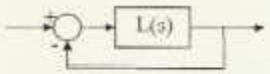
b) Design a proportional and integral controller, $G = k_p \frac{s + 1/T_i}{s}$ for the plant, $P = \frac{1}{(s+1)(s+3)}$ to have dominant poles with $\omega_n = 1.5$, $\zeta = 0.6$.

i) Use rough sketches of the root locus to determine the location of the controller zero (i.e. find T_i). (Hint: The controller zero is between the plant poles.) (7)

ii) Calculate the required controller gain, k_p. (An accurate root locus is not required.) (4)

Question 1: Nyquist analysis

Consider the following open loop system: $L = \dfrac{s+3}{s^2+2}$



a) Make a rough sketch of the Bode plot (5)

b) Sketch full Nyquist diagram. (10)

c) Determine if the closed loop system is stable or not (5)

d) sketch of the positive gain root locus of the system with open loop transfer function, $kL(s)$ and comment on your answer in (2c) corresponding to $k = 1$. (5)

Question 3: Root Locus (10 marks)

Plot the root locus for the following system: $L = k\dfrac{s^2+2s+2}{s(s+1)(s+2)}$ as the feedback gain is varied from $-\infty$ to ∞. 1/L(s) has turning points at $s = -1.49$ and $s = -0.51$.