

Total number of printed pages – 4

B. Tech  
CPEE 5302

FIFTH SEMESTER EXAMINATION – 2005

CONTROL SYSTEM ENGINEERING

Full Marks – 70

Time : 3 Hours

*The figures in the right-hand margin indicate marks.*

*Answer Question No. 1 which is compulsory and any five from the rest.*

*Use of Semilog Graph paper and Rectangular coordinate Graph papers is permitted.*

1. Answer the following : 2×10
- (a) Define Control System. Enumerate different kinds of control systems (classification).
  - (b) Distinguish between Open-loop and Closed-loop systems.
  - (c) Show the difference between a Regulator and a Servo mechanism.

P.T.O.

(d) Distinguish between Transfer Function and Frequency Transfer Function.

(e) Modification of Rules of construction of Root locus of systems with Transportation-lag.

(f) Illustrate through example the effect of addition of pole and zero on the shape of the root locus.

(g) Find correlation between step-Transient and Frequency Response Specifications.

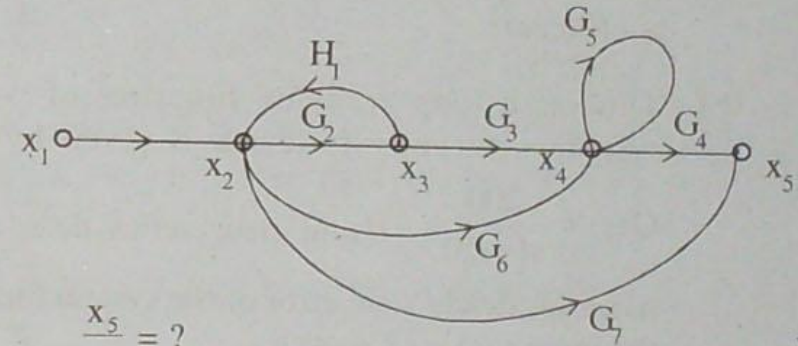
(h) Write notes on M-circles.

(i) Explain the principle of Argument.

(j) Differentiate between PI & PID controllers.

2. Derive the Transfer Function of armature controlled d.c. servomotor. Explain its merit in comparison with a field controlled d.c. servomotor. 8+2

3. State and explain Mason's gain formula for a signal flow graph. Obtain the Transfer Function  $\frac{x_5}{x_1}$  of the system shown in Fig. 1. 10



$$\frac{x_5}{x_1} = ?$$

Fig. 1

Handwritten note:  $\frac{x_5}{x_1} = 204$

4. The characteristic equation of a closed loop system is given by :  $s^4 + 3s^3 + 3s^2 + 2s + K = 0$

(i) Determine the range of K for which all the characteristic root will be in the left half of the s-plane. 6

(ii) Determine the range of values of K for which all the characteristic roots will be to the left of line  $\sigma = -1$ . 4

5. (a) Sketch the root locus for the given loop transfer function : 8

$$G(s)H(s) = \frac{K(s+4)}{s^2 + 6s + 13}$$



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- (b) Illustrate how to determine the value of  $K$  from the root locus for a specific value of  $\delta$  (damping ratio). 2
- 6. (a) Derive expressions for generalised error coefficients. 4
- (b) The open-loop transfer function of a system with unity feedback is given by  $G(s) = \frac{200}{s(s+5)}$ . Using error series determine the steady state error of the system for the input  $r(t) = (3 + 4t)t$ . 6
- 7. Write short notes on any *four* of the following :  $2\frac{1}{2} \times 4$ 
  - (a) A. C. Servomotor
  - (b) Synchros
  - (c) Derivative and Integral Controllers
  - (d) Static Error Constants
  - (e) Root Contours
  - (f) Nichols Chart.
- 8. Explain and illustrate through example the Zeigler-Nichols method of tuning PID controller. 10