Reg. No. : | | | | | | | | | | |

Question Paper Code: 41051

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2015.

Fourth Semester

Electronics and Instrumentation Engineering

01UEI401 - CONTROL ENGINEERING

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. Define Transfer function of a system.
2. Differentiate open loop and closed loop control system.
3. List the standard test signals used in control system.
4. Define steady state error.
5. Name the frequency domain specifications.
6. What is compensator? What are the different types of compensator?
7. What are asymptotes? How will you find the angle of asymptotes?
8. What is the necessary and sufficient condition for stability?
9. What is the advantage and disadvantage in canonical form of state model?
10. Write the solution of homogeneous state equations.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) Find the transfer function V_0 (S) / V_i (S) of the given electrical network Fig.1.

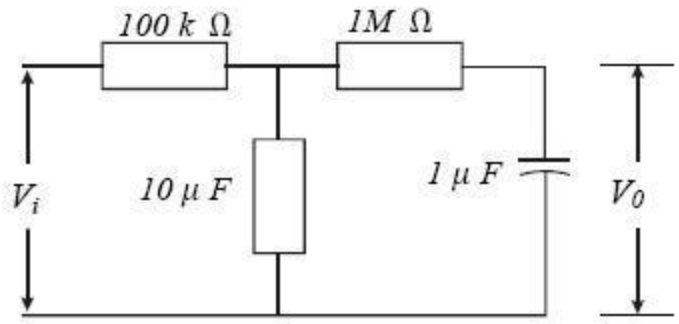

Fig. 1 (8)

(ii) Find the transfer function of the Mechanical system shown in Fig. 2.

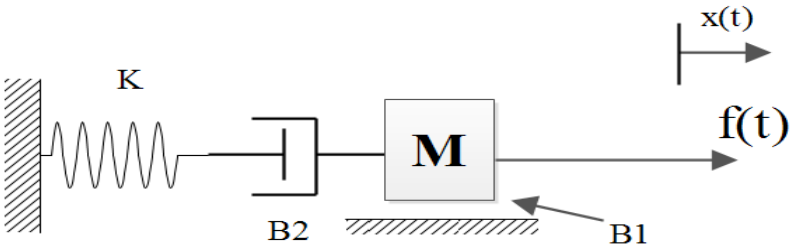

Fig. 2 (8)

Or

(b) Draw the signal flow graph and find *C(S) / R(S)* using Mason's gain formula for the system shown in Fig. 3.

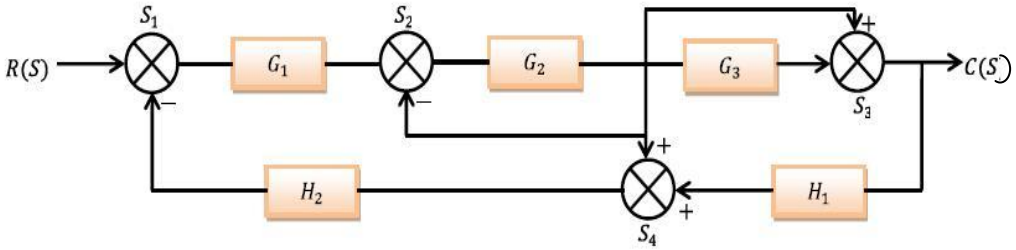

Fig. 3 (16)

12. (a) (i) Open loop transfer function of a unity feedback system is $G(s) = \frac{K}{S(S+1)}$. For a particular value of *K*, the peak overshoot is 50 %. Find the value of *K* to be increased so as to reduce the peak overshoot by half. (8)

(ii) Closed loop transfer function of a system with unity feedback is given by $C(s)/R(s) = (Ks + b) / (s^2+as+b)$. Find the open loop transfer function *G(s)* and also show that Steady state error with unit ramp input is given by *(a-k) / b*. (8)

Or

(b) (i) Find the position , velocity and acceleration error constants of a unity feedback control system with open loop transfer function $G(s) = \frac{10(s+2)}{s^2(s+1)}$. (6)

(ii) Derive the equation for unit step response of under damped second order system. (10)

13. (a) A system shows resonance peak of *2* and resonance frequency 3 *rad/sec*. Determine the transfer function of the equivalent second order system and hence, find the T_r , T_p, T_s , % overshoot, time of oscillations and number of oscillations before settling. Draw a sketch of frequency response. (16)

Or

(b) A unit step input is applied to a unity feedback control system having open loop transfer function $(s) = \frac{K}{s(1+sT)}$. Determine the values of *K* and *T* to have M_p =20% and resonant frequency $\omega_r = 6\, rad/sec$. Calculate the resonant peak M_r. (16)

14. (a) Using Nyquist Criterion obtain the range of values of K for which the system with open loop transfer function $G(s)H(s) = \frac{K(s+1)}{[s^2(s+2)(s+4)]}$. (16)

Or

(b) Analyze the stability of the system whose characteristic equation is given by $S^7+S^6+3S^5+2S^4+9S^3+9S^2+27S+18=0$. And also comment on the location of its roots. (16)

15. (a) (i) Derive the relationship between the state equation and transfer function. (8)

(ii) Obtain the transfer function of the system defined by the following state equations

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$Y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

(8)

Or

(b) Find the solution of the system represented in state space as $X' = AX$

Where $A = \begin{bmatrix} -2 & -4 \\ 1 & -2 \end{bmatrix}$ and $X(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. (16)