

20% 1) Explain what is a) a proper system and b) an improper system! Which of the two is more likely be the true representation of the physical systems of this old familiar universe of ours? Explain your arguements!

15% 2) In the usual cases of control system design, it is always required that the compensator(s) so designed contains *no* more zeros than poles, explain why so?

25% 3) With the open-loop Bode plot shown in Fig. 1 and assume the corresponding open-loop transfer function to be in the form

$$G(s) = K \frac{(s - z_1)(s - z_2) \cdots (s - z_m)}{(s - p_1)(s - p_2) \cdots (s - p_n)}$$

- a) What is  $K$ ? b) What is the system order?
- c) In your opinion, is it safe to apply the unity feedback control to this system? Why or why not?

15% 4) Use at least two different methods to find the minimum positive value of  $K$  of the polynomial

$$s^3 + 2s^2 + 5s + K = 0$$

that will lead (some of) the roots of the polynomial into right half s-plane.

25% 5) For the plant Bode plot shown in Fig. 2, design a feedback compensator that will result in a cross-over frequency of 100 rad/s and a phase margin of  $50^\circ$ .

