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

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B. Tech

PCEI 4303

Sixth Semester Examination – 2013

CONTROL SYSTEMS

BRANCH : AEIE / ICE / IEE / EIE

QUESTION CODE : A 151

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) What are the attributes of a linear system ? Take an example of a control system and show that they possess the requisite properties to be termed as a linear system.

(b) What is the equivalent spring constants for two springs connected in series ?

(c) What are magnetic amplifiers ? What is their utility ?

(d) What are the advantages and disadvantages of increasing the 'type' of a system ?

(e) What is rate feedback control ? What benefit can be achieved by it ?

(f) What do you mean by conditional stability on root locus ?

(g) Define 'Gain Margin' and 'Phase Margin'. What significance do they have in frequency domain analysis ?

(h) A unity feedback system has $(s) = \frac{K}{s(s+1)(s+2)}$.

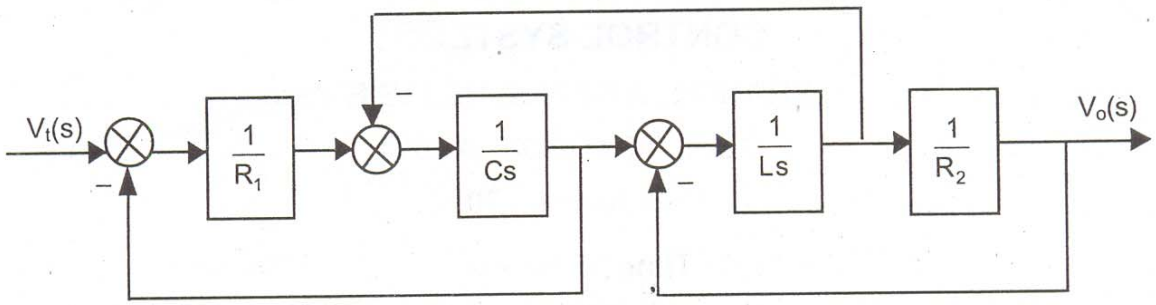
Find out the number of asymptotes of its root loci and the integral points between which the breakaway point occurs.

P.T.O.

(i) What do you understand by the term 'Nyquist Contour' ?

(j) List the advantages of State Variable Analysis'.

2. (a) For the figure shown below, find the transfer function $V_0(s)/V_i(s)$ from its signal flow graph : 5



(b) The transfer function of a system is 5

$$\frac{1}{s(s+a)(s^2+b^2)}$$

Determine the impulse response of the system.

3. (a) The open-loop transfer function of a unity feedback system is 5

$$G(s) = \frac{K}{s(s+15)}$$

If K = 225, what change must be made in the system to reduce the peak overshoot by 50%, keeping the settling time the same. Also find the new transfer function.

(b) A unity feedback control system has the closed-loop transfer function 5

$$\frac{C(s)}{R(s)} = \frac{K(s+5)}{s(s+1)^2(s+0.25)}$$

Find the value of K so that the steady state error is to be kept less than 0.05 for an input of $2+5t$.

4. Construct the root locus plot for a feedback system with characteristic equation 10

$$(s + 2)(s + 3)(s + 4) + K(s + 1) = 0$$

Comment on the effect of the open-loop zero on the system performance.

5. (a) Consider a closed loop system whose open-loop transfer function is given by 5

$$G(s)H(s) = \frac{K}{(T_1 s+1)(T_2 s+1)}$$

Examine the stability of the system by applying Nyquist stability criteria.

(b) The characteristic equation of a system is given by 5

$$s^5 + 2s^4 + 24s^2 + 48s^2 - 25s - 50 = 0$$

Applying Routh- Hurwitz Criteria, determine the symmetrically placed real roots and conjugate imaginary roots.

6. (a) Explain the working of a synchro control transformer. 5

(b) For a unity feedback system, the open-loop transfer function is 5

$$G(s) = \frac{0.25(1+0.5s)}{s(1+2s)(1+4s)}$$

Draw the approximate log-magnitude plot and the phase plot.

7. (a) Consider the following transfer function. 5

$$\frac{Y(s)}{U(s)} = \frac{s+6}{s^2+5s+6}$$

Obtain the state-space representation of the system in

(i) Controllable canonical form

(ii) Observable canonical form and

(iii) Diagonal canonical form.

(b) Consider the following matrix A. 5

$$\begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$$

Determine the state transition matrix.

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

(a) Proportional, Derivative and Integral Control

(b) Constant M circle

(c) Constant N circle

(d) Stepper Motor.