Student Exam No.____________________

GANPAT UNIVERSITY

B. Tech. Semester: IV(Electrical) Engineering
Regular Examination April – June 2015
2EE403: Control System Engineering

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

Instruction:
1 Attempt all questions.
2 Make suitable assumptions wherever necessary.
3 Figures to the right indicate full marks.

Section - I

Que. – 1 **(A)** The open loop transfer function of a unity feedback control system is **[6]**

$$G(s) = \frac{4}{s(s+1)}$$

Determine the response of the closed loop system for a unit step input. Also determine the rise time, peak time, peak overshoot, and settling time.

(B) For unity feedback system having an open loop transfer function **[6]**

$$G(s) = \frac{K(s+2)}{s(s^3+7s^2+12s)}$$

Determine: (a) type of system (b) error constants K_p, K_v, K_a (c) steady state error for unit parabolic input

OR

Que. – 1 **(A)** Derive the time response of the following second order system for step input. **[6]**

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

(B) Determine the position, velocity and acceleration error constants and the steady state error for (i) unit step input (ii) unit ramp input (iii) unit parabolic input. The open loop transfer function of the unity feedback control system is given below **[6]**

$$G(s) = \frac{K}{s(s^2+3s+100)}$$

Que. – 2 **(A)** Derive the state space representation of a system whose dynamics has been expressed in the form of a differential equation given below. **[5]**

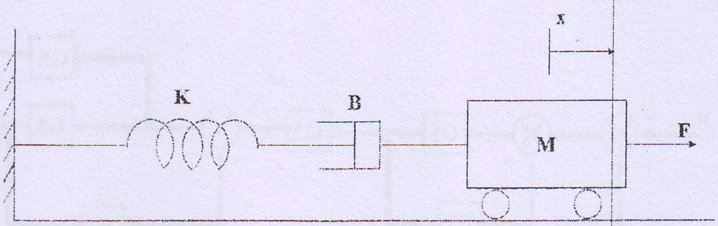
$$\frac{d^4y}{dt^4} - \frac{d^2y}{dt^2} + \frac{dy}{dt} + 7y = u$$

(B) Using the Nyquist criterion determine the stability of the system whose open loop transfer function is given as **[6]**

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

OR

Que. – 2 **(A)** For the given mechanical system derive the state space model. **[6]**



(B) The open-loop transfer function of the unity feedback control system is **[5]**

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

Draw the Nyquist plot and determine the closed loop stability by applying Nyquist criterion.

Que. – 3 **Attempt any three**

(A) How to close the Nyquist plot from s = +j0 to s = -j0? **[4]**

(B) What are the advantages of state space analysis over transfer function analysis? **[4]**

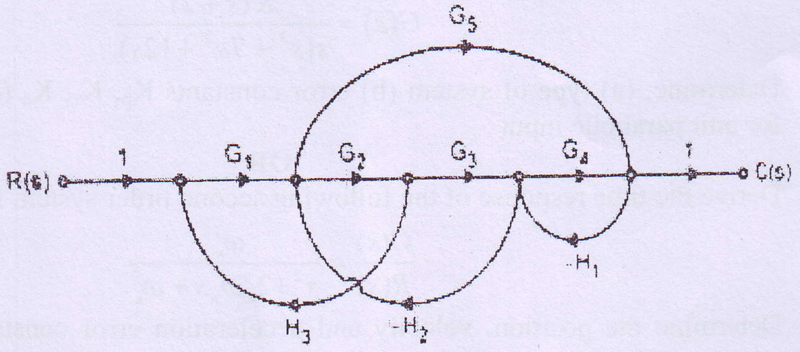
(C) Find the inverse Laplace transform of the following function **[4]**

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

(D) What is closed loop system? Give two practical examples. **[4]**

Section – II

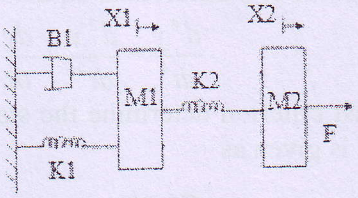
Que. – 4 (A) Obtain the transfer function relating to the C and R for given figure with help of Mason's gain formula. **[8]**



(B) For the system shown in below Fig. **[4]**

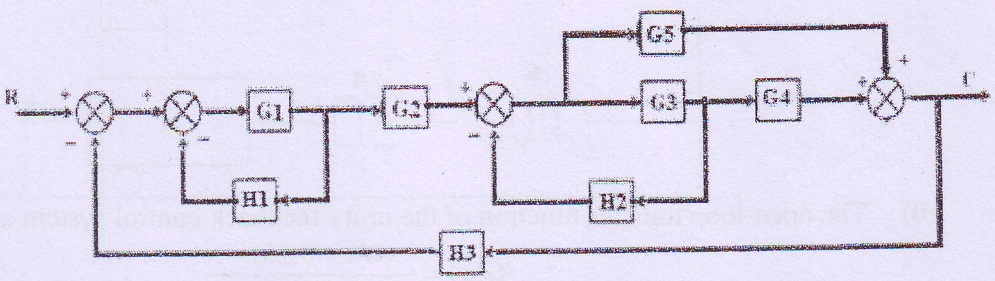
(i) Draw the mechanical network.

(ii) Write the system equations.



OR

Que. – 4 (A) Obtain the overall transfer function for the given block diagram by block diagram reduction method. **[8]**



(B) Derive the equation for force-voltage analogy system and make a comparison between translational and electrical quantity. **[4]**

Que. – 5 **(A)** Sketch the root locus for unity feedback control system with $G(s) = \frac{K}{s(s+1)(s+3)}, K > 0$ and determine the value of K for marginally stable system. **[8]**

(B) Define the angle of departure for $G(s)H(s) = \frac{K(s+2)}{\{s+(1+j)\}\{s+(1-j)\}}$ and locate in s-plan. **[3]**

OR

Que. – 5 **(A)** For the system having the open-loop transfer function **[8]**

$$G(s)H(s) = \frac{10}{s(s+1)(s+5)}$$

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

(B) What do you mean by disturbance rejection ability? **[3]**

Que. – 6 **Attempt any two**

(A) Determine the stability for $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$ by Routh's criteria method, and mention that, how many roots are in right hand side of S-plane? **[6]**

(B) Derive the system equation for gear train mechanism. **[6]**

(C) (i) Locate the poles and zeros for the given transfer function, $G(s) = \frac{12(s+3)}{s(s+2)(s+4)}$, and also derive the value of transfer function for S=1. **[6]**

(ii) Explain the rules for shifting a take off point after a summing point with help of necessary blocks.

END OF PAPER