CBCS SCHEME

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18EC43

Fourth Semester B.E. Degree Examination, July/August 2021
Control Systems

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Define control system. Compare open loop and closed loop control system. **(05 Marks)**

b. For the mechanical system shown in Fig. Q1 (b) :
   (i) Draw the mechanical network.
   (ii) Write the differential equations.
   (iii) Draw electrical network by F-V analogy.

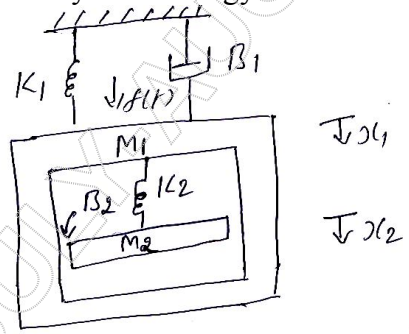

Fig. Q1 (b) **(07 Marks)**

c. Find the transfer function $\frac{X_1(s)}{F(s)}$ for the system shown in Fig. Q1 (c). **(08 Marks)**

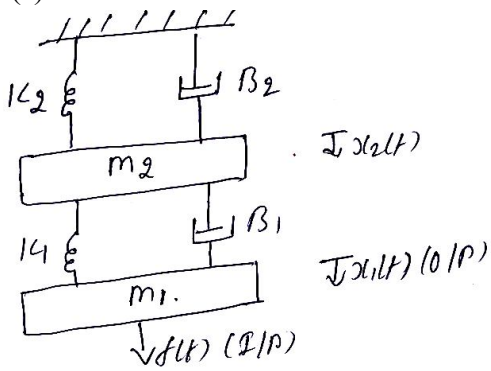

Fig. Q1 (c)

2 a. What are the effects of negative feedback in control systems? **(05 Marks)**

b. For the rotational system shown in Fig. Q2 (b). Draw the electrical network based on T-I analogy. **(07 Marks)**

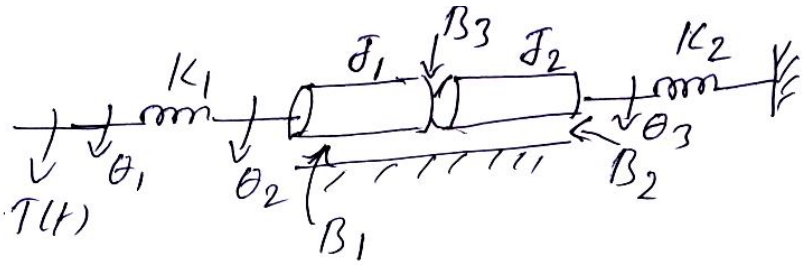

Fig. Q2 (b)

c. Find the transfer function $\frac{X_2(s)}{F(s)}$ for the system shown in Fig. Q2 (c).

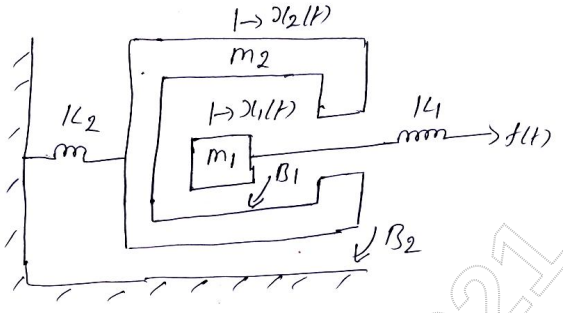

Fig. Q2 (c) **(08 Marks)**

3 a. Define transfer function. Write the features of transfer function. **(06 Marks)**

b. Derive the transfer function for a lag-lead network shown in Fig. Q3 (b). **(06 Marks)**

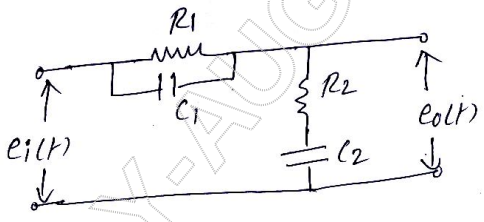

Fig. Q3 (b)

c. Obtain $\frac{C(s)}{R(s)}$ for the block diagram shown in Fig. Q3 (c) using reduction techniques.

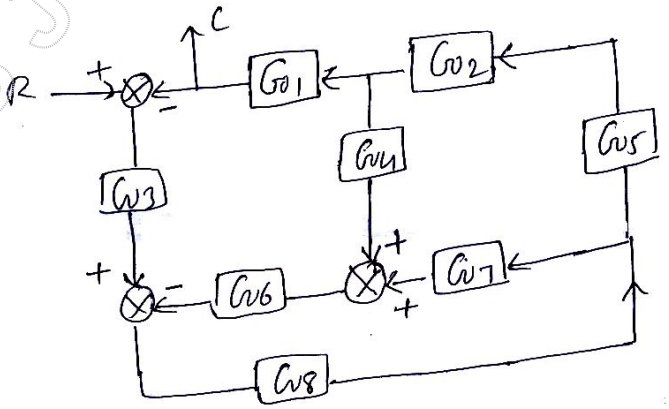

Fig. Q3 (c) **(08 Marks)**

4 a. Explain Mason's gain formula with a suitable example. **(04 Marks)**

b. Using Mason's gain formula find the gain of the following system shown in Fig. Q4 (b). **(10 Marks)**

