Code No. : **5199/M**

FACULTY OF ENGINEERING
B.E. 3/4 (Mech.) II Semester (Main) Examination, May/June 2012
CONTROL SYSTEM THEORY

Time : 3 Hours] [Max. Marks : 75

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

PART – A **(25 Marks)**

1. Draw a component block diagram for a feedback system consisting of a human steering an automobile. Identify the location of following elements and their units associated with each signal.
   a) The process
   b) The process desired output signal
   c) The sensor. **3**

2. State the reasons for approximating a physical model of a systems. **2**

3. What is the major objective of adding a derivative signal in a feedback system ? **2**

4. State Mason's gain formula. **2**

5. Find the type and order of a system represented by the transfer function
   $G(s) = \dfrac{s+2}{s^2(s^2+2s+1)}$ **2**

6. Determine the range of value 'K' for stability of a unit feedback system whose open loop transfer function is $G(s) = \dfrac{k}{s(s+1)(s+3)}$. **4**

7. If $A = \begin{bmatrix} -4 & -1.5 \\ 4 & 0 \end{bmatrix}$, find e^{At}. **3**

8. What are the advantages of frequency response techniques over time domain techniques. **2**

9. Explain the procedure for the design of a lead compensator. **3**

10. Differentiate between open and closed loop systems. **2**

PART – B (50 Marks)

11. a) Find the transfer function $G(s) = \frac{X_2(s)}{F(s)}$ for the translational mechanical system shown in fig. (1). 5

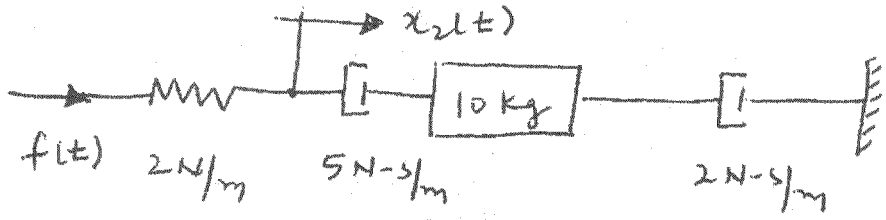

Fig. 1

b) For the given mechanical system in fig (2) obtain an equivalent electrical system. 5

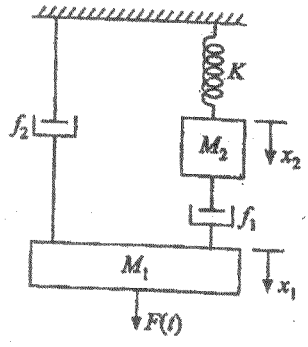

Fig. 2

12. For the system represented by fig. (3) obtain the transfer function using block reduction technique. 10

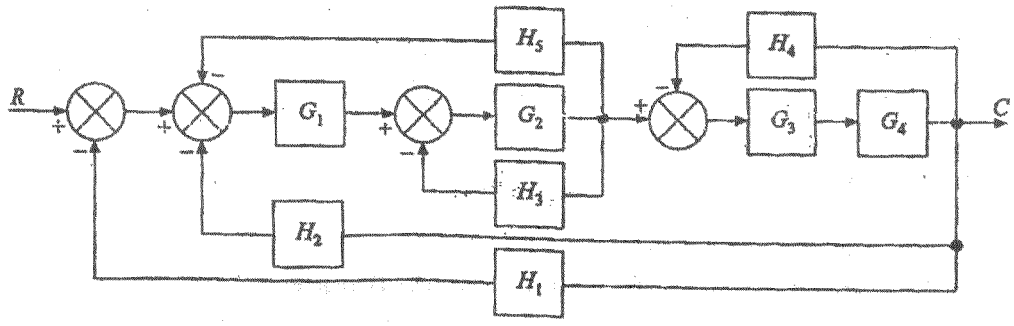

Fig. 3

13. Sketch the root locus for the given characteristic equation and find the range of stability.

$F(s) = s(s+1)(s^2+4) + k(s^2+1) = 0$ **10**

14. Sketch the bode plot for the system represented by transfer function

$$G(s) = \frac{K_c^{-0.25}}{s(1+s)(1+.25)}$$

comment on the stability of the system for K = 1. **10**

15. Sketch the Nyquist plot and comment on the stability of the closed loop system whose open loop transfer function is $G(s) = \frac{K}{s(s^2+2s+1)}$. **10**

16. Given a system described by the dynamic equations **10**

$$\frac{dx(t)}{dt} = Ax(t) + bu(t)$$

$$y(t) = cx(t)$$

Where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix} \quad C = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix}$$

a) Find the transfer function relation between x(s) and u(s).

b) Find whether the system is output controllable.

c) Find whether the system is observable.

17. Write short notes on : **10**

a) Linearisation of non-linear systems.

b) Sensitivity performance indices.

c) 2nd order system specifications.
