MAKERERE  UNIVERSITY



# COLLEGE OF ENGINEERING, DESIGN, ART AND TECHNOLOGY
# DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
# SCHOOL OF ENGINEERING

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BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

ELE2111 MATLAB ASSIGNMENT

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**Question 1**
**Plot the Bode magnitude and phase for the system with transfer function**

$$G_{(s)} = \frac{2000(s+0.5)}{s(s+10)(s+50)}$$

First we expand the function as a polynomial as matlab uses the polynomial version of the transfer function.

$$G_{(s)} = \frac{2000 \times s + 2000 \times 0.5}{s(s \times s + 10 \times s + 50 \times s + 10 \times 50)}$$

$$G_{(s)} = \frac{2000s + 1000}{s(s^2 + 10s + 50s + 500)}$$

$$G_{(s)} = \frac{2000s + 1000}{s^3 + 60s^2 + 500s}$$

The polynomial is then used to create a transfer function. The transfer function is then plotted using the bode function. The code is shown below.

```
% Define the transfer function
numerator = [2000, 1000];
denominator = [1, 60, 500, 0];

% Create a transfer function
sys = tf(numerator, denominator);

% Plot the Bode plot
figure;
bode(sys);
title('Bode Plot');
grid on;
```

The resulting figure is shown below

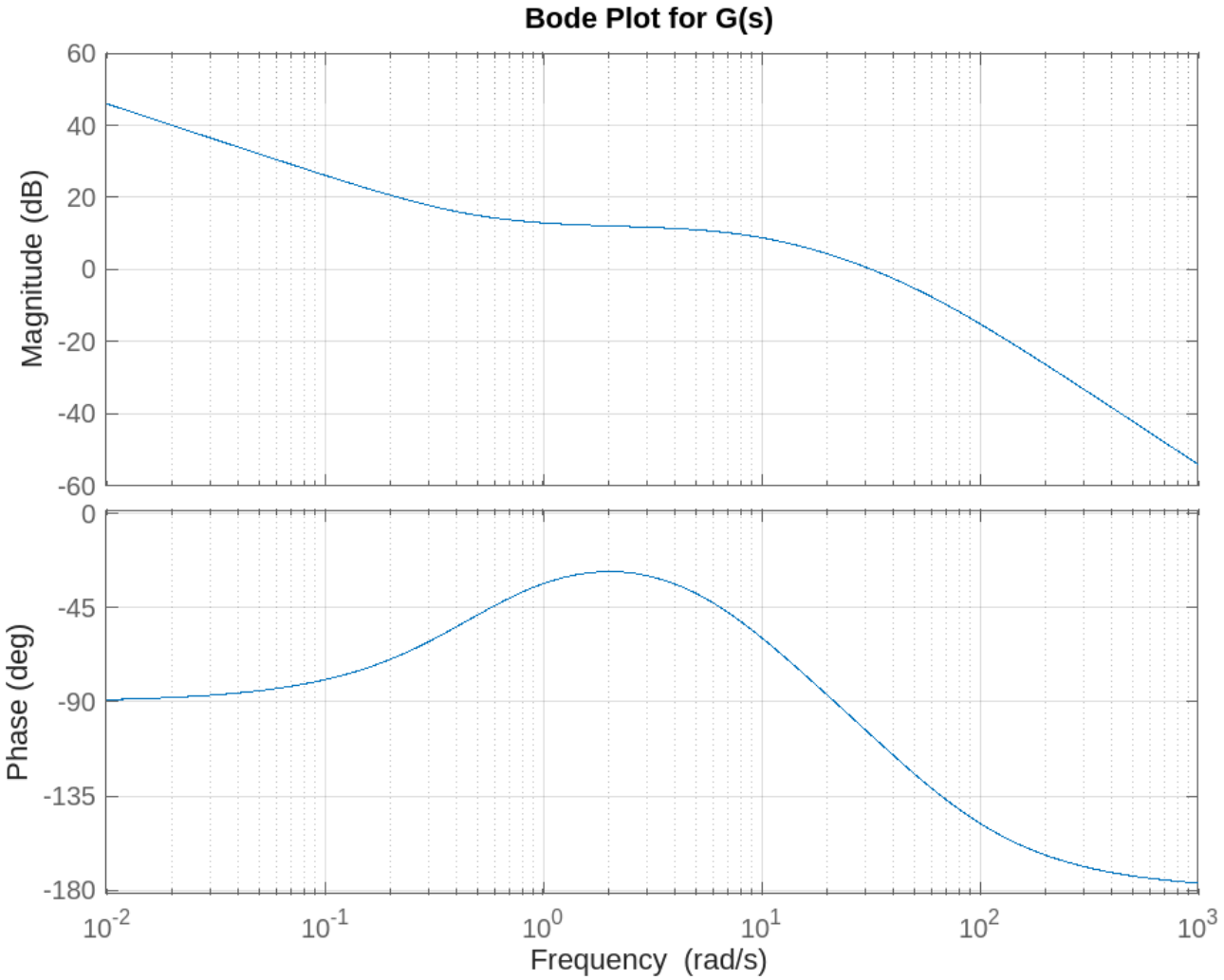


Figure 1: Bode plot for G (s)

**Question 2**
**Sketch the Bode plot (Magnitude and Phase Angle) for**

$$H = \frac{10000(S+1)}{(S+10)(S+1000)}$$

First we expand the function as a polynomial as matlab uses the polynomial version of the transfer function.

