

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, DECEMBER 2006

EE 2K 603—CONTROL SYSTEMS—I

Time : Three Hours

Maximum : 100 Marks

Answer all questions.

1. (a) Define and explain open-loop and closed-loop control systems. Differentiate them.
- (b) For the mechanical system shown in Fig. 1. Find $X/Y (s)$

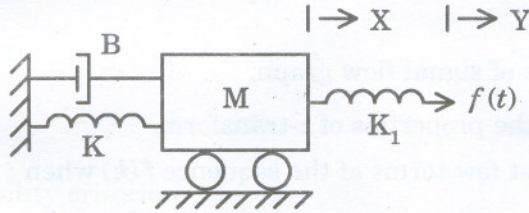


Fig. 1

- (c) Explain the principle of data reconstruction and hold circuits with a neat sketch.
- (d) List the properties of inverse-z transform.
- (e) Choose the real value of K so that the system is just oscillatory for the function :

$$F(s) = s^4 + Ks^3 + (K + 4)s^2 + (K + 3)s + 4 = 0.$$

- (f) Explain the steps to construct root locus with an example.
- (g) Explain the logarithmic plots.
- (h) Explain the advantages of Nichol's chart.

(8 × 5 = 40 marks)

2. (a) (i) Derive Mason's gain formula.

(8 marks)

- (ii) Find $\frac{C(s)}{R(s)}$ for the system shown in Fig. 2.

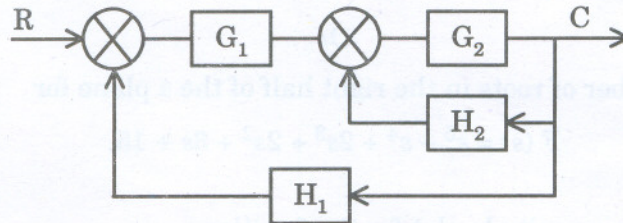


Fig. 2

(7 marks)

Or

Turn over

- (b) (i) For the mechanical system shown in Fig. 3 write the differential equation and hence find $\frac{\theta_2}{T}(s)$.

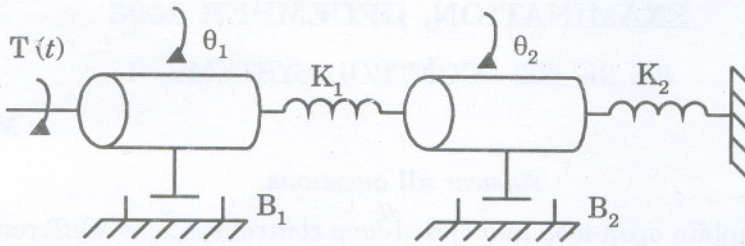


Fig. 3

- (ii) Explain the terms of signal flow graph. (8 marks)
3. (a) (i) State and derive the properties of z -transform. (7 marks)
- (ii) Determine the first few terms of the sequence $f(k)$ when :

$$F(z) = \frac{z^2 + z}{z^2 - 2z + 1}$$

(7 marks)

Or

- (b) (i) Explain the principle of a sampled data system with digital computer. (8 marks)
- (ii) Find the inverse z -transform of $\frac{3z^2 + 2z + 1}{z^2 + 3z + 2}$. (7 marks)
4. (a) (i) Explain the concept of bilinear transformation with an example. (8 marks)
- (ii) For a system whose $GH(s) = \frac{10}{s(s+1)(s+2)}$, find the steady-state error when it is subjected to the input $r(t) = 1 + 2t + 3t^2/2$.

(7 marks)

Or

- (b) (i) Find the number of roots in the right half of the s plane for

$$F(s) = s^5 + s^4 + 2s^3 + 2s^2 + 3s + 15.$$

(8 marks)

- (ii) Sketch the log magnitude plot for the function :

$$G(s) = \frac{100s(1+0.1s)}{(1+0.01s)(1+s)}$$

(7 marks)

(a) (i) Draw the Bode plots for the function

$$G(s) = \frac{(1 + sT_a)(1 + sT_b)}{(1 + sT_1)(1 + sT_2)},$$

where $T_1 > T_a > T_b > T_2$.

(8 marks)

(ii) Find the gain margin and phase margin for $HG(s) = \frac{2(s+1)}{s^2}$. Also find ξ and ω_n .

(7 marks)

Or

(b) Write short notes on :

- (i) M-N circles.
- (ii) Polar plot.
- (iii) Nyquist stability criterion.

(3 × 5 = 15 marks)

[4 × 15 = 60 marks]