B.E. Electronics & Communication/Telecommunication Engineering (Model Curriculum)
Semester-VI

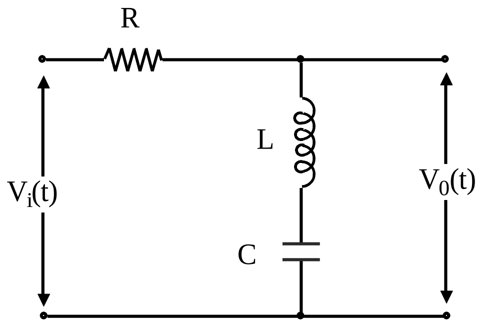
ET605M - Control Systems

P. Pages : 4 **GUG/W/24/13938**

Time : Three Hours Max. Marks : 80

Notes :
1. All questions carry equal marks.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Obtain the transfer function of following electrical network. **8**

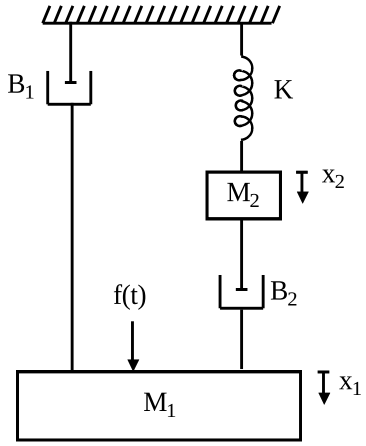


b) For the mechanical system shown **8**

i) Draw node diagram (mechanical network)

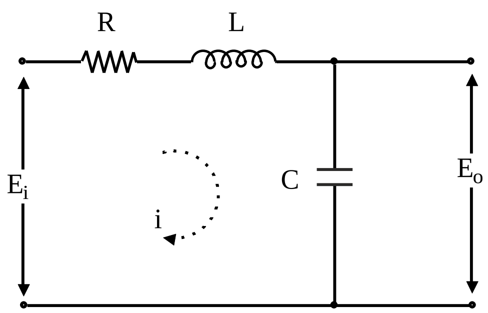
ii) Write differential equations of performance

iii) Draw Force-Voltage analogous network.



OR

2. a) Find the transfer function of the circuit shown in figure. **8**



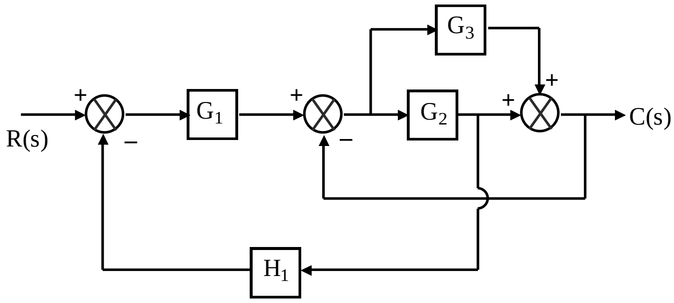
b) i) Write a short note on Praportional+Derivative (P+D) Controllers. **4**

ii) Write a short note on Praportional+Integral (P+I) Controllers. **4**

3. a) Determine the stability of system having characteristic equation as: **8**

$s^5+2s^4+3s^3+6s^2+2s+1=0$

b) Using Block diagram reduction technique, find the transfer function $\frac{C(s)}{R(s)}$ of system shown below: **8**



OR

4. a) Consider a system represented by the following set of equations. Draw the signal flow graph. **8**

$x_2 = a_{12}x_1 + a_{32}x_3 + a_{42}x_4 + a_{52}x_5$

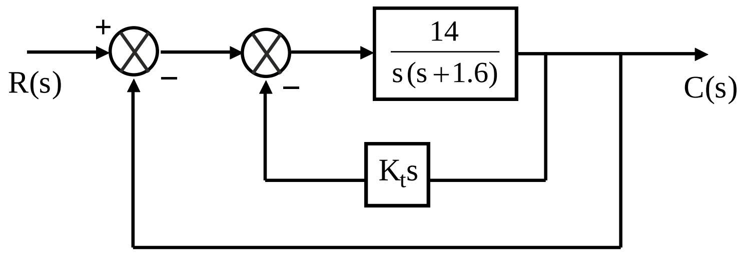
$x_3 = a_{23}x_2$

$x_4 = a_{34}x_3 + a_{44}x_4$

$x_5 = a_{35}x_3 + a_{45}x_4$

Here x_1 is the input variable and x_5 is the output variable.

b) For the system shown in figure, find k_t so that $\xi = 0.5$. Find corresponding time domain specifications. **8**



5. a) A unity feedback system has $G(s) = \frac{100(s+12)}{s(s+4)(s+5)}$ **8**

Determine

i) The type of system.

ii) All error coefficients

iii) Steady state error when subjected to input 4t.

b) Draw the root locus for the system $G(s)H(s) = \frac{k}{s(s+3)(s+6)}$ **8**

Determine the value of k for marginal stability and Critical damping.

OR

6. a) The open loop transfer function of a unity feedback control system is given by **8**

$$G(s) = \frac{25}{s(s+5)}$$

Obtain maximum overshoot, peak time, rise time and settling time.

b) A feedback control system has **8**

$$G(s)H(s) = \frac{100(s+3)}{s(s+1)(s+5)}.$$

Draw Bode plot and comment on stability.

7. a) Derive the frequency domain specifications: **8**
Resonant Peak (M_r) and Resonant Frequency (ω_r).

b) A particular second order system has a Resonance Peak of 2 at a Resonance Frequency of 3 rad/sec. Determine Peak Overshoot, Peak time, Settling time and Rise time. **8**

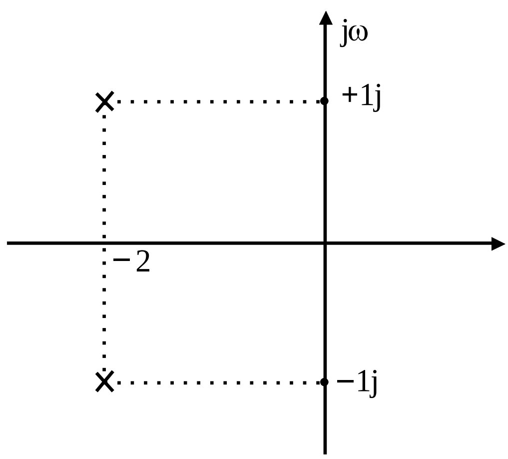
OR

8. a) A unit step input is applied to a unity feedback control system having open loop transfer function **8**

$$G(s) = \frac{k}{s(1+sT)}$$

Determine the values of k and T to have $M_p = 20\%$ and resonant frequency $\omega_r = 6 \text{ rad/sec}$. Calculate the resonant peak M_r.

b) The pole zero configuration of a closed loop transfer function is plotted as shown in figure. Determine bandwidth of this system. **8**



9. a) Find the state transition matrix $\phi(t)$. **8**

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

Also find $\phi^{-1}(t)$.

b) A feedback system is having the closed loop transfer function: **8**

$$T(s) = \frac{s^2 + 3s + 3}{s^3 + 2s^2 + 3s + 1}$$

Construct a state model for the system.

OR

10. a) The state variable model of a continuous LTI system is **8**

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ -3 & -5 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r(t)$$

Calculate state vector $\left[x_1(t) \quad x_2(t)\right]^T$.

b) Define the terms: **8**

i) State

ii) State variables

iii) State vector

iv) State space

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