B. Tech. 6th Semester (Mechanical Engg.) F. Scheme

Examination, May–2012

AUTOMATIC CONTROL

Paper–ME–308–F

Time allowed : 3 hours] *[Maximum marks : 100.*

Note : ***This Q. 1 is compulsory*** *and of short answer type. Each question carries equal marks (20 marks). Students have to attempts 5 questions in total at least* ***one*** *question from each section.*

1. (a) Define poles and zeros of a transfer function.

(b) What is Mason's gain formula ?

(c) What are the basic elements in thermal system ?

(d) Sketch the various test input signals for transient analysis.

(e) Explain the relationship between damping ratio and % overshoot.

(f) What is a polar plot ?

(g) What is Bandwidth ?

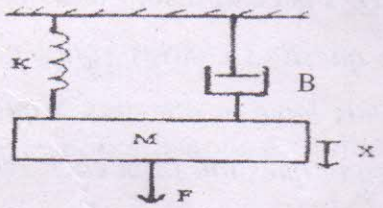
(h) Define marginally stable system.

(i) Explain the term asymptotes and centroid.

(j) Define eigenvalues and eigenvectors. 2×10=20

Section–A

2. (a) Obtain equivalent electrical circuits for the given mechanical systems in Fig. 1, using force to voltage and force to current analogy. Also draw circuit diagrams of results obtained.

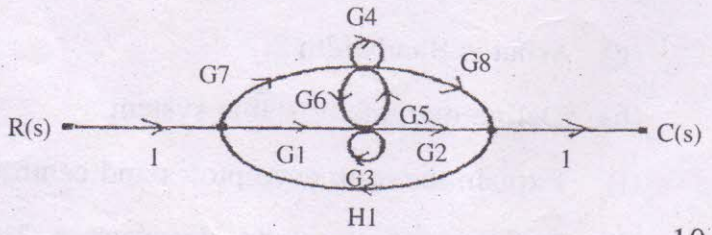


10

Fig. 1

(b) Define transfer function of control system. Derive the transfer function for canonical form of control system. Write merits and demerits of transfer function. 10

3. (a) Find the transfer function of the control system given by its signal flow graph in Fig. 2.



10

Fig. 2

(b) Explain various types of controllers with suitable example. 10

Section–B

4. A system having a forward path transfer function $G(s) = 16/s(s + 1)$ and unity feedback. Determine the value of undamped natural frequency, damping ratio. If tachometer feedback is introduced, the feedback path, transfer function becomes $(1 + Ks)$. What should be the value of K to obtain damping ratio of 0.6. Also calculate the percentage overshoot, first overshoot, t_p and setting time with in the 2% of final value. 20

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.

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

(b) Explain the procedure and significance of Nyquist criterion. 10

7. The forward path transfer function of a unity feedback system is given by

$$(S) = \frac{K}{s\,(s+4)\,(s+5)},$$

Sketch the root locus as k varies from zero to infinity. 20

Section–D

8. For the given transfer function, obtain the state model

$$G\,(S) = \frac{K}{s^3 + a_3 s^2 + a_2 s + a_1}.$$ 20

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