

4. (35%) Given a unit feedback system as shown in Figure 4, where  $r$  is the reference,  $y$  is the output and  $e$  is the error.  $G(s)$  is the plant.

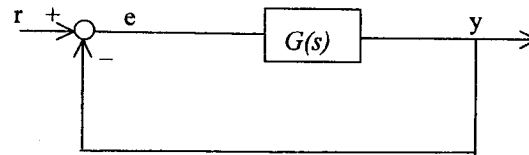


Figure 4

The transfer function  $G(s)$  is given as:

$$G(s) = \frac{100}{(s+1)(s+10)}$$

- (10%) Plot the asymptotic approximate Bode diagram of the  $G(s)$ .
  - (5%) Plot the Nyquist diagram of  $G(s)$ , and identify the stability of the closed loop system from the diagram.
  - (10%) Find the gain margin and phase margin using both the **analytical method** and **Bode plot** obtained from (a).
  - (10%) Use the information from (a) and (c), find the steady state error, approximate overshoot, and settling time when  $r(t)$  is equal to a unit step.
- Note: You **should only** use the information obtained from (a) and (c) to solve this problem. You **should not and need not** find the closed loop transfer function.