Student Exam No._____

GANPAT UNIVERSITY

B. Tech. Semester: IV Electronics & Communication Engineering

CBCS Regular Examination April – June 2015

2EC402 Control Systems

Time: 3 Hours **Total Marks: 70**

Instructions: 1. Attempt all questions.
2. Answers to the two sections must be written in separate answer books.
3. Figures to the right indicate full marks.
4. Assume suitable data, if necessary.

SECTION-I

Que.-1 **(A)** For the electrical system shown in fig. (1), derive the transfer function Vo(s)/Vi(s). 5

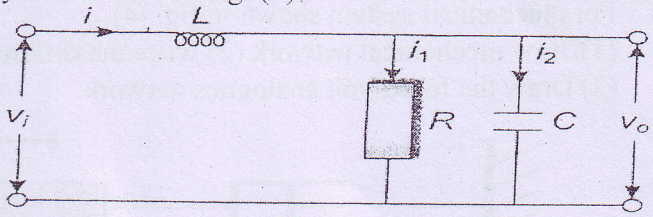

Fig.(1)

(B) Define the following terms: 3
1. Close loop system
2. Error detector
3. Servomechanism

(C) Justify the following statements with necessary diagram 4
1. The traffic control system used in road crossings in typical Indian cities is open loop control system.
2. A domestic washing machine is open loop control system.

OR

Que.-1 **(A)** Derive the transfer function for a general closed loop control system. 4

(B) Write short note on DC Tachometer. 5

(C) For the system input x, output y given by 3

$$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + y = x + \frac{dx}{dt}$$

Find the transfer function.

Que.-2 **(A)** Reduce the block diagram and obtain its transfer function as shown in fig. (2). 6

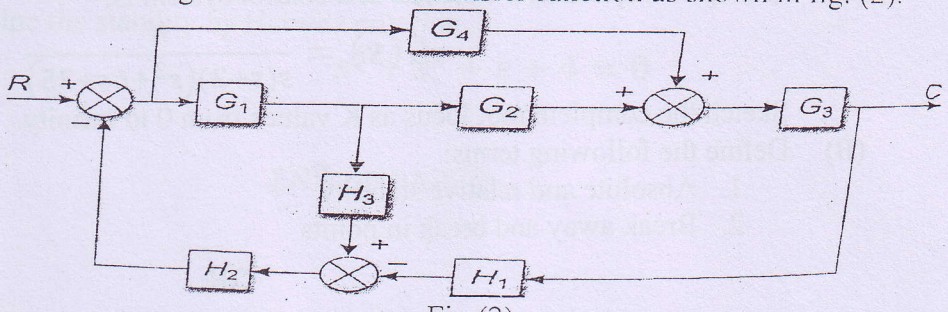

Fig.(2)

(B) Find $\frac{C(S)}{R(S)}$ for given signal flow graph shown in fig. (3) using Mason's gain formula. 6

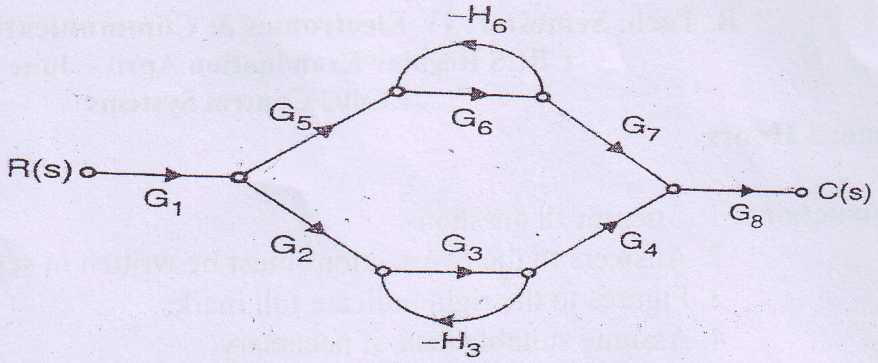

Fig.(3)

OR

Que.-2 (A) For mechanical system shown in fig. (4). 6
(1)Draw mechanical network (2) write the differential equations of performance
(3) Draw the force-volt analogues network.

