CBCS Scheme

USN | | | | | | | | | | | **15MT34**

Third Semester B.E. Degree Examination, June/July 2018

Control Systems

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define control systems. Explain the classification of control system in details. **(08 Marks)**

b. Derive transfer function for lag – lead network shown in figure below if $R_1 = 100k\Omega$, $R_2 = 200k\Omega$, $C_1 = 1\mu F$, $C_2 = 0.1\mu F$.

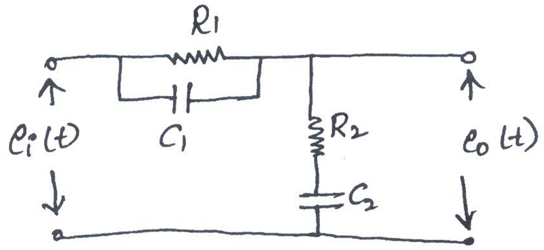

Fig Q1(b) **(08 Marks)**

OR

2 a. Draw the equivalent mechanical system and analogous system based on F – V and F – I methods for given system.

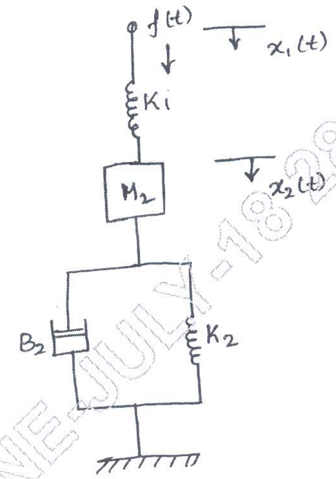

Fig Q2(a) **(08 Marks)**

b. Determine the transfer function C(s)/R(s) of the system shown in the figure.

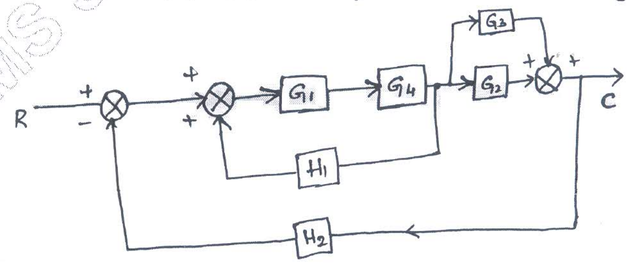

Fig Q2(b) **(08 Marks)**

Module-2

3 a. State and explain the Mason gain formula. **(08 Marks)**

b. Find the transfer function $\frac{C(s)}{R(s)}$ using signal flow graph.

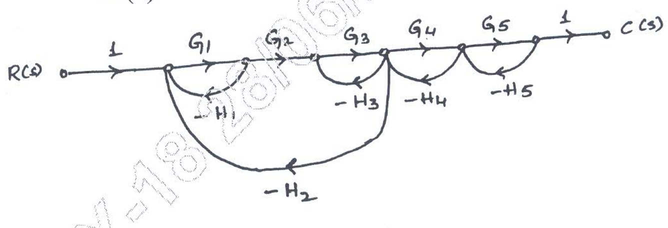

Fig Q3(b) **(08 Marks)**

OR

4 a. 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 specifications for unit step input. **(08 Marks)**

b. Consider unity feedback control system whose open loop transfer function is given by $G(s)=\frac{0.4s+1}{s(s+0.6)}$. Calculate rise time, peak overshoot, peak time and settling time. **(08 Marks)**

Module-3

5 a. For system $s^4+22s^3+10s^2+s+K=0$ find K_{mar} and 'w' at K_{mar}. **(08 Marks)**

b. The open loop transfer function of a feedback system is $G(s)H(s)=\frac{K(s+5)}{s(1+Ts)(1+2s)}$ Parameters K and T are represented on a plane with K on x-axis and T on y-axis. **(08 Marks)**

OR

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

Module-4

7 a. Using unit step response data of a second order system is given in Table Q7(a) corresponding frequency indices M_r, w_r and w_b for the system.

Time on sec	0	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
C(t)	0	0.25	0.8	1.08	1.12	1.02	0.98	0.98	1.0	1.0	1.0

Table Q7(a) **(08 Marks)**

b. A unit feedback control system has $G(s)=\frac{80}{s(s+2)(s+20)}$. Draw the Bode plot. Determine G.M, P.M, w_{gc} and w_{pc}. **(08 Marks)**

OR

8 a. Consider a system with open loop transfer function as $G(s)H(s)=\frac{10}{s}$, obtain its polar plot. **(08 Marks)**

b. Sketch the Nyquist plot and comment on closed loop stability of a system whose open loop transfer is $G(s)H(s)=\frac{10}{s^2(s+2)}$. **(08 Marks)**

Module-5

9 a. Define:
   i) State
   ii) State Vector
   iii) State space
   iv) State variable. **(08 Marks)**

b. Derive the transfer function for state model. **(08 Marks)**

OR

10 a. Determine the transfer function matrix for MIMO system given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 3 \\ -2 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$ **(08 Marks)**

b. Obtain the time response of the following system.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(t)$$

Where u(t) is the unit step occurring at t = 0 and $x^T(0) = [1 \ \ 0]$ **(08 Marks)**

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