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

ET605M - Control Systems

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

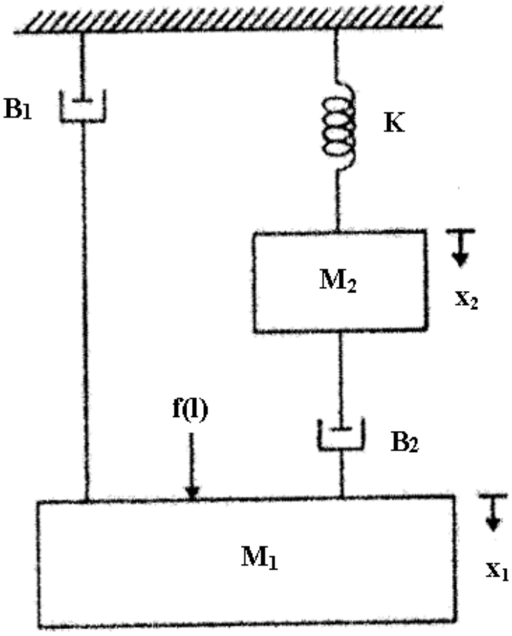
Time : Three Hours Max. Marks : 80

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

1. a) i) The output of a linear system for a unit step input is given by t^2e^{-t}. Find the transfer function of the system. **4**

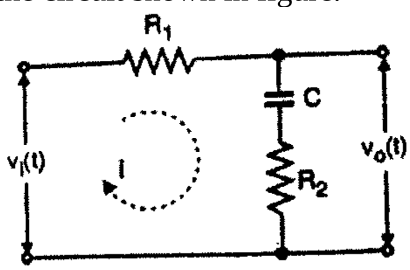
ii) Determine the transfer function of the system if DC gain is 5, the poles are at $(s=-3)$ and $(s=-1\pm j)$, the zeros are at $(s=-2\pm j)$. **4**

b) For the mechanical system shown. **8**
i) Draw node diagram (mechanical network)
ii) Write differential equation of performance
iii) Draw Force-Voltage analogous network



OR

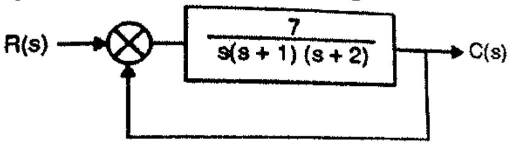
2. a) Find the transfer function of the circuit shown in figure. **8**



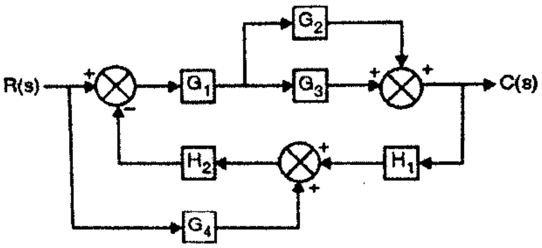
2. b) Draw the Pole-Zero representation in s-plane and also obtain the characteristics equation of the system having Transfer function as: **8**

$$G(s) = \frac{C(s)}{R(s)} = \frac{5(s^2+4s+3)}{s(s^2+7s+10)}$$

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

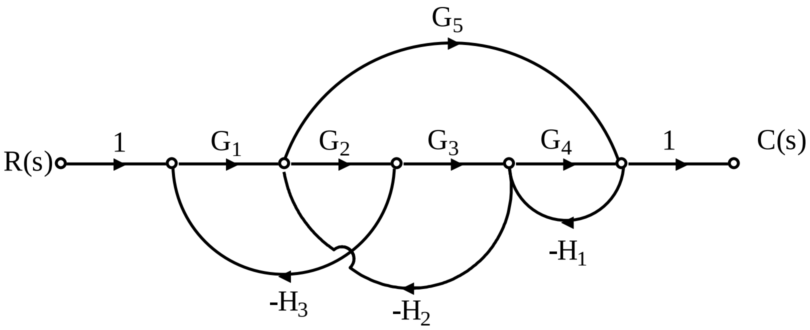


b) Reduce the following block diagram of a system into a single equivalent block by using block diagram reduction techniques. **8**



OR

4. a) Obtain the transfer function of the system represented by signal flow graph below by using Mason's gain equation. **8**



b) Determine stability of the system having characteristic equation **8**
$s^5+s^4+2s^3+2s^2+3s+5=0$ using Routh stability criterion.

5. a) For a second order underdamped system if step input is applied, obtain the derivation of Rise time (t_r). **8**

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.

OR

6. a) Draw Nyquist plot and comment on stability of the system **8**

$$G(s)H(s) = \frac{1}{(s+2)\ (s+4)}$$

b) The open loop transfer function of a system is **8**

$$G(s)H(s) = \frac{k}{s(s+2+2j)\ (s+2-2j)}$$

Draw the complete root locus and comment on the stability of the closed loop system.

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

b) For $T(s) = \dfrac{64}{s^2+5s+64}$ **8**

Find frequency domain specifications.

OR

8. a) Derive the frequency domain specification: Resonant Peak (M_r) for a second order system. **8**

b) A second order system has a resonance peak of 2 at a resonance frequency of 3rad/sec. Determine Peak overshoot, Peak time, Settling time and rise time. **8**

9. a) 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.

b) Find CCF form **8**

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

OR

10. a) Obtain state variable model in phase variable form for the transfer function. **8**

$$T(s) = \frac{Y(s)}{R(s)} = \frac{s+3}{s^3+5s^2+8s+4}$$

b) Find transfer function of **8**

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

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

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