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

Total Number of Pages : 03 **B.Tech**
PEI4I102

4th Semester Regular / Back Examination 2018-19
CONTROL SYSTEM ENGINEERING
BRANCH : AEIE, EIE, IEE
Max Marks : 100
Time : 3 Hours
Q.CODE : F482

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Define control system. Write the difference between open loop and closed loop control system.

b) The lop gain of GH of a control system is given by the following expression $G(s)H(s)=\frac{K}{s(s+2)(s+4)}$. Find the value of K the just becomes unstable?

c) The closed loop transfer function of a system is $T(s)=\frac{4}{(s^2+0.4s+4)}$.What is the steady state error due to unit step input?

d) The Nyquist plot of open loop transfer function G(s)H(s) passes through the point (-1, j0) in the G(s) H(s) plane. What is its phase margin?

e) What is gain margin of a unity feedback control system whose open loop transfer function is $G(s)=\frac{(s+1)}{s^2}$.

f) State the state equation of state space with usual meanings.

g) Determine the sensitivity of S_K^T overall transfer function to variation with forward path transfer function.

h) What is the significance breakaway point of root locus?

i) Define phase margin and gain margin.

j) Sketch the polar plot of $G(s)=\frac{1}{1+s}$

Part- II

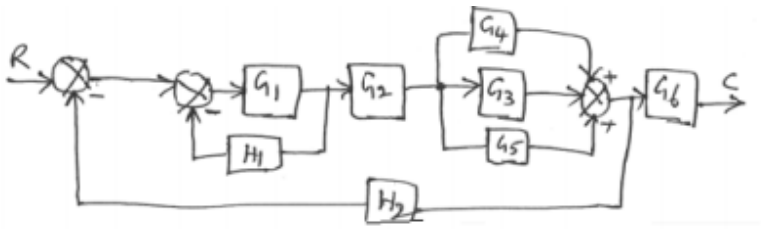
Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) The open loop transfer function of a unity feedback control system is given by $G(s)H(s)=\frac{5}{s^2(s+2)(s+5)}$. Find the position, velocity and acceleration error constant and also find the steady state error?

b) Describe the construction and working of Stepper Motor.

c) A unity feedback system has a forward path transfer function $G(s)=\frac{9}{s(s+1)}$. Find the value of damping ratio, undamped natural frequency of the system, percentage over shoot, peak time and settling time.

d) Using block diagram reduction technique finds the transfer function for the system shown in below figure



e) Sketch the polar plot for a given open loop transfer function $G(s)=\frac{10}{s(s+1)(s+2)}$.

f) Decide the stability of the system whose characteristics equation is given by $s^5+2s^4+5s^3+10s^2+4s+8=0$

g) Draw the complete Nyquist plot for a system whose open loop transfer function is $G(s)H(s)=\frac{K}{s(s+2)(s+10)}$. Determine range of K for which closed loop system is stable.

h) Explain M-circle and N-Circle.

i) What do you mean by state transition matrix? State the properties of STM.

j) Define Sensitivity.

In a position control system the forward path transfer function is $\frac{100}{s(1+s)}$ and feedback path transfer function is 10. Determine the sensitivity of T with respect to feed forward feedback elements respectively in the vicinity of $\omega=1\ rad/\sec$.

k) The state space equation is given as $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}-2 & 0\\ 0 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}1\\ 1\end{bmatrix}u \ and \ y=\begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$. Find the Transfer function?

l) The state model of state space is given as follows. Compute the eigen values and Eigen vectors of the following state model $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 3 & 0 & 2\\ -12 & -7 & -6\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 State the specification of time domain 2nd order control system and explain each term with proper labeling. **(16)**

The open loop transfer function of a unity feedback system is given by $G(s) = \frac{K}{s(1+sT)}$ where T and K are constant having positive values. By what factor the amplifier gain is reduced so that i) the peak overshoot of unit step response of the system is reduced from 75% to 25%. ii) The damping ratio increases from 0.1 to 0.6.

Q4 State the rules for constructing root locus. Sketch the root locus of system with open loop transfer function $G(s) = \frac{K}{(s+2)(s^2+2s+4)}$. **(16)**

Q5 Derive the correlation between time domain and frequency domain specifications. **(16)**
Sketch the Bode plot and determine the Gain margin and phase margin for the transfer function is given, $G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$.

Q6 State and explain signal flow graph. Write the application of SFG. **(16)**
Construct SFG from the following equations and find the overall transfer function

$$x_1 = t_{01}x_o$$
$$x_2 = t_{12}x_1 + t_{32}x_3 + t_{42}x_4$$
$$x_3 = t_{03}x_0 + t_{13}x_1 + t_{23}x_2$$
$$x_4 = t_{04}x_0 + t_{34}x_3 + t_{54}x_5$$
$$x_5 = t_{15}x_1 + t_{45}x_4 + t_{65}x_6$$
$$x_6 = t_{06}x_0 + t_{76}x_7 + t_{56}x_5$$
$$x_7 = t_{67}x_6 + t_{77}x_7$$
$$x_8 = t_{78}x_7$$