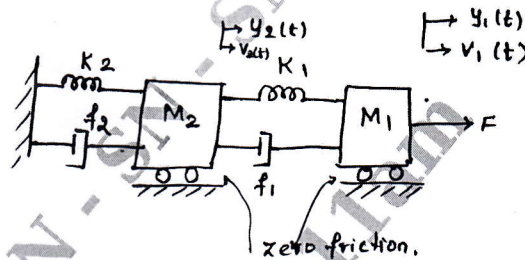


Fig.Q1(b)

(12 Marks)

OR

- 2 a. Obtain the governing equation for the given electrical network and derive its transfer function shown in Fig.Q2(b).

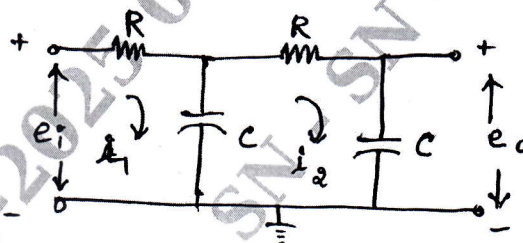


Fig.Q2(b)

(10 Marks)

- b. Discuss about : i) Synchros ii) Gear trains. (10 Marks)

Module-2

- 3 a. Give the list of block diagram reduction rules. (08 Marks)
 b. Obtain the transfer function of the feedback control system shown in Fig.Q3(b) by block diagram reduction technique.

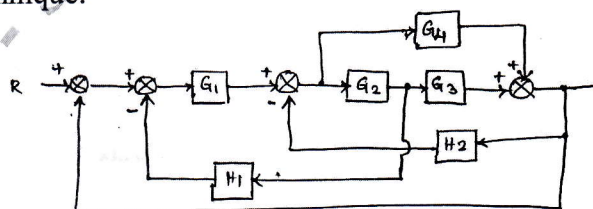


Fig.Q3(b)

(12 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

OR

- 8 a. A unit-step response test conducted on a second-order system yielded peak overshoot $M_p = 0.12$, and peak time $t_p = 0.2s$. Obtain the corresponding frequency response indices (M_r, W_r, W_b) for the system. (08 Marks)
- b. Sketch the bode plot for the following transfer function and determine the system gain K for the gain cross over frequency $w_g = 10$ rad/s.

$$G(s)H(s) = \frac{Ks^2}{(1+0.25s)(1+0.025s)} \quad (12 \text{ Marks})$$

Module-5

- 9 a. Define principle of argument. Discuss in detail about Nyquist stability criterion. (10 Marks)
- b. Design a lead compensator for a unity feedback system with an open-loop transfer function :

$$G_f(s) = \frac{k}{s(s+1)}$$

For the specifications of $K_v = 10s^{-1}$ and $\phi_m = 35^\circ$. (10 Marks)

OR

- 10 a. Draw the Nyquist plot and assess the stability of the closed loop system whose open loop transfer function is :

$$G(s)H(s) = \frac{(s+4)}{(s+1)(s-1)} \quad (10 \text{ Marks})$$

- b. Consider a unity feedback system with open loop transfer function :

$$G(s) = \frac{5}{s(s+0.5)(s+1)}$$

Design a PD controller so that the phase margin of the system is 30° at a frequency of 1.2 rad/sec. (10 Marks)