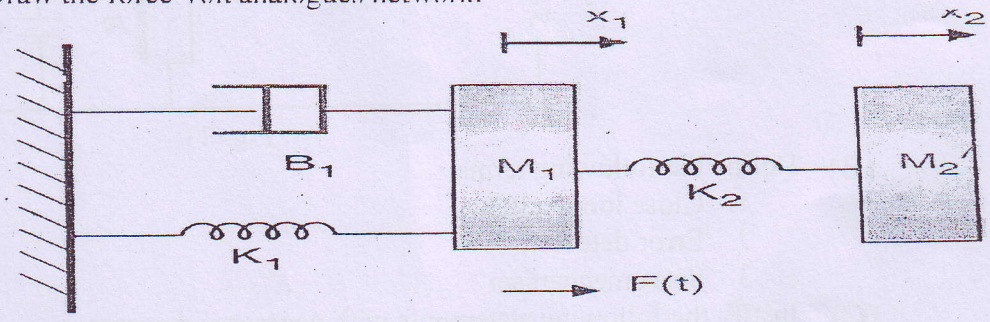

Fig.(4)

(B) Define steady state error. Derive the expression for steady state error. 6

Que.-3 (A) Construct the signal flow graph for the following set of simultaneous equation. 3

$$X_2 = A_{21}X_1 + A_{23}X_3$$
$$X_3 = A_{31}X_1 + A_{32}X_2 + A_{33}X_3$$
$$X_4 = A_{42}X_2 + A_{43}X_3$$

(B) State and explain Mason's gain formula. 3

(C) Write the rules for block diagram reduction techniques.

SECTION-II

Que.-4 (A) The open loop transfer function of a control system is, 8

$$G(s) = \frac{K}{s(s+2)(s^2+6s+25)}$$

Sketch the complete root locus as K values from 0 to infinity.

(B) Define the following terms: 4

1. Absolute and relative stability
2. Break away and break in points

OR

Que.-4 **(A)** Sketch the polar plot for the following function

$$G(s)H(s) = \frac{20}{s^2(s+1)(s+2)}$$

(B) Answer the following questions:

1. How the roots of characteristic equation are related to stability?
2. What will be the nature of impulse response, when the roots of characteristic equation are lying on imaginary axis?
3. What is centroid? How it is calculated?
4. In routh array what conclusion can you make when there is row of all zeros?

Que.-5 **(A)** Sketch the bode plot and hence find Gain cross over frequency, Phase cross over frequency, Gain margin and phase margin.

$$G(s)H(s) = \frac{2(s+0.25)}{s^2(s+1)(s+0.5)}$$

(B) Define the following terms:

1. Polar plot
2. Bode plot
3. Gain margin
4. Critically stable system

OR

Que.-5 **(A)** Sketch the nyquist plot for the control system with open loop transfer function given by $G(s)H(s) = \frac{(s+1)}{s^2(s-2)}$ comment on the stability. 6

(B) Determine the value of k so that the closed loop system in fig.(5) is stable using Routh's stability criterion. 6

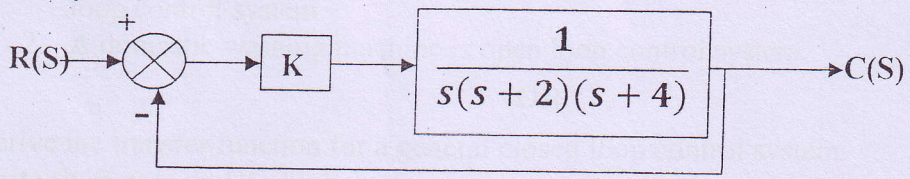

Fig.(5)

Que.-6 **(A)** What is the necessary condition for stability? Using Routh criterion determine the stability of the system whose characteristic equation is 8

$$s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0.$$

Comment on stability. Determine the number of roots on imaginary axis.

(B) Examine the stability by Hurwitz criterion, 3

$$s^3 + s^2 + s + 4 = 0$$

END OF PAPER