CBCS SCHEME

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15MT34

Third Semester B.E. Degree Examination, Aug./Sept. 2020
Control System

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain the block diagram reduction techniques rules with necessary block diagrams. **(08 Marks)**

b. Refer the mechanical system shown in Fig Q1(b), obtain the cause –effect equations and then draw the electrical circuit based on force current analogy.

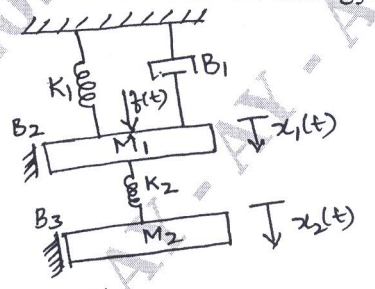

Fig Q1(b) **(08 Marks)**

OR

2 a. List the merits and demerits of open loop and closed loop control systems. Give at least one example for each. **(08 Marks)**

b. Obtain the equations of motions for the inertia J_1, J_2 for the rotational systems shown in Fig Q2(b) and find the transfer function $\frac{\theta_1}{T(s)}$

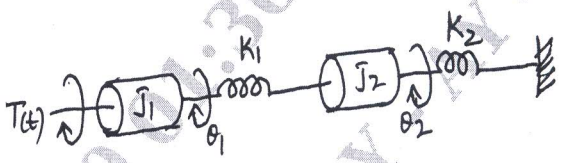

Fig Q2(b) **(08 Marks)**

Module-2

3 a. Discuss the terminologies used in signal flow graph for the signal flow graph shown in Fig Q3(a), i) Source, sink and chain node ii) Forward path, feedback and self loop, path gain iii) Non touching loops and loop gain.

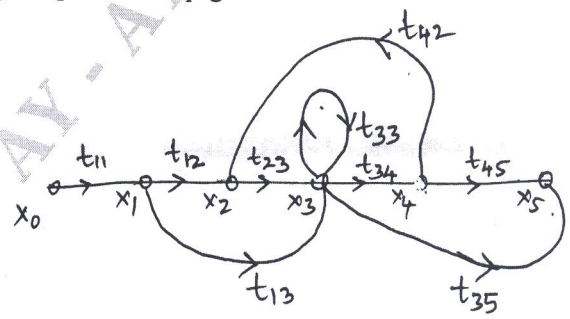

Fig Q3(a) **(08 Marks)**

b. Find $\frac{C(s)}{R(s)}$ by using Mason's gain formula for the signal flow graph shown in Fig Q3(b)

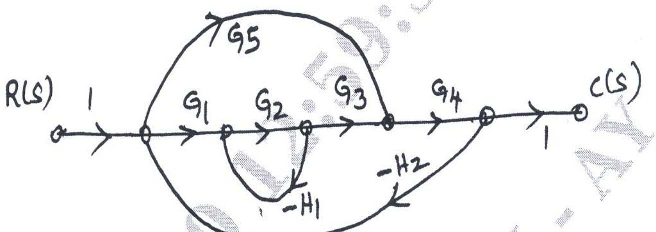

Fig Q3(b) **(08 Marks)**

OR

4 a. Derive an expression C(t) for a second order system subjected to an unit step input for an underdamped system. **(08 Marks)**

b. A second order system in given by $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$. Find its rise time, peak time, peak over shoot and settling time if subjected to a step input. Also calculate expression for its output response. **(08 Marks)**

Module-3

5 a. For the range of K for which the system, whose characteristics in given below, is stable, $F(s) = s^3 + (K + 0.5)s^2 + 4Ks + 50 = 0$. **(08 Marks)**

b. Using Routh Hurwitz criterion, determine the stability of a system whose characteristics equation is given by $2s^5 + s^4 + 6s^3 + s + 1 = 0$. **(08 Marks)**

OR

6 Draw the approximate root locus diagram for a closed loop system whose loop transfer function is given by $G(s)\,H(s) = \frac{K}{s(s+5)(s+10)}$. **(16 Marks)**

Module-4

7 Construct Bode magnitude and phase diagrams for $G(s)\,H(s) = \frac{100(0.1\,s+1)}{s(s+1)^2(0.01\,s+1)}$.

Comment on the closed – loop stability of the system. **(16 Marks)**

OR

8 Using Nyquist stability criterion, investigate the stability of a closed – loop system whose open-loop transfer functions is given by $G(s)\,H(s) = \frac{K}{(s+1)(s+2)}$. **(16 Marks)**

Module-5

9 a. Represent the differential equation into a state model

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

b. Obtain the state model of the given electrical circuit in the Fig Q9(b).

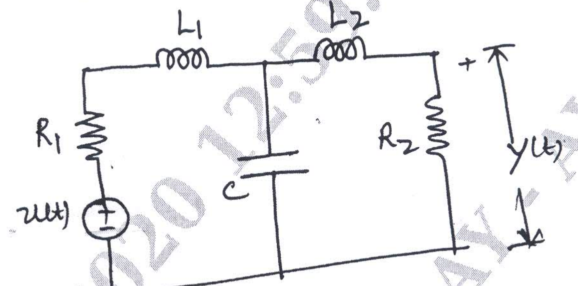

Fig Q9(b) **(08 Marks)**

OR

10 a. Obtain the state transition matrix $\phi(t)$ of the following system.

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$ **(08 Marks)**

b. For the electrical network shown in Fig Q10(b), Find a state space representation if the output in the current through the resistor.

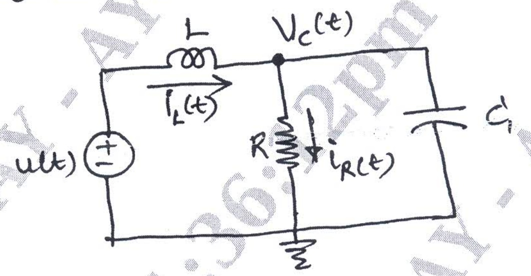

Fig Q10(b) **(08 Marks)**

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