

Lab practice #10

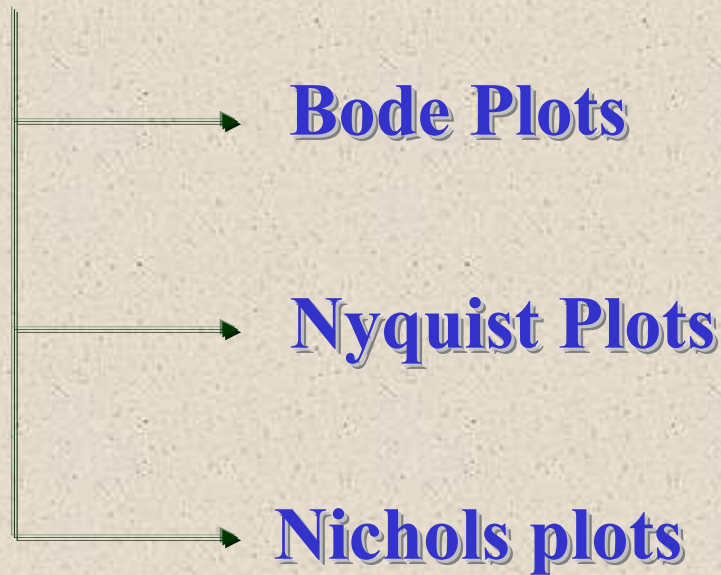
Frequency Domain Analysis of Control systems

Subject: - Feedback Control Systems
By:- Engr.Imtiaz Hussain Kalwar

Introduction

Why Frequency Domain?

