24357

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-Hurwtiz 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

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.

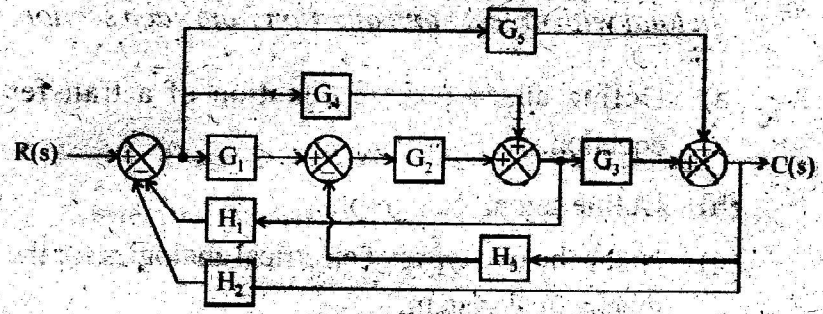

Fig.-1

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

(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.

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

(b) A system oscillates with frequency ω, 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

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

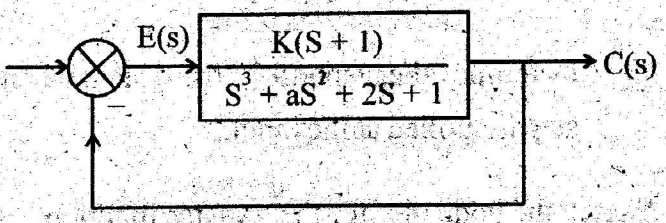

Fig.-2

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

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

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

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

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