

--	--	--	--	--	--	--	--	--	--

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020 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. Draw the general block diagrams of an automatic control system and explain. (05 Marks)
- b. Show that the two system shown in Fig Q1(b) are analogous systems.

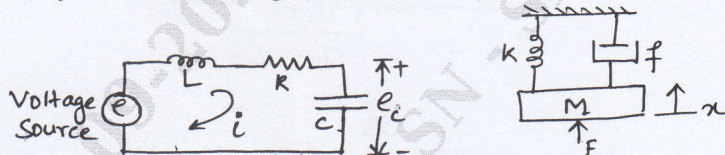


Fig Q1(b)

(05 Marks)

- c. Obtain the Force-current analogous electrical network for the mechanical system shown in Fig Q1(c).

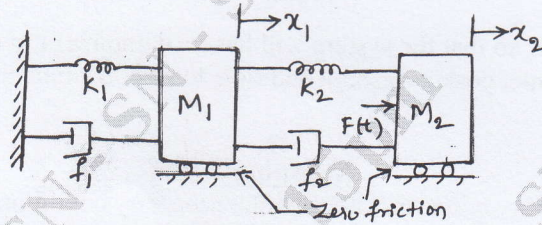


Fig Q1(c).

(10 Marks)

OR

- 2 a. Obtain the transfer function for the block diagram, shown in Fig Q2(a). Using block diagram reduction.

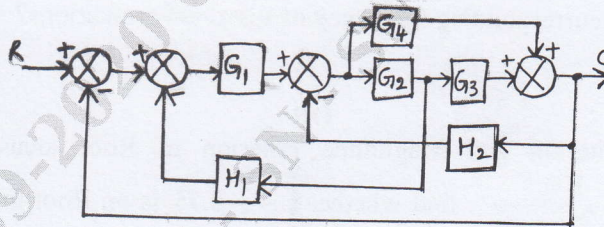


Fig Q2(a)

(10 Marks)

- b. Obtain the transfer function of the system shown in Fig Q2(b). Using Mason's gain formula.

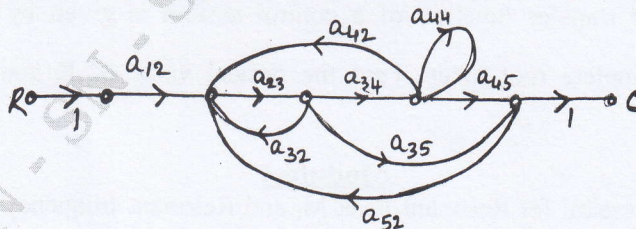


Fig Q2(b)

(10 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.

Module-2

- 3 a. Obtain the time response of a first order system subjected to unit step input. Plot the response. (06 Marks)
- b. Derive an expression for Peak time t_p of an under damped second order systems, subjected to step input. (06 Marks)
- c. For the system shown in Fig Q3(c), determine K and T so that the maximum overshoot is 25% and the settling time is 3 seconds for a 5% tolerance band when subjected to step input.

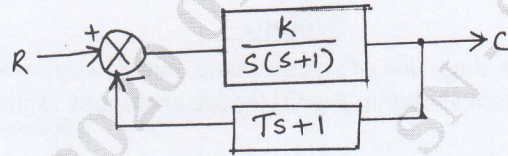


Fig Q3(c)

(08 Marks)

OR

- 4 a. Obtain the steady state error e_{ss} of Type - 0, Type - 1 and Type - 2 systems for standard inputs. (10 Marks)
- b. 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 a damping ratio of 0.5. For this value of K determine settling time, peak overshoot and time to peak overshoot for a unit step input. (10 Marks)

Module-3

- 5 a. Define Routh's stability criterion. Describe the necessary conditions for stability. (10 Marks)
- b. The open loop transfer function of unity negative feedback control system is given by, $G(s) = \frac{K}{s(s^2 + s + 1)(s + 4)}$.
- i) Using the Routh's criterion, calculate the range of 'K' values for the system to be stable
- ii) Determine the value of K which causes sustained oscillations in the closed loop system. What is the corresponding frequency of sustained oscillations? (10 Marks)

OR

- 6 a. State Angle criterion and Magnitude criterion of Root locus. For a system with $G(s) = H(s) \frac{K}{s(s+2)(s+4)}$, find whether $s = -0.75$ is on Root locus or not, using Angle criterion. (04 Marks)
- b. The open loop transfer function of a control system is given by $G(s) = \frac{K}{s(s+1)(s+2)}$. Sketch the complete root locus. Find the critical value of K and location of roots on $j\omega -$ axis. (16 Marks)

Module-4

- 7 a. Derive an expression for Resonant Peak M_r and Resonant frequency ω_r for a second order system in frequency response analysis. (08 Marks)
- b. Sketch the Bode plot for the system having $G(s) = \frac{20}{s(1+0.1s)}$. (12 Marks)

OR

- 8 a. Explain the concept of Polar – Plots by considering a simple RC filter circuit. (10 Marks)
 b. State and explain Nyquist criterion (05 Marks)
 c. Write a short note on Lead compensator. (05 Marks)

Module-5

- 9 a. Draw the block diagram of a typical system with Digital controller and explain. (06 Marks)
 b. What is uniform sampling? Mention the circumstances that lead to the use of sampled data control system. (06 Marks)
 c. Define state and state variable. Compare the transfer function approach and state variable approach of analyzing control system. (08 Marks)

OR

- 10 a. Obtain the state model of the mechanical system shown in Fig Q10(a).

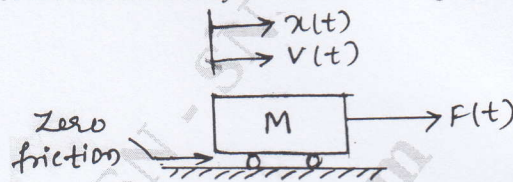


Fig Q10(a)

- b. Construct the state model for a system characterized by differential equation

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = u$$

(10 Marks)

(10 Marks)