- It's a graphical approach
- We will use three types of graphical approaches



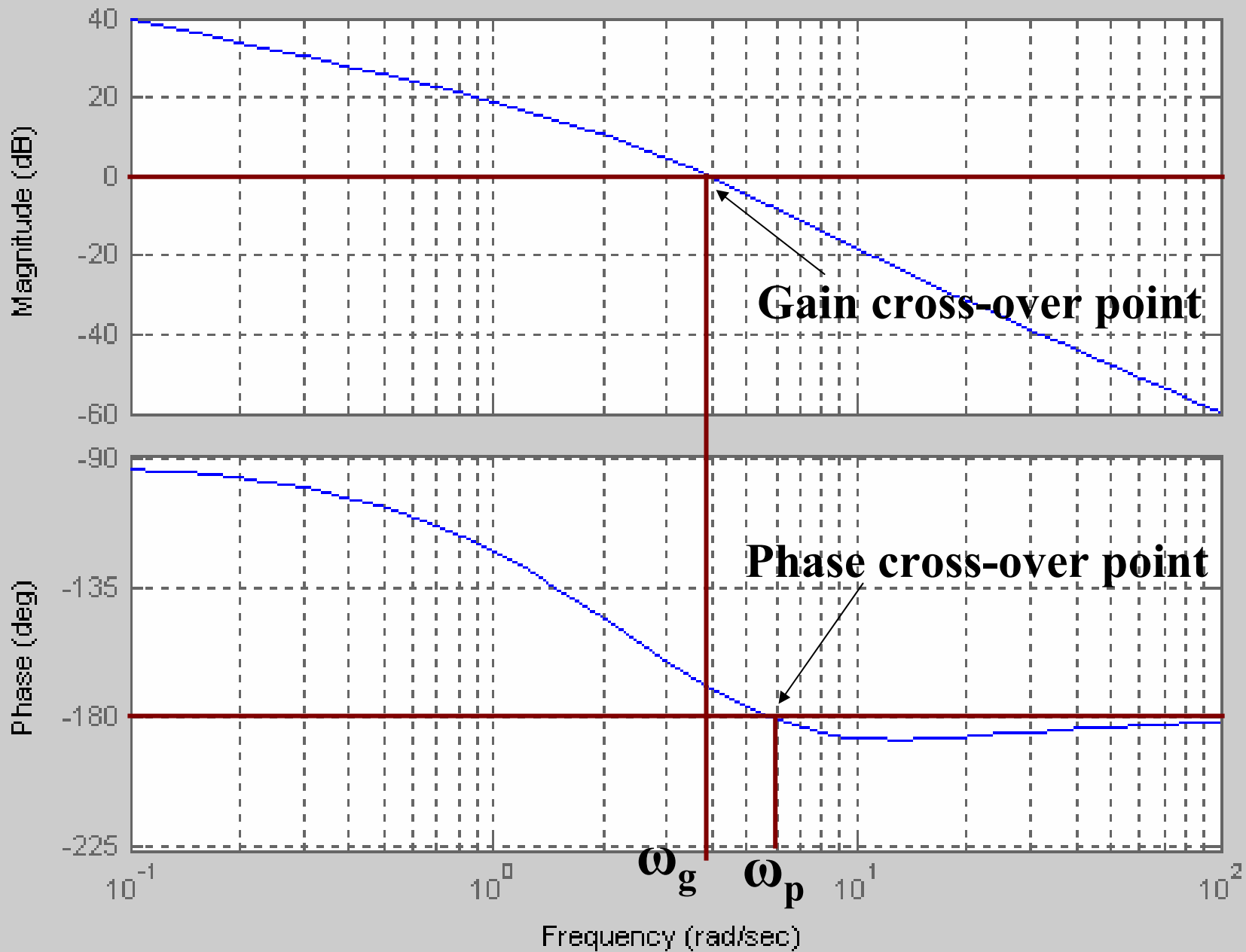
Bode Plots

$$G(S) = \frac{10(S + 10)}{S(S + 2)(S + 5)}$$

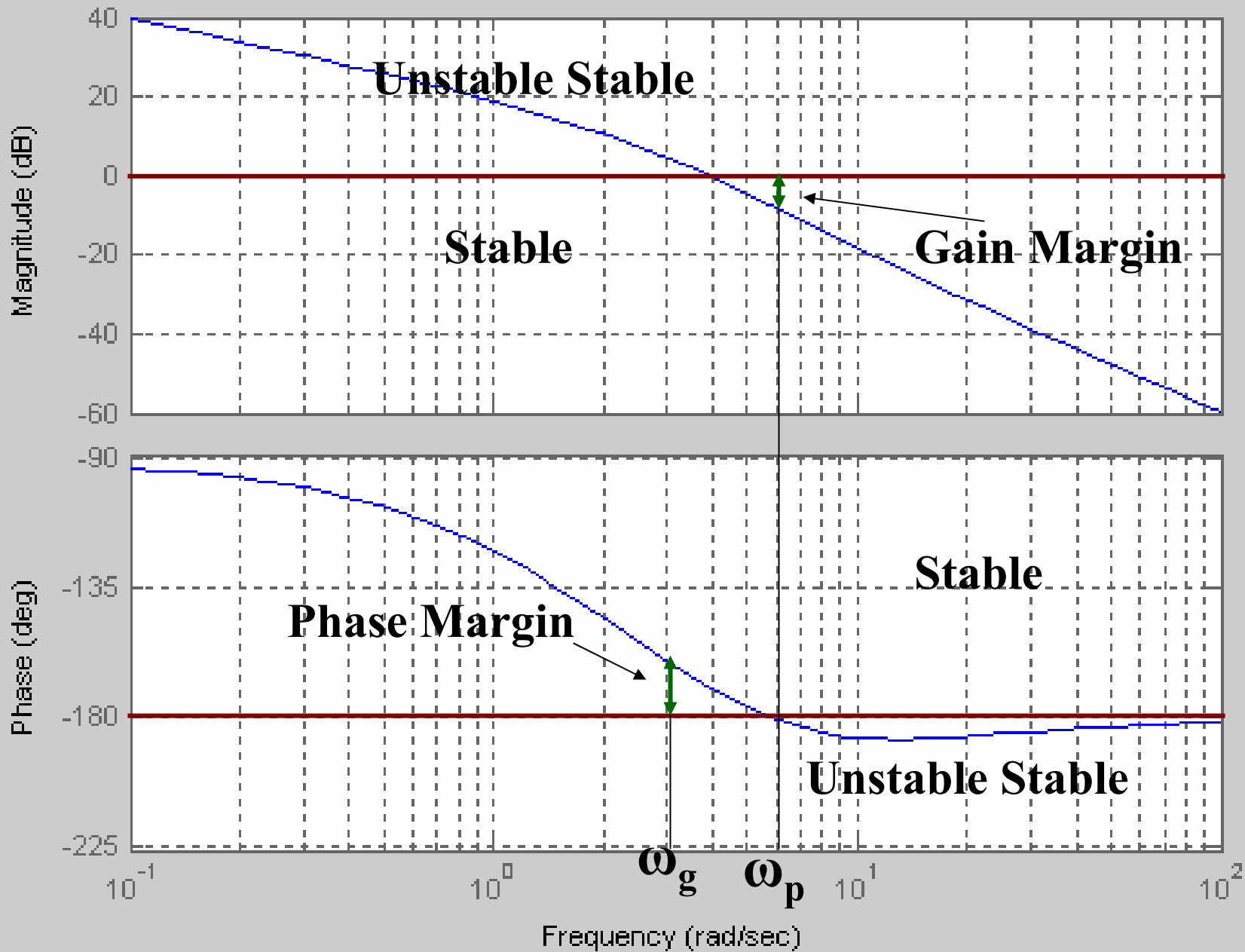
To obtain the bode plot we will write following **MATLAB** code

```
num = 10*[1 10];  
den1 = [1 0];  
den2 = [1 2];  
den3 = [1 5];  
den12 = conv(den1,den2);  
den = conv(den12,den3);  
bode(num,den)
```

