Q. P. Code : 26210

[Time: Three Hours] [Marks: 80]

NB:-

a) Question number 1 is compulsory.
b) Attempt any three questions out of remaining questions.
c) Assume suitable data wherever necessary.

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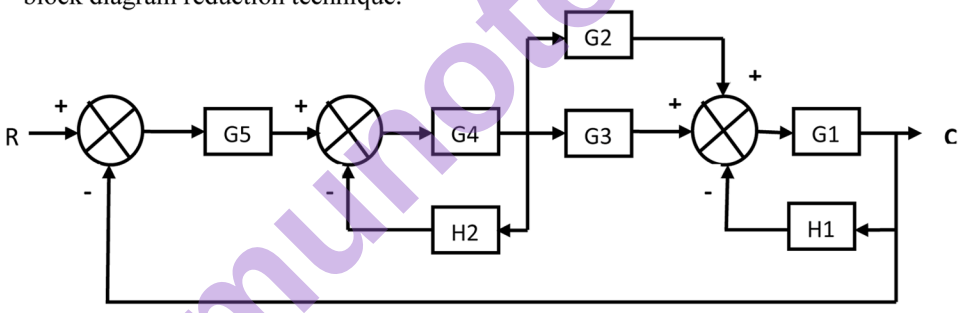
1. Attempt any four of the following questions: **20**

a) A feedback control system is represented by the characteristic equation, $S(S^2+S+1)(S+4) + K = 0$. Find the range of K for making the system stable.
b) State and prove the properties of the State Transition Matrix.
c) What are the effects of a PD controller on a system?
d) Define different static error coefficients. State the equations for the error in a TYPE 0 system subjected to Step, Ramp and Parabolic input.
e) Explain the Mason's Gain formula with reference to Signal Flow Graph technique.

2. **a)** Derive the expression for output response of a second order under-damped control system, subjected to the Unit Step Input. **10**

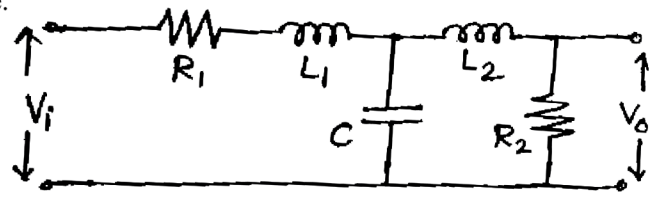
b) Find the equivalent transfer function from R to C of the following system using the block diagram reduction technique. **10**



3. **a)** A unity feedback system has $G(s) = \dfrac{40\,(s+2)}{s(s+1)\,(s+4)}$. **10**

Determine:
(i) Type of the system.
(ii) All error coefficients.
(iii) Error for ramp input with magnitude 4.

b) Obtain the transfer function of the following electrical system using Signal Flow Graph technique. **10**



TURN OVER

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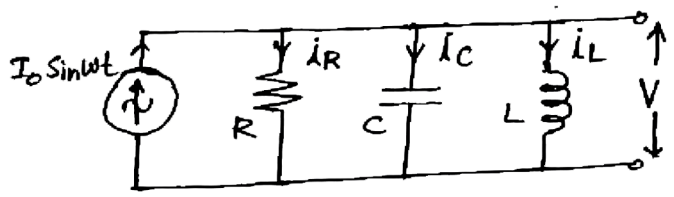
4. **a)** Obtain the State variable model of the parallel R-L-C network shown below: **10**



b) Test the controllability and observability of the system described by:

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \\ \dot{x_3} \end{bmatrix} = \begin{bmatrix} 0 & 6 & -5 \\ 1 & 0 & 2 \\ 3 & 2 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix} u$$

and $y = [1\ 2\ 3]\, x$ **10**

5. **a)** Sketch the Bode Plot and determine G.M. & P.M. for the open loop transfer function given by

$$G(s) = \frac{4(s+5)(s+10)}{s^2(s+20)}$$ **10**

b) Construct the Root Locus for the following transfer function:

$$G(s)H(s) = \frac{K(s+13)}{s(s+3)(s+8)}$$ **10**

6. Write short notes on any three of the following: **20**

a) Model predictive control system.

b) Gain Margin and Phase Margin.

c) PID Controller.

d) Open Loop and Closed Loop control system.
