Code No. 6347 / M

# FACULTY OF ENGINEERING

**B.E. 3/4 (Mech.) II – Semester (Main) Examination, June 2014**

**Subject: Control System Theory**

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

***Note: Answer all questions from Part A. Answer any five questions from Part B.***

## PART – A (25 Marks)

1 What are the characteristics of Negative feedback?

2 What is the effect of feedback on overall gain of a control system?

3 Find Inverse Laplace Transform of $F(s) = \frac{1}{s^2(s^2 + w^2)}$.

4 Compare AC and DC servo motors.

5 The open loop transfer function for a servo system with unity feedback is $G(s) = \frac{10}{s(0.1s + 1)}$ find the static error coefficients for a unit step input.

6 Mention the effects of PD compensation on the nature of the system.

7 Define State Transition Matrix and mention its properties.

8 What is the motivation behind the concept of observability?

9 Write short notes on correlation between time response and frequency responses for a second order system.

10 Sketch the polar plot of $G(s) = \frac{(S + 8)}{S(1 + 8S)(1 + S)}$.

## PART – B (50 Marks)

11 (a) Determine the equations of motion for the following mechanical system given in Figure (1) where an inertia J of radius r attached to a fixed axis of rotation A as shown below. The inertia is in contact with a mass M attached via a spring of stiffness K to a fixed wall. The intetia-mass contact is subject to viscous friction of coefficient $f_v$. The motion of the mass with respect to the horizontal floor is subject to the same viscous friction coefficient $f_v$. The system input is a horizontal force f(t) on the mass M and the output is the rotation θ(t) of the inertia. 5

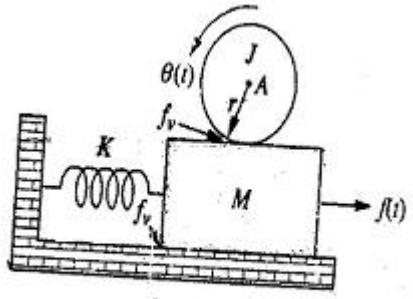


Fig (1)

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(b) Obtain the analogous electrical system for the given mechanical system in Fig. 2. 5

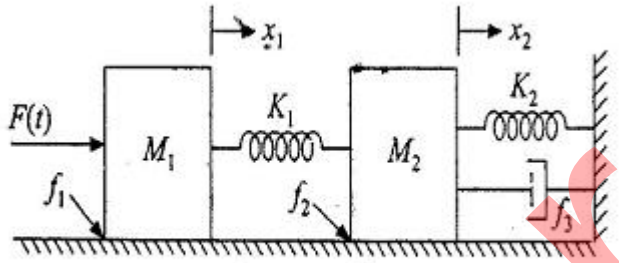


Fig (2)

12 (a) Reduce the block diagram given in figure (3) to a single transfer function $T(S) = \frac{C(S)}{R(S)}$. 5

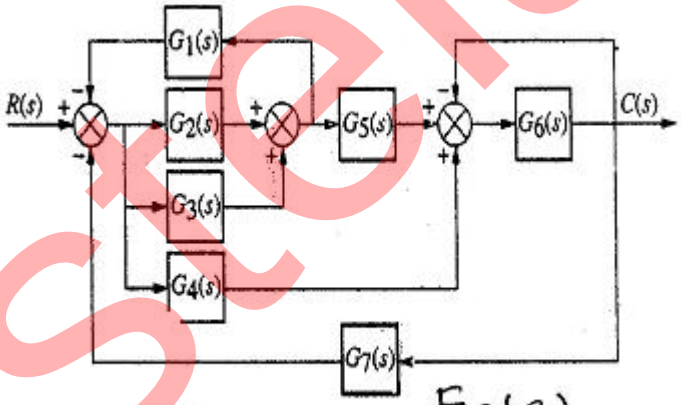


Fig (3)

(b) For the system represented by Figure 4, determine the damping ratio, natural frequency, percent overshoot, settling time, peak time, rise time and damped frequency of oscillation. 5

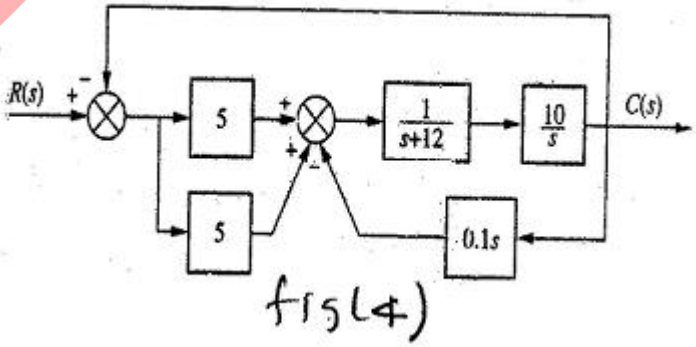


fig (4)

13 Sketch the root locus of the of a system represented by unity feedback system $G(S) = \frac{K(S+1)}{S^2(S+9)}$. 10

14 Sketch the Bode plot for the system represented by unity feedback system $G(S) = \frac{KS}{(S+5)(S+20)(S+50)}$ and determine Gain margin, phase margin and range of K for stability. 10

15 Sketch the Nyquist plot and determine the stability of the system represented by unity feedback system $G(S) = \frac{K(S+6)}{S^2(S+2)}$. 10

16 Check for controllability and observability of a system represented by unity feedback system

$$G(S) = \frac{S^2+3S+4}{S^3+2S^2+3S+2}$$ 10

17 Write short notes on the following:
a) Steady state error coefficients
b) Lag compensation
c) Rouths stability criterion.

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