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

Total number of printed pages – 3

B. Tech

CPEE 5302(Old)

Sixth Semester (Back) Examination – 2013

CONTROL SYSTEM ENGINEERING

BRANCH : EC, ETC

QUESTION CODE : B 341

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) Differentiate between closed loop and open loop control systems.

   (b) What is the function of a gear train ? Which electrical equipment it is analogous to ?

   (c) Differentiate between the characteristics of a two-phase induction motor and an ac servomotor. Give reasons for this difference.

   (d) What are K_p, K_v and K_a ? Write expressions for them.

   (e) Write down the conditions for a point on the real axis to be on the root locus.

   (f) What do you mean by the frequency range of one decade and one octave ? What is the slope of the high frequency asymptote in the magnitude plot for $1/1+jwT$?

   (g) Define the 'type' and 'order' of a system. How can the type of a system be determined from the Bode plot ?

   (h) What do you mean by settling time of a response ? On which factors does it depend upon ?

   (i) Why is the point $-1+j0$ a critical point in the determination of stability ? Define Gain Margin and Phase Margin.

P.T.O.

(j) Draw the block diagram of a PID controller. Write the input-output relation for such a controller.

2. (a) Enumerate the effect of negative feedback on system dynamics and sensitivity. 5

(b) The following relationships are given between various variables of a system.

(a) $X_1(s) = R(s) - H_1(s)\,X_2(s) - H_2(s)\,X_2(s)$

(b) $X_2(s) = R(s) - G_1(s)\,X_1(s) - H_2(s)\,C(s)$

$X_2(s) = G_2(s)\,X_2(s)$

$C(s) = G_2(s)\,X_2(s)$

Draw the signal flow graph and block diagram of the system. 5

3. (a) Find the steady state error for unit step, unit ramp and unit acceleration inputs for the following system. 5

$$G(s) = \frac{1000(s+1)}{s^2(s+1)(s+2)}$$

(b) Consider the characteristic equation 5

$D(s) = s^5 + s^4 + 3s^2 + 3s^2 + 6s + 4$

Comment on its stability.

4. Consider a unity feedback system with 10

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

(a) Determine the centroid and the breakaway points.

(b) Find the frequency at which the root locus branches cross the imaginary axis.

5. (a) Find the frequency response specifications Mr and ωr for the system with the following closed loop transfer function 5

$$\frac{16}{s^2+4.8s+16}$$

(b) Draw the polar plot for 5

$$G(s) = \frac{1}{s(1 + T_1 s)}$$

6. (a) The specifications on a second order unity feedback system with the closed loop transfer function Are that the overshoot of the peak response should not exceed 12% and the peak time must be less than 0.2 sec. Determine the damping coefficient and the peak time. 5

(b) Write down the analogous electrical and mechanical quantities in force-voltage and force-current analogy. 5

7. (a) For a unity feedback system having forward path transfer function 6

$$G(s) = \frac{K}{s(1 + 0.6s)(1 + 0.4s)}$$

Determine

(a) The range of values of K for stability

(b) Marginal value of K

(c) Frequency of sustained oscillations.

(b) Define all pass, minimum phase and non-minimum phase systems, giving examples in each case. 4

8. Write short notes on any **two** : 5×2

(a) Synchro

(b) Stepper Motor

(c) Constant M-circles

(d) Constant N-circles

(e) Nyquist stability criteria