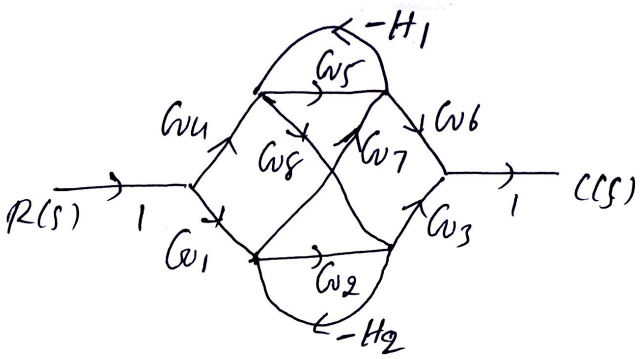

Fig. Q4 (b)

c. For the circuit shown in Fig. Q4 (c), draw the block diagram.

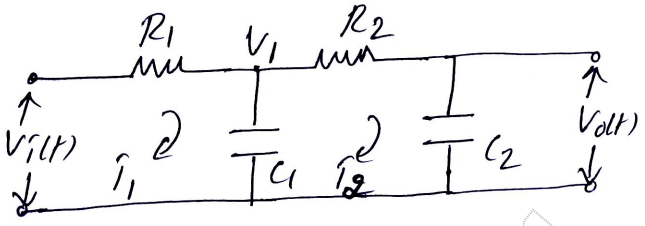

Fig. Q4 (c) **(06 Marks)**

5 a. Explain the following test signals with the help of graph and mathematical expression,
(i) Step signal
(ii) Ramp signal
(iii) Parabolic signal. **(06 Marks)**

b. What are static error coefficients? Derive the formula for each. How they are related to the steady state error. **(06 Marks)**

c. An unity feedback system has $G(s)=\frac{20(1+s)}{s^2(2+s)(4+s)}$. Calculate its steady state error coefficients and error when the applied input $r(t) = 40 + 2t + 5t^2$. **(08 Marks)**

6 a. Derive an expression for unit step response of under damped second order system. **(08 Marks)**

b. Explain the effects of PI and PD controllers on the performance of a second order control system. **(04 Marks)**

c. A system is given by differential equation $\frac{d^2y}{dt^2}+4.\frac{dy}{dt}+8y=8x$, where y = output and x = input. Determine all time domain specification for unit step input. **(08 Marks)**

7 a. Explain Routh's stability criterion for determining the stability of the system and mention its limitations. **(06 Marks)**

b. Check the stability of the given characteristic equation using Routh's method. **(06 Marks)**
$S^6+2S^5+8S^4+12S^3+20S^2+16S+16=0$.

c. Sketch the root locus diagram for open loop transfer function $G(s)H(s)=\frac{K}{s(s+2)(s+5)}$. **(08 Marks)**

8 a. Explain the construction rules of root locus. **(06 Marks)**

b. Derive the expressions for resonant peak M_r and resonant frequency W_r for a standard second order system. **(06 Marks)**

c. Sketch the bodes magnitude and phase diagram for, $G(s)H(s)=\frac{5}{s(1+0.5s)(1+0.05s)}$. **(08 Marks)**

9 a. Write a note on lead compensator. **(06 Marks)**

b. Draw polar plot of $G(s)H(s)=\frac{100}{(s+2)(s+4)(s+8)}$. **(08 Marks)**

c. Clearly explain the steps to solve problems by Nyquist criterion. **(06 Marks)**

10 a. State the advantages of state variable approach. **(04 Marks)**

b. Obtain the state model for a system shown in Fig. Q10 (b).

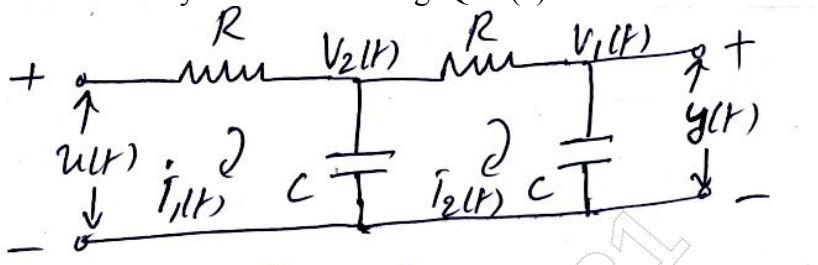

Fig. Q10 (b) **(08 Marks)**

c. Find the state transition matrix for, $A = \begin{bmatrix} 0 & -1 \\ +2 & -3 \end{bmatrix}$. **(08 Marks)**

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