Bode Diagram



Bode Diagram



Bode Plots

Exercise: - Obtain the bode plot of the following system

$$G(S) = \frac{2500}{S(S + 5)(S + 50)}$$

And determine the resonant peak, gain margin and phase margin

Bode Plots

Exercise: - Obtain the bode plot of the second order system

$$\omega_n = 0.1 \text{ rad / sec}$$

$$\zeta = 0.1, 0.5, 1, 1.5$$

$$G(S) = \frac{0.01}{(S^2 + 0.02S + 0.01)}$$

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$$G(S) = \frac{0.01}{(S^2 + 0.03S + 0.01)}$$

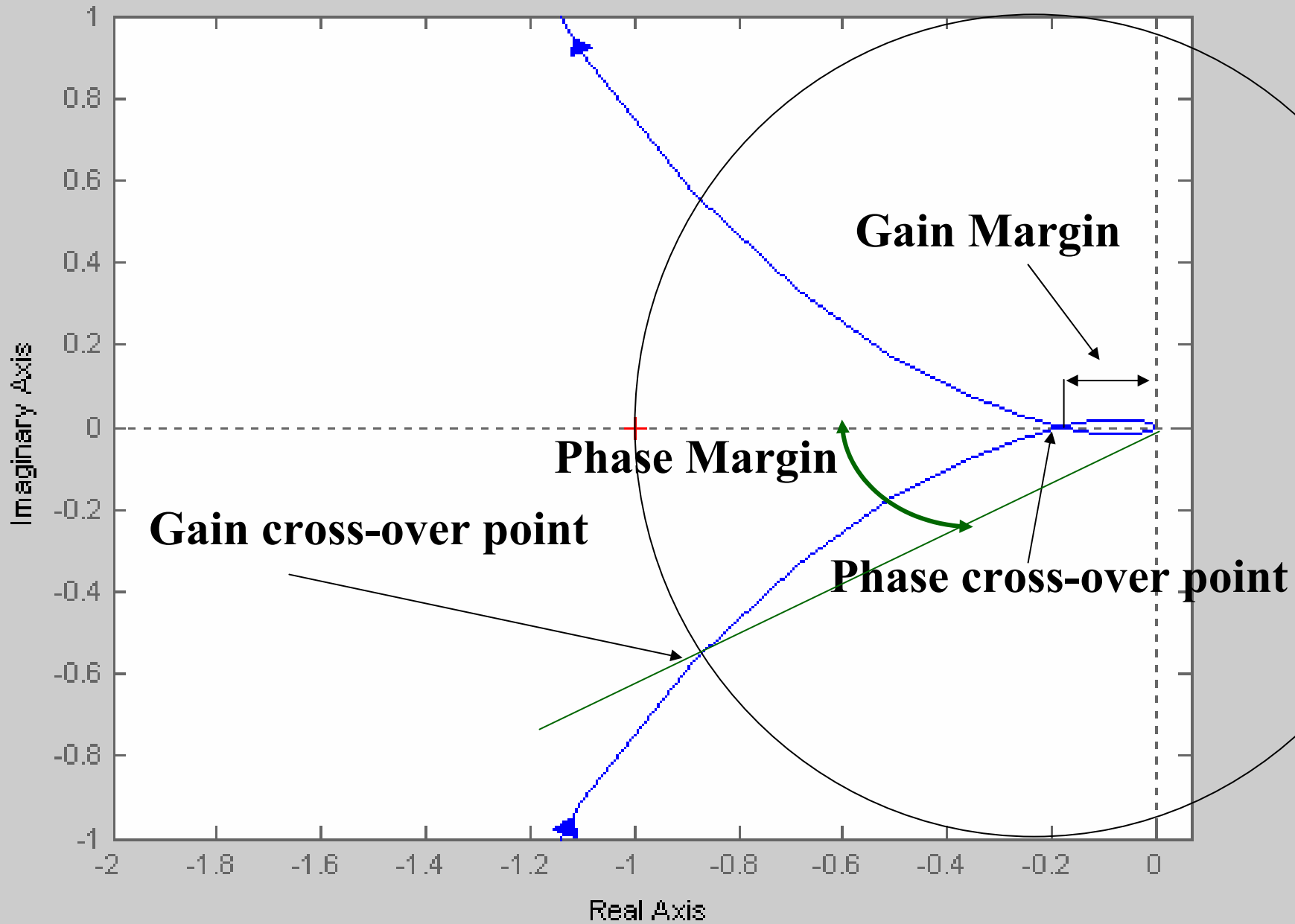
Polar plots or Nyquist plot

$$G(S) = \frac{2500}{S(S + 5)(S + 50)}$$

To obtain the Nyquist plot we will write following **MATLAB** code

```
num =2500;  
den1= [1    0];  
den2=[1    5];  
den3=[1    50];  
den12=conv(den1,den2);  
den=conv(den12,den3);  
nyquist(num,den)
```

