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

Total Number of Pages : 03 **B.Tech**
PEE4I102

4th Semester Regular / Back Examination 2018-19
CONTROL SYSTEM ENGINEERING - I
BRANCH : ELECTRICAL
Max Marks : 100
Time : 3 Hours
Q.CODE : F256

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) What do you understand about two control objective such as regulatory and servomechanism?

b) Why state variable is not unique?

c) Define causal system with both a statement and an equation?

d) Why it is necessary that poles of a system should be lie in the left half of S-plane for a stable system?

e) Find correlation between step transient and frequency response specification?

f) Explain principle of argument?

g) Why D controller cannot alone used?

h) Prove that 20db/decade is equal to 6db/octave?

i) Differentiate between Hurwitz stability criterion and Routh stability criterion?

j) What are the limitations of classical control system?

Part- II

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

a) Using Nyquist criterion determine the stability of the system $G(s)H(s) = \frac{10(s+3)}{s(s-1)}$

b) Explain the constant M circles, the constant N-circles and the Nichol's chart?

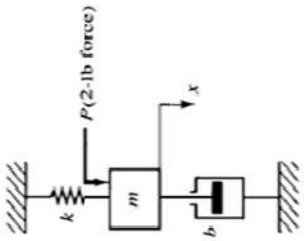
c) What is BIBO stability of a system ?state the condition and derive it?

d) For a unity feedback second order system whose open loop transfer function $G(s) = \frac{4}{s(s+2)}$. Determine the maximum overshoot and the time to reach the maximum overshoot when step displacement of 18o is given to the system. Find the rise time, delay time and settling time for a steady state error of 7%.

e) A system described by $\frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 8y = -\frac{dr(t)}{dt} + 5r(t)$ and given y(0)=0 ,y'(0)=1,r(0)=7,r(t)=7e^{-3t}. Find the forced response component and natural response component?

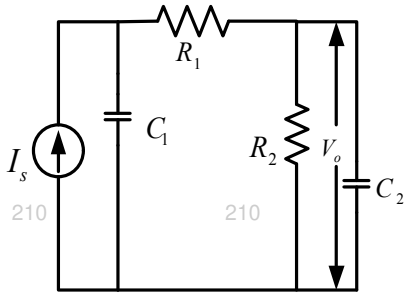
f) A unity feedback system has an open loop transfer function $G(s) = \frac{K}{s(s+a)^2}$. Determine the values of K and 'a' for which the gain margin is 9.54dB and the phase crossover frequency is 3 rad/sec.

g) A force of 2N (step input) is applied to the mass shown in below. The ideal spring has stiffness of K N/m. the frictional force is B Ns/m. damped oscillation. The maximum value of displacement X is 0.1254m occurring at t=3s and steady state displacement is 0.1m. Determine the values of m,B,K?



h) Sketch the root locus of the system whose $G(s)H(s) = \frac{Ke^{-s}}{s(s+2)}$. When K varies from 0 to infinite?

i) Draw the signal flow graph for the circuit shown in below. Also from signal flow graph determine the $\frac{V_0(s)}{I_s(s)}$.



j) For a first order time delay process how can you determine the PID controller parameters using Zeigler-Nichols method? Explain.

k) Determine the number of roots of a given characteristics equation with real parts between 0 and -1. The given characteristics equation is $8S^5 + 44S^4 + 126S^3 + 219S^2 + 258S + 85 = 0$

l) Obtain the state space equation as well as output equation of given transfer function

$$\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$$

Part-III

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

Q3 Sketch the nyquist plot for the system with loop transfer function $G(s)H(s) = \frac{K(1+0.5s)(s+1)}{(10s+1)(s-1)}$. Determine the range of K for system is stable. **(16)**

Q4 Sketch the bode plot of open loop transfer function is $G(s)H(s) = \frac{K}{s(0.1s+1)(s+1)}$. Find the gain margin and phase margin. Also Find the value of K for which Gm is 20 dB and Pm is 60degree. **(16)**

Q5 Define the output controllability, State controllability, Obsevability and its mathematical expression. Find the solution of non homogeneous state equation? A linear time invariant system is characterized by the homogeneous state equation $\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$. Compute the solution of the equation assuming initial state vector $x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ **(16)**

Q6 Sketch the Root Locus of the system whose transfer function $G(s)H(s) = \frac{K}{s(s+2)(s+4)}$ **(16)**

a) What is the value of K which will produce sustained oscillation?
b) Find the range of K for which the system is stable?
c) What is the value of K for which the system is critically damped?
d) For K=8, find $\varepsilon, \omega_n, t_s, e_{ss}$ and peak overshoot.
e) For K=8, find the closed loop transfer function.
f) Find the range of K for which the system response is under damped or system shows damped oscillatory response.