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

Total Number of Pages : 02 **B.Tech**

PET5I101

5th Semester Regular / Back Examination 2019-20

CONTROL SYSTEMS

BRANCH : ECE, ETC

Max Marks : 100

Time : 3 Hours

Q.CODE : HRB078

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) Differentiate between time variant and time invariant system?

b) Write down the magnitude criterion and the angle criterion for a point to be on the root locus. How is the gain K at a particular location determined?

c) What are the two special case of Routh's criteria?

d) Define words and equation, the sensitivity of feedback control system?

e) What is the effect of the negative feedback on time constant and bandwidth of the system?

f) Explain Nquist Criterion?

g) State the analogous quantities for mechanical rotational system and electrical systems in force-voltage analogy.

h) Distinguish between transfer function and frequency transfer function?

i) Why Nichols chart is used?

j) Given the following polynomial equation $s^3 + 5.5s^2 + 8.5s + 3 = 0$. Determine the number of roots of the polynomial which have real parts strictly less than -1.

Part- II

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

a) Explain the constant M circles, the constant N-circles with expression?

b) The open loop transfer function of a unity feedback system is $(S) = \frac{K}{S(ST+1)}$. Where K and T are constants. How many times the gain should be increased to increase the overshoot from 50% to 60%.

c) The transfer function of a system is given as $G(s) = \frac{Y(s)}{R(s)} = \frac{1}{s^2 + 2s + 5}$ .Find y(t), if the input is a unit step signal. Identify the transient and the steady state components of the output response Using final value theorem find the steady state value of y(t).

d) 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.

e) Consider a system described by a differential equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 25y = 50x(t)$. Find out the time domain behavior and the maximum output for a 2.5 unit step input.

f) 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 18° is given to the system. Find the rise time, delay time and settling time for a steady state error of 7%.

g) 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.

h) State the condition of BIBO stability and derive its expression?

i) $\ddot{x} - (K+2)\dot{x} + (2K+5)x = 0$ .Find the value of K for which system is stable, unstable and Limited stable . For stable case for what a value of K is the system is under damped and over damped.

j) Derive the generalised error coefficient?

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

l) An integral controller is used for temperature control within a range 40-60° C . The set point is 48°C. The controller output is initially 12% when the error is zero. The integral constant K_i=-0.2% controller output/sec/% error. If the temperature increases 54°C. Calculate the controller output after 2sec for a constant error.

Part-III

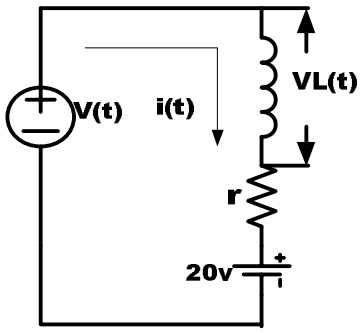
Only Long Answer Type Questions (Answer Any Two out of Four)

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

Q4 Sketch the Root Locus of the system whose transfer function is given $G(s)H(s) = \frac{K}{s(s+2)(s+4)}$ **(16)**

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

Q5 Find the transfer function $\frac{V_L(s)}{V(s)}$ for the electrical network which contain nonlinear resistor whose voltage current relationship is defined by $i_r = 2e^{0.1V_r}$, where i_r and V_r are the resistor current and voltage respectively. Also V (t) is a small signal source. **(16)**



Q6 For a first order time delay process how can you determine the PID controller parameters using Zeigler-Nichols method? Explain with examples. **(16)**