Nyquist Diagram



Polar plots or Nyquist plot

Exercise: - Obtain the nyquist plot of the following system

$$G(S) = \frac{10 (S + 10)}{S (S + 2) (S + 5)}$$

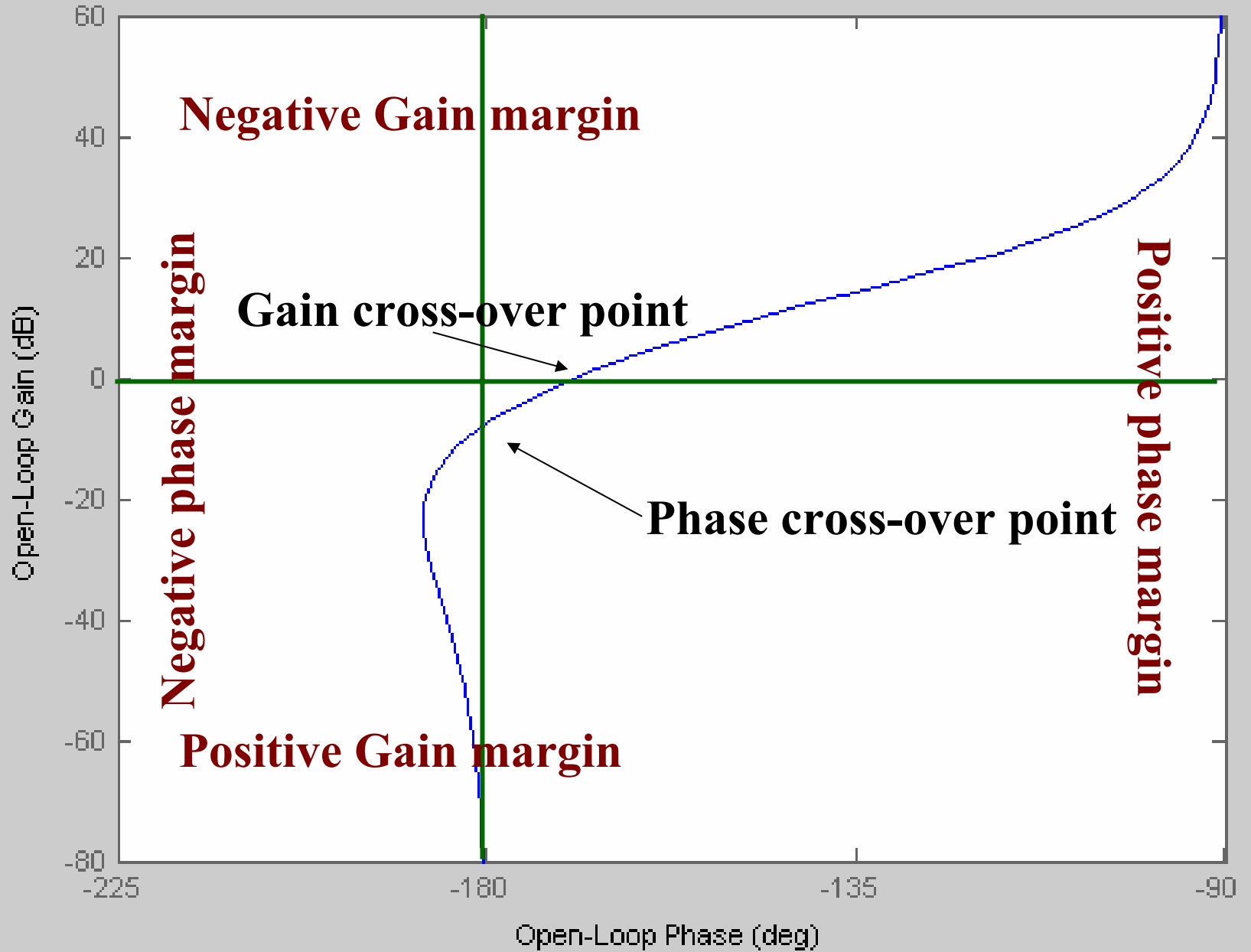
Magnitude-Phase plot or Nichols Plot

$$G(S) = \frac{10(S + 10)}{S(S + 2)(S + 5)}$$

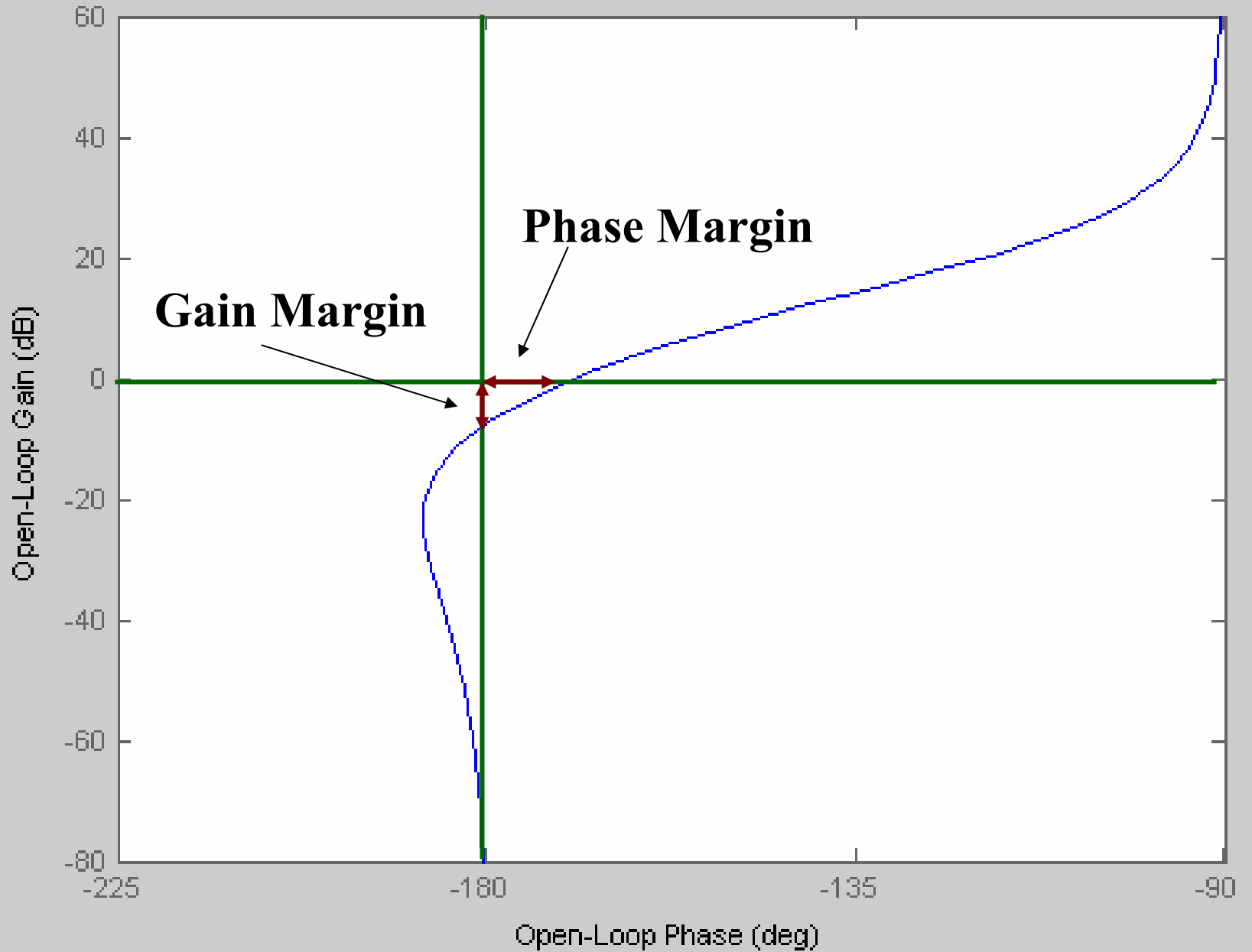
To obtain the nichols plot we will write following **MATLAB** code

```
num = 10*[1 10];  
den1 = [1 0];  
den2 = [1 2];  
den3 = [1 5];  
den12 = conv(den1,den2);  
den = conv(den12,den3);  
nichols(num,den)
```

Nichols Chart



Nichols Chart



Exercise: - Obtain the Nichols plot of the following system

$$G(S) = \frac{2500}{S(S + 5)(S + 50)}$$

And determine the gain margin and phase margin