Registration No. : | | | | | | | | | | |

*Total number of printed pages – 3*

**B. Tech**

**PCEC 4303**

# Fifth Semester Back Examination – 2014

## CONTROL SYSTEM ENGINEERING

## BRANCH(S) : EEE, ELECTRICAL

**QUESTION CODE : L 218**

**Full Marks – 70**

**Time – 3 Hours**



*Answer Question No. 1 which is compulsory and any five from the rest.*
*The figures in the right-hand margin indicate marks.*

1. Answer the following questions : 2×10

(a) Define 'Transfer Function' of a system.

(b) Determine transfer function of a system comprising parallel combination of R, L and C, excited by a current source i(t), if the node voltage is taken as the output.

(c) What is a signal flow graph ? Write down Mason's Gain formula.

(d) If the transfer function of a second order system is given as

$$T(s) = \frac{K/\tau}{s^2 + \frac{1}{\tau}s + \frac{K}{\tau}}$$

Determine the damping factor and the damped natural frequency of the system.

(e) If a unity feedback system has open loop transfer function

$G(s) = \dfrac{K}{s(s+2)[(s)]^2 + 2s + 4)}$ , how many branches of the root locus will move towards infinity and what will be the angles of the asymptotes with the real axis ?

(f) What do you mean by 'Nyquist Contour ? How is the Nyquist contour modified in the presence of open loop poles on the jw axis ?

(g) What do you mean by 'type' of a system ? How does increase in 'type' affect system accuracy ?

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(h) How is relative stability determined by applying Routh stability criterion ?

(i) Define phase Margin and Gain Margin.

(j) What is one 'octave' and one 'decade' frequency ranges ?

2. (a) Enumerate the effects of feedback on parameter sensitivity. 5

(b) Derive the transfer function of a field-controlled DC servomotor and draw its block diagram. 5

3. (a) Derive the expression for the response of a second order system to unit step input. 6

(b) Draw the locus of roots of a second order system when the damping coefficient varies from 0 to a value more than 1. Describe the nature of roots of the characteristic equation for each case. 4

4. (a) Consider $D(s) = s^6 + s^5 + 6s^4 + 5s^2 + 10s^2 + 5s + 5$ 4

Obtain the number of roots in the RHS of the s-plane.

(b) Find the steady state error for unit step, unit ramp and unit acceleration inputs for the system given below : 6

$G(s) = 1000/(s(s+10(s+50))$



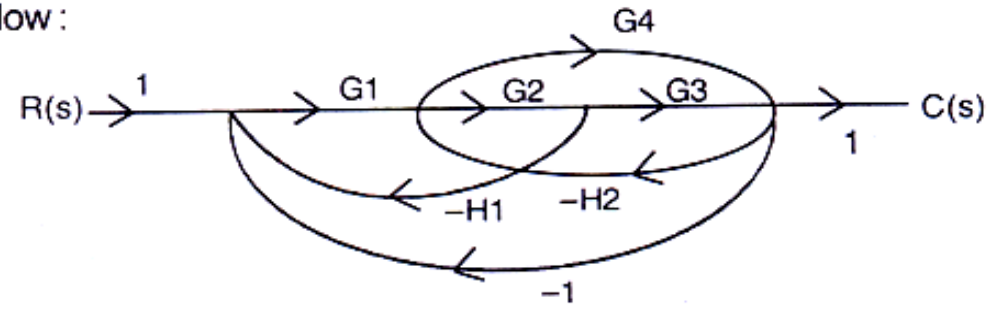
5. (a) Draw the polar plot of $G(s) = \frac{1}{(1+T_1 s)(1+T_2 s)}$ 5

(b) Find the frequency response specifications $M_r$ and $\omega_r$ for the system with the closed loop transfer functions 5

(i) $\frac{64}{s^2 + 6.4s + 64}$

(ii) $\frac{100}{s^2 + 16s + 100}$

6. (a) Obtain the transfer function $C(s)/R(s)$ of the signal flow graph shown below : 7




(b) What are the various test signals used in control systems ? 3

7. The open loop transfer function of a unity feedback system is given by

$$G(s) = \frac{K}{s(s\tau+1)} \qquad K,\ \tau > 0$$

With a given value of K, the peak overshoot was found to be 80%. It is proposed to reduce the peak overshoot to 20% by decreasing the gain. Find the new value of K in terms of the old value. 10

8. Write short notes on any **two** : $5 \times 2$

(a) Rules for drawing root locus

(b) Analogy between electrical and mechanical systems

(c) Synchro transmitter

(d) P, PI and PID Controllers.