CBCS SCHEME

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17EC43

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.

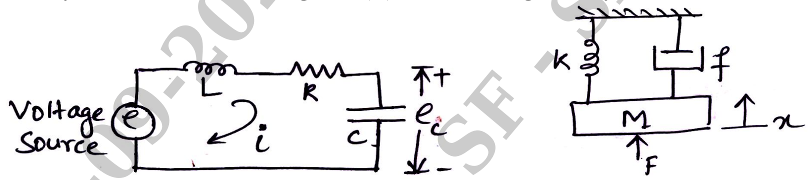

Fig Q1(b) **(05 Marks)**

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

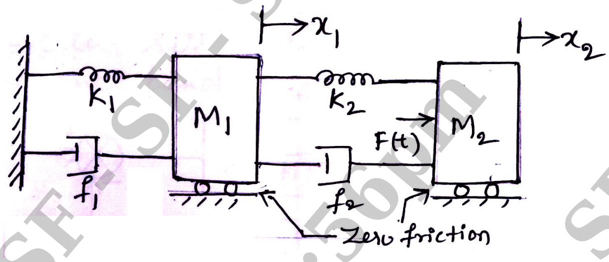

Fig Q1(c). **(10 Marks)**

OR

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

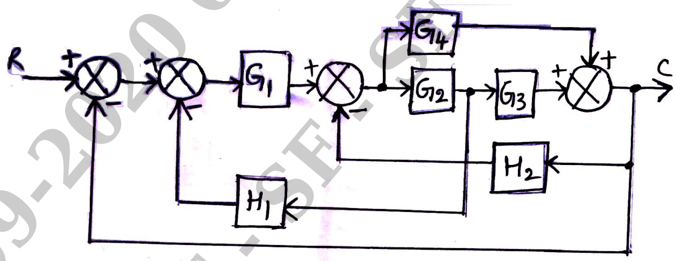

Fig Q2(a) **(10 Marks)**

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

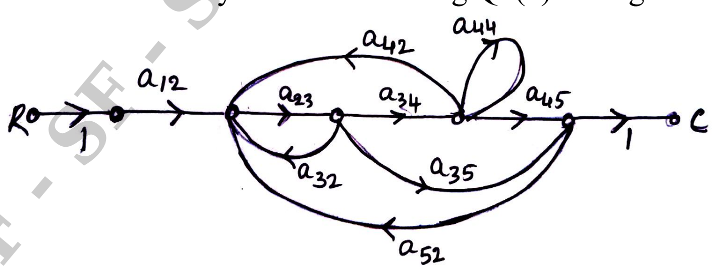

Fig Q2(b) **(10 Marks)**

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.

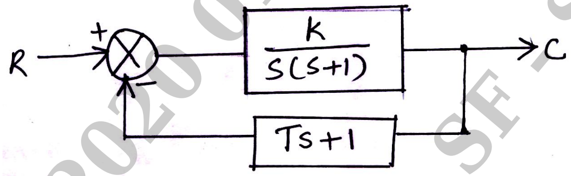

Fig Q3(c) **(08 Marks)**

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 jw – axis. **(16 Marks)**

Module-4

7 a. Derive an expression for Resonant Peak M_r and Resonant frequency W_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).

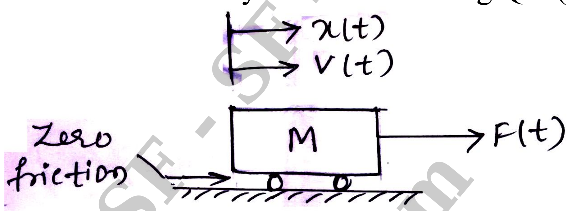

Fig Q10(a) **(10 Marks)**

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)**

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