

## 9.5 Gain Margin

True or False:

- (a) The gain margin is the amount of allowable variation in the phase of the plant before the closed loop becomes unstable.
- (b) As a rule of thumb (not being strict), the closed-loop should remain stable for gain variations in the range  $[0.5, 2](= \pm 6dB)$ .

**Solution :**

- (a) False. (should be the allowable variation in the gain of the plant)
- (b) True.

**GPT Answer :**

**True or False:**

- (a) **False.** The gain margin actually refers to the amount of gain increase or decrease that can be tolerated before the system becomes unstable. It is measured at the phase crossover frequency, where the phase angle is  $-180^\circ$  (or equivalently, when the phase margin is zero). The gain margin is typically expressed in dB. The definition given mixes the concept of gain margin with that of phase margin, which is the amount of additional phase shift that will bring the system to the verge of instability.
- (b) **True**, with caveats. The guideline that the system should remain stable for gain variations in the range  $[0.5, 2]$  or  $\pm 6dB$  is a general rule of thumb used in control system design to ensure some level of robustness against gain variations. However, the specific range for stability depends on the system and the desired performance criteria. This rule is not strict and can vary based on the context and the design requirements.

**Confidence level: 90%**

**Correct**

**Claude Answer:**

To answer your true/false questions:

- a) False. The gain margin is not related to the phase of the plant. The gain margin is the amount of additional gain that can be added to the open-loop system before the closed-loop system becomes unstable. It is a measure of how much the open-loop gain can increase before instability occurs.

b) True. As a rule of thumb, the closed-loop system should remain stable for gain variations in the range  $[0.5, 2]$ , which corresponds to a gain variation of  $\pm 6\text{dB}$ . This provides a reasonable stability margin for gain variations in the system.

**Confidence level: 95%**

**Correct**