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)**

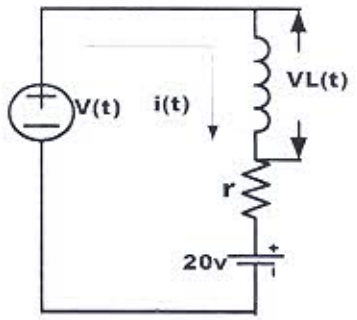
a) What is the value of K which will produce sustained oscillation and Find the range of K for which the system is stable?

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)**