

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.

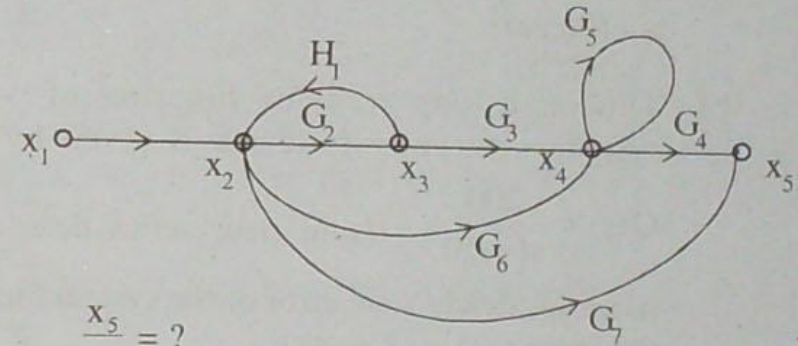
(h) Write notes on M-circles.

(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

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 δ (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