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

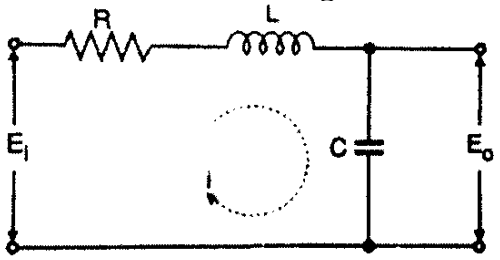
ET605M - Control Systems

P. Pages : 3 **GUG/S/23/13938**

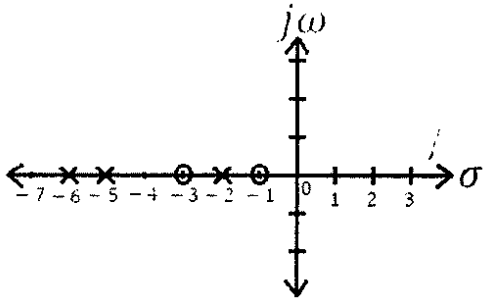
Time : Three Hours Max. Marks : 80

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

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

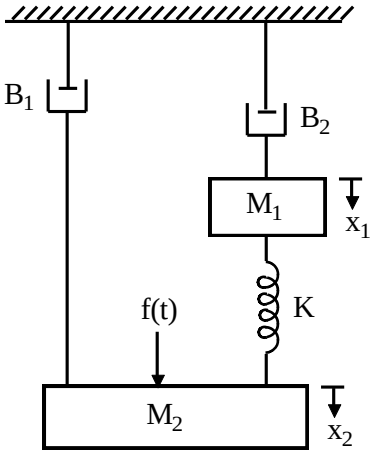


b) Obtain the transfer function and characteristic equation of the system whose DC gain is 3 and system poles and zeros are located as shown in the s-plane. **8**



OR

2. a) For the mechanical system shown **8**
i) Draw node diagram (mechanical network)
ii) Write differential equations of performance
iii) Draw Force-Current analogous network.



b) i) Given the system transfer function **4**

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

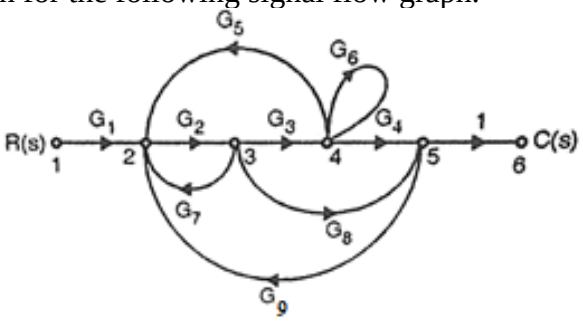
Find the differential equation.

ii) The impulse response of a system is e^{-3t}. Find the transfer function. **4**

3. a) Using Routh stability criterion, find the stability of the following system whose characteristic equation is **8**

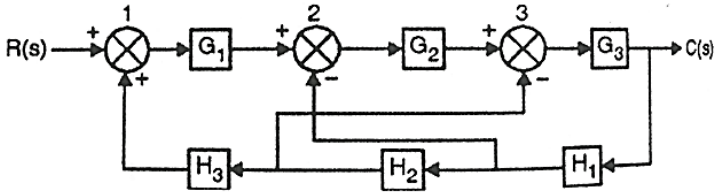
$$s^6 + s^5 + 3s^4 + 3s^3 + 2s^2 + s + 1 = 0$$

b) Obtain transfer function for the following signal flow graph. **8**

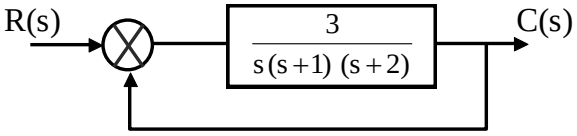


OR

4. a) Using block diagram reduction techniques reduce the following block diagram of a system into a single equivalent block. **8**



b) Check whether the given system is stable or not using Hurwitz stability criterion. **8**



5. a) Sketch the root locus for the system having **8**

$$G(s)H(s) = \frac{k(s+3)}{s(s^2+2s+2)}$$

Comment on the stability of system.

b) For the following system comment on stability using Nyquist plot. **8**

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

OR

6. a) For a second order underdamped system if step input is applied, obtain the derivation of Peak time (t_p). **8**

b) Draw the Magnitude Bode plot of given unity feedback system. **8**

$$G(s) = \frac{160}{(s+2)\ (s+20)}$$

7. a) For a second order system with unity feedback. **8**

$$G(s) = \frac{200}{s(s+8)}$$

Find the frequency domain specifications.

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

$$G(s) = \frac{c}{s(s+c)}$$

i) Determine value of c so that maximum overshoot is 40%
ii) For this value of c, determine resonant peak value and resonant frequency.

OR

8. a) Compare frequency and time domain specifications of control system. **8**

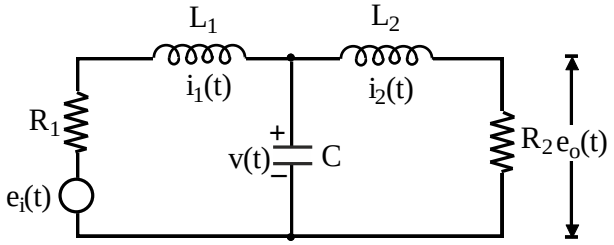
b) Derive the equation for frequency domain specification: Resonant frequency (ω_r) for a second order system. **8**

9. a) Find transfer function of **8**

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

$$y = \begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

b) Obtain the state model of the given circuit. **8**



OR

10. a) Define the terms: **8**

i) State
ii) State variables
iii) State vector
iv) State space

b) Find CCF form **8**

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 3 \\ 1 & 1 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$$

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