Exam No: _____

GANPAT UNIVERSITY

B. TECH SEM- IV (ELECTRICAL)

REGULAR EXAMINATION– APRIL-JUNE 2017

2EE401: Control System Engineering

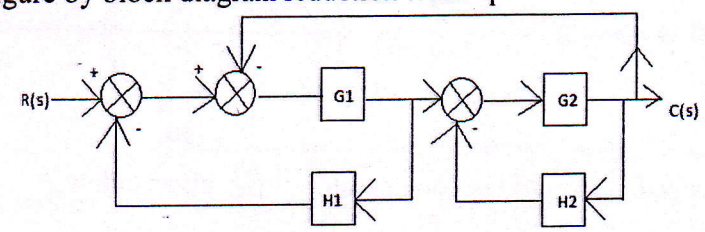
Time: 3 Hrs **TOTAL MARKS: 60**

Instructions: (1) This Question paper has two sections. Attempt each section in separate answer book.
(2) Figures on right indicate marks.
(3) Be precise and to the point in answering the descriptive questions.

SECTION I

Q.1

(A) Obtain the transfer function of the control system whose block diagram is shown in below Figure by block diagram reduction technique. [05]

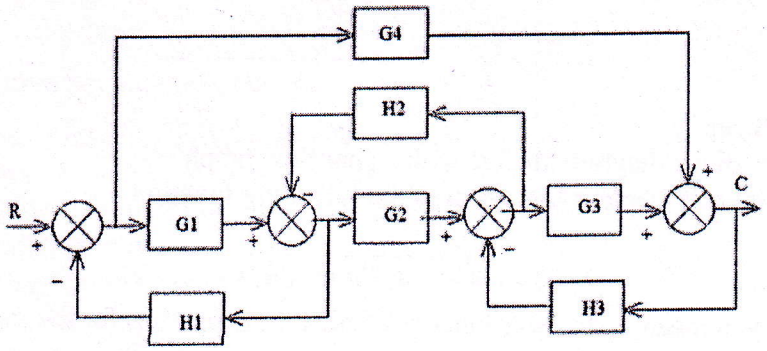


(B) Explain force – voltage analogy in detail. [05]

OR

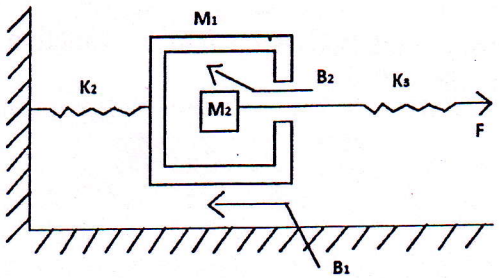
Q.1

(A) Reduce the block diagram shown in fig. by using block diagram reduction techniqu [05]



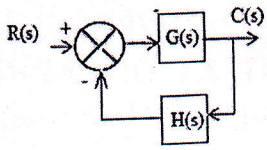
(B) For the system shown in below Fig. [05]

(i) Draw the mechanical network.
(ii) Only draw force current analogous network.
(iii) Only draw force voltage analogous network.



Q.2

(A) Derive the transfer function of closed loop system showing in below Figure. [04]

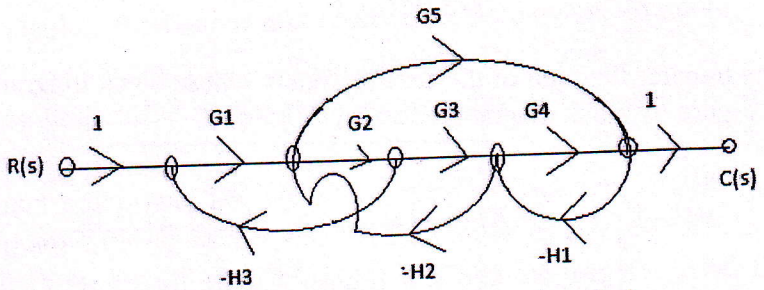


(B) Explain Mason's gain formulae with suitable example and figure. [06]

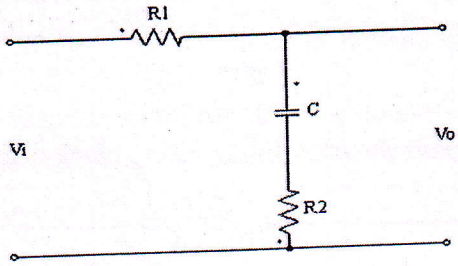
OR

Q.2

(A) The system signal flow graph is shown below. Find the transfer function of the system. [07]



(B) Find the transfer function of lag compensator of fig. given below. [03]



[10]

Q.3 **Attempt any three.**

(A) Compare: Block diagram algebra with signal flow graph

(B) Find the inverse Laplace transform of the following function

$$G(s) = \frac{4}{s(s^2 + 6s + 90)}$$

(C) What do you mean by transfer function? Enlist the properties for the same.

SECTION II

Q.4

(A) Apply Routh stability criterion and find the value of K for which the system is stable for given characteristics equation. $s^4 + 5s^3 + 5s^2 + 4s + K = 0$ [03]

(B) Sketch the root locus for the open loop transfer function of a unity feedback control system given below, K > 0. [07]

$$G(s) = \frac{K}{s(s+3)(s+9)}$$

OR

Q.4

(A) Check the stability of the following system using Routh criterion. [04]

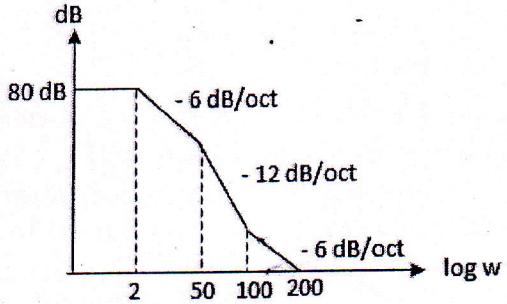
$$s^5 + s^4 + 4s^3 + 24s^2 + 3s + 63 = 0$$

(B) Determine centroid, no of asymptotes, angle of asymptotes, and angle of departures for the unity feedback system shown below. [06]

$$G(s) = \frac{K}{s(s+2+3j)(s+2-3j)}, K > 0$$

Q.5

(A) Recover the transfer function of the system from the figure shown below. Also obtain the value of system gain. [05]



(B) Derive expressions of (i) Rise time, t_r (ii) Peak time, t_p and (iii) Peak overshoot, M_p for the system of above equation. [05]

$$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

OR

Q.5

(A) For the system having the open-loop transfer function [07]

$$G(s)H(s) = \frac{10}{s(s+1)(s+10)}$$

Determine the stability of the system by plotting the Bode Plot of the system.

(B) Define following term. [03]
(a) type of system (b) order of system (c) steady state error

Q.6 **Attempt any three.** [10]

(A) Determine the value of K such that the roots of the characteristics equation given below lie to the left of line s = -1. $s^3 + 10s^2 + 18s + K = 0$

(B) Using the Nyquist criterion determine the stability of the system whose open loop transfer function is given as

$$G(s)H(s) = \frac{50}{(s+1)(s+2)}$$

(C) Discuss the designing steps of Phase lead-lag compensator.

END OF PAPER