TEC-501   1041

Odd Semester Examination 2017-18

B. TECH (SEMESTER-V)

AUTOMATIC CONTROL SYSTEM

Max Marks : 100

Time: 3.00 Hours   [5X4]

1.   Attempt **any four** questions of the following :

(a)   What is Mason's gain formula?

(b)   What is control system and give the main classification of control system?

(c)   The characteristics equation of given system is

$S^3+10s^2+18s+k=0$

Using the Routh stability criteria, determine the value of k such that the roots of characteristics equation lie to the left of line s=-1

(d)   Determine the transfer matrix from the data.

$$A=\begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix}, \quad B=\begin{bmatrix} 1 \\ 1 \end{bmatrix}, \quad C=\begin{bmatrix} 1 & 1 \end{bmatrix} \quad \text{and} \quad D=0$$

(e)   What are the standard test input signals? Give their mathematical expression with respective graphical representation.

(f)   Explain M and N circles with mathematical expression.

                                                    [5X4]

2.   Attempt **any four** questions of the following :

(a)   What are the standard test input signals? What are they used for?

(b)   What are the difference in characteristics of PD, PID and PI controller?

(c)   The closed-loop transfer function is given : $C(s)/R(s) =25/s^2+4s+25$

Determine :

(i)   Damping ratio   [P.T.O.]

TEC-501/700   (1)

    (ii)   Natural undamped frequency

    (iii)   Percentage overshoot

(d)   Write short note on:

    (i)   Polar plot

    (ii)   Inverse polar plot

(e)   Explain robust stability test.

3.   Attempt **any two** questions of the following :   [10X2]

(a)   Sketch the root locus plot for the system having open-loop transfer function is given by

$G(s) H(s) = K/s(s+4)(s^2+4s+13)$

Determine:

    (i)   The breakaway points.

    (ii)   The angle of departure from complex poles and

    (iii)   The stability condition

(b)   Sketch the Nyquist plot to determine :

    (i)   Phase crossover frequency and gain margin for

    $G(s) H(s) = 2.5K/s(0.4s+1)(0.25+1)$

    (ii)   Determine phase margin for K=3

    (c) Derive the expression for the transfer function of lag-lead compensation

4.   Attempt **any two** questions of the following :   [10X2]

(a)   The open loop transfer function of a unity feedback control system is $G(s) = 10/s(s1)(s+5)$

Draw the polar plot.

(b)   Sketch the bode plot for the transfer function $G(s) = 1000/s(1+0.5s)(1+0.001S)$

Determine:

(i)   gain cross over frequency

(ii)   phase cross over frequency

(iii)   G.M and P.M

(c)   What is the significance of Lyapunov function with respect to the stability concept?

5.   Attempt **any two** questions of the following   [10X2]

(a)   Comment on the controllability and observability of the system having following coefficient matrices.

$$A = \begin{bmatrix} -1 & -2 & -1 \\ 0 & -1 & 1 \\ 1 & 0 & -1 \end{bmatrix}, \; B = \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix} C = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix}, D = 0$$

(b)   Find e^{At} by Laplace transform method and caylay Hamilton theorem for

$$A = \begin{bmatrix} 0 & 1 \\ -12 & -7 \end{bmatrix}$$

(c)   What is the different time response specification of a second order control system? Derive expression for rise time, peak time, settling time for second order control system when subjected to unit step

*****

TEC-501/700   (3)