Code No. 2140

FACULTY OF ENGINEERING

B.E. 3/4 (Mech.) II-Semester (Supplementary) Examination, January 2013

Subject : Control System Theory

Time : 3 Hours **Max. Marks: 75**

Note: Answer all questions of Part - A and answer any five questions from Part-B.

PART – A (25 Marks)

1. Describe the block diagram of a person playing a video game. Suppose that the input device is a joystick and the game is being played on a desktop computer. (3)
2. A spring used in an auto shock absorber develops a force 'f' represented by the relation $f=kx^4$ where x is the displacement of the spring. Determine a linear model for the spring when $x_0=1$. (3)
3. The error of a control system is given as $\frac{9s+15}{s(s+5)}$. Find the initial and final values of the signal. (3)
4. What is the motivation behind the concept of Observability? (2)
5. Sketch the polar plot of a system whose $G(s)=\frac{e^{-st}}{(1+sT)}$. (3)
6. What is the effect of positive feedback on the stability of the system? (2)
7. What is the effect of PI controller on the rise time and settling time of a control system? (2)
8. The terms in the first column of Routh's array of the characteristic equation of a certain system are 4, 7, 6, -5, -4, -3. The no. of closed loop poles that are to the right of the S-plane are. (2)
9. Find $\phi(t), if A=\begin{pmatrix}1 & 2\\ 2 & 3\end{pmatrix}$. (3)
10. State whether the given statements below are True or False. (2)
    (i) A simple on-off switch is an example of a linear system
    (ii) A bode plot can be used for stability analysis of both minimum and non-minimum phase systems.
    (iii) The general effect of adding a pole to the loop transfer function is to make the closed loop system less stable while decreasing the bandwidth.
    (iv) The Design objective of the phase lead controller is to place the maximum phase lead at the new gain cross over frequency.

PART – B (5x10=50 Marks)

11. For the given Mechanical system in figure (1), find the transfer function $G(s)=\frac{\theta(S)}{F(S)}$. (10)

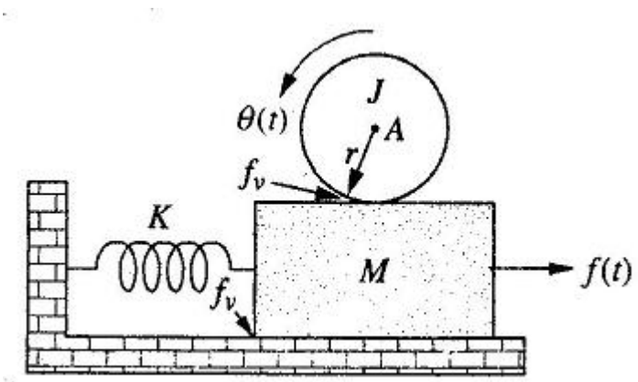

Fig.1

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12. A second order system has the closed loop transfer function $T(S)=\frac{Y(S)}{R(S)}$. The system specification for a step input follow.
    Percent overshoot ≤ 5%
    Settling time Ts= 4 sec
    Peak time Tp = 1 sec (10)

    Determine the permissible area for the poles of T(s) in order to achieve the desired response. (use 2% settling criterion)

13. Sketch the root locus for a system represented by unity feedback function $G(S)=\frac{K(S^2+3.6S+81)}{S(S+1)(S+5)}$. Fine the value of gain K so that the damping ratio of complex roots is 0.707. (10)

14. Sketch the bode plot for a feedback control system with loop transfer function $G(S)=\frac{30(S+8)}{S(S+2)(S+4)}$ and determine Gain margin and phase margin. (10)

15. If $\frac{Y(s)}{X(s)}=\frac{S+a}{S^4+9S^3+28S^2+38S+24}$. Determine real value of 'a' so that the system is unobservable or uncontrollable. (10)

16. The loop transfer function of a single feedback loop control system is given by (10)
$$G(S)=\frac{K(S^2-5S+1)}{S(S+1)(S^2+4)}$$
    Apply Nyquist criterion and determine the values of K for the system to be stable.

17. Answer any **three** of the following: (10)
    (a) Routh's criteria
    (b) Lead compensation
    (c) Transfer function
    (d) Frequency response specification of a 2nd order system
    (e) Signal flow graphs

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