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**B.Tech. 6th Semester Mechanical Engineering**

**Examination, May-2013**

**AUTOMATIC CONTROL**

**Paper-ME-308-F**

Time allowed : 3 hours } [ Maximum marks : 100

*Note : Question No. 1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt five questions in total with at least one question from each section.*

1. (a) Define characteristic equation of a transfer equation.
  - (b) Define signal flow graph.
  - (c) Name the two types of electrical analogies for the mechanical system.
  - (d) Define transient response.
  - (e) What is steady state error ?
  - (f) What is a bode plot ?
  - (g) Define relative and absolute stability.
  - (h) State limitations of Routh-Hurwitz criterion.
  - (i) What are the effects of adding pole and zero on the root locus ?
  - (j) What are the advantages of state space techniques ?
- 2×10=20

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Section-A

2. (a) Compare the following control systems : 10
- (i) Feedback and feed forward control systems.
  - (ii) Causal and non-causal control systems.
  - (iii) Stable and unstable control systems.
  - (iv) Time variant and time invariant control systems.
- (b) Determine overall transfer function shown in figure 1. Use block diagram reduction rules.

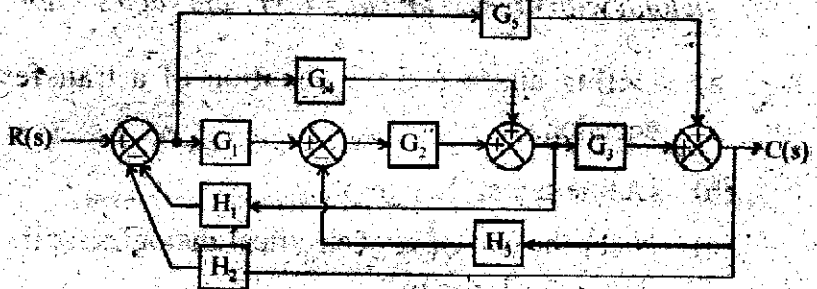


Fig-1

3. Explain Hydraulic controllers, electronic controllers and pneumatic controllers with suitable example. 20

Section-B

4. (a) Derive the expression for response of second order control system if unit step signal is applied. Draw graph for the same. Also mention all the terms on the graph. 10

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- (b) The closed loop transfer function is given by

$$G(s) = \frac{s(s^2 + 9s + 19)}{s^3 + 7s^2 + 14s + 8}$$

Determine the response of the system when a unit step is applied at the input. 10

5. Sketch the bode plot for the transfer function

$$G(s) = \frac{1000}{(1 + 0.1s)(1 + 0.001s)}$$

Determine phase margin, gain margin and stability of the system. 20

### Section - C

6. (a) Investigate the stability using Routh-Hurwitz criterion of following characteristic equation.

$$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0 \quad 10$$

- (b) A system oscillates with frequency  $\omega$ , if it has pole at  $s = \pm j\omega$  and no pole in the right half of  $s$ -plane. Determine the value of  $k$ , and the system

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shown in figure 2 oscillates at frequency of 2rad/sec. 10

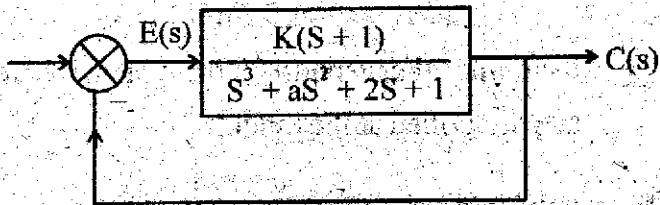


Fig-2

7. For a unity feedback system the open loop transfer function is given by

$$G(s) = \frac{K_s}{s(s+2)(s^2+6s+25)} \quad 20$$

Sketch the root locus as k varies from zero to infinity.

#### Section-D

8. Find the time response of the system described by the equation

$$\dot{x}(t) = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

$$x(0) = \begin{bmatrix} -1 \\ 0 \end{bmatrix}, u(t) = 1, t > 0 \quad 20$$

9. Explain hold device and pulse transfer function with suitable example. 20