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

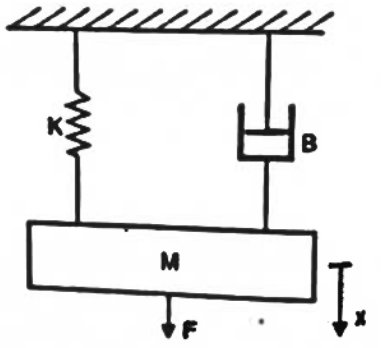
ET605M - Control1- Control Systems

P. Pages : 3 **GUG/S/25/13938**

Time : Three Hours * 2 3 4 8 * 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.

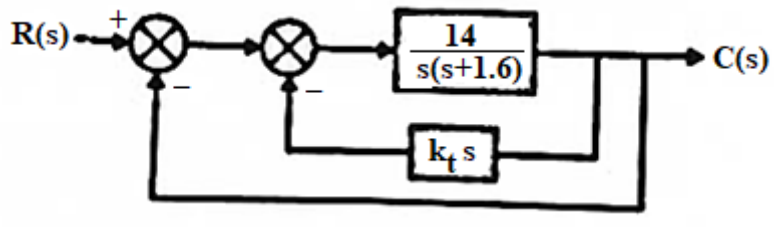
1. A) For the mechanical system shown in figure write the system differential equations of performance. Also obtain the electrical analogous circuit using force-current analogy. **8**



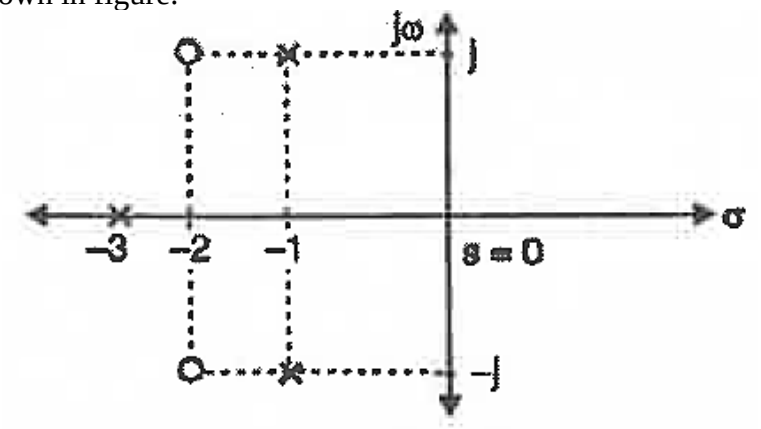
B) Define Transfer Function of a system. **8**
Also give advantages and disadvantages of Transfer Function.

OR

2. A) Find k_t so that $\xi = 0.5$. Find corresponding time domain specifications. **8**



B) Determine the transfer function if the DC gain is 5 for system having pole-zero plot in the S-plane is as shown in figure. **8**



3. A) Determine the stability of system using Routh's criteria if the system characteristic equation is $s^8 + 5s^6 + 2s^4 + 3s^2 + 1 = 0$. **8**

B) Consider a system represented by the following equations. Draw the SFG of the given system. **8**

$x_1 = 6x_0 + 3x_2$

$x_2 = 12x_1 + 5x_2 + 2x_3$

$x_3 = 2x_2 + 3x_4$

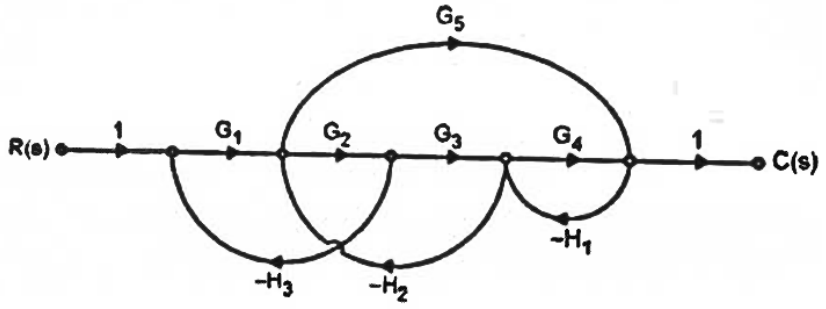
$x_4 = 11x_3$

OR

4. A) By Hurwitz criteria find stability of the system having characteristic equation as: **8**

$s^4 + 8s^3 + 18s^2 + 16s + 5 = 0$

B) Obtain the transfer function for the SFG shown in figure using Mason's Gain equation. **8**



5. A) Draw the root locus for the system. **8**

$$G(s)H(s) = \frac{k}{s(s+3)(s+6)}.$$

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

B) Derive the equation for settling time (T_s) as a transient response specification for second order underdamped system. **8**

OR

6. A) A unity feedback system has a forward path transfer function **8**

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

Determine rise time, peak time, peak overshoot, settling time (2% tolerance), delay time, output response to a unit step input.

B) A unity feedback system has **8**

$$G(s) = \frac{100(s+12)}{s(s+4)(s+5)}$$

Determine

i) The type of system

ii) All error coefficients

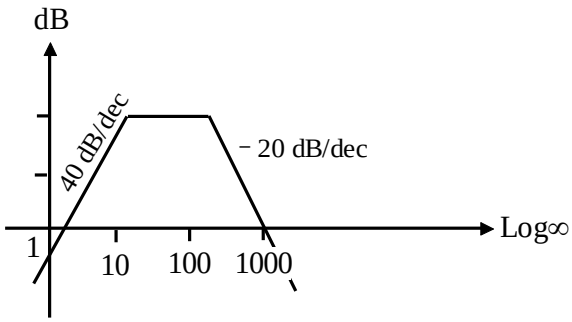
iii) Steady state error when subjected to input 4t.

7. A) 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.

B) Recover the transfer function of system from following gain plot. **8**



OR

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

9. A) Obtain state transition Matrix for the system **8**

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

B) Obtain state variable model in phase variable form for the transfer function **8**

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

OR

10. A) Obtain a state space model of the system with transfer function **8**

$$\frac{Y(s)}{U(s)} = \frac{6}{s^3+6s^2+11s+6}.$$

B) Find Eigen values of A **8**

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

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