$$H = \frac{10000(S+1)}{(S+10)(S+1000)}$$

$$H = \frac{10000S + 10000}{S^2 + 1010S + 10000}$$

The polynomial is then used to create a transfer function. The transfer function is then plotted using the bode function. The code is shown below.

```
% Define the transfer function
numerator_H = [10000, 10000];  % 10000(S + 1)
denominator_H = [1, 1010, 10000];  % (S + 10)(S + 1000)

% Create a transfer function
sys_H = tf(numerator_H, denominator_H);
```

```
% Plot the Bode plot
figure;

% Bode magnitude plot
bode(sys_H);
title('Bode Magnitude Plot for H(s)');
grid on;
```

The resulting figure is shown below

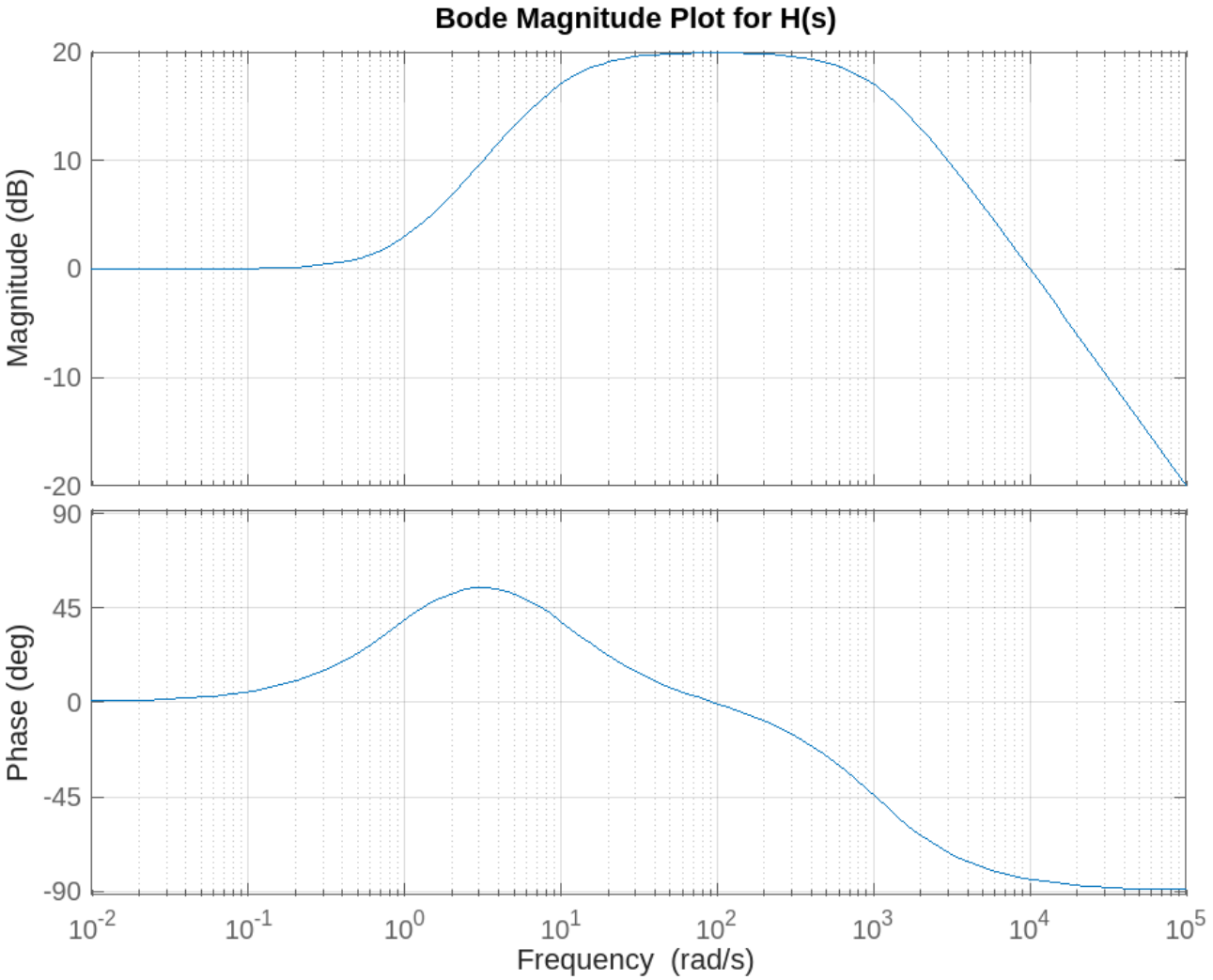


Figure 2: Bode plot for a H (s)

**Question 3**
**Plot a Bode plot of a highpass filter with a gain of 0 dB and cutoff frequency of 3000 Hz.**

Assume a first order continous implementation of a high pass filter. The transfer function is given by

$$H = \frac{s\tau}{s\tau + 1}$$

$$f = \frac{1}{2\pi\tau}$$

$$\tau = \frac{1}{2\pi f}$$

$$H = \frac{s\frac{1}{2\pi f}}{s\frac{1}{2\pi f} + 1}$$

$$H = \frac{s}{s + 2\pi f}$$

$$H = \frac{s}{s + 6000\pi}$$

$$DC\ Gain = \lim_{s \to 0} s \times \frac{s}{s + 6000\pi}$$

$$DC\ Gain = 0$$

The code is shown below.

```
gain = 0;  % Gain in dB
cutoff_frequency = 3000;  % Cutoff frequency in Hz

% Create a highpass filter transfer function
numerator_highpass = [1, 0];  % (s)
denominator_highpass = [1, 2 * pi * cutoff_frequency];  % (s + 2*pi*f)

% Create a transfer function
sys_highpass = tf(numerator_highpass, denominator_highpass);

% Plot the Bode plot
figure;

% Bode magnitude plot
bode(sys_highpass);
title('Bode Plot for Highpass Filter');
grid on;
```

The resulting figure is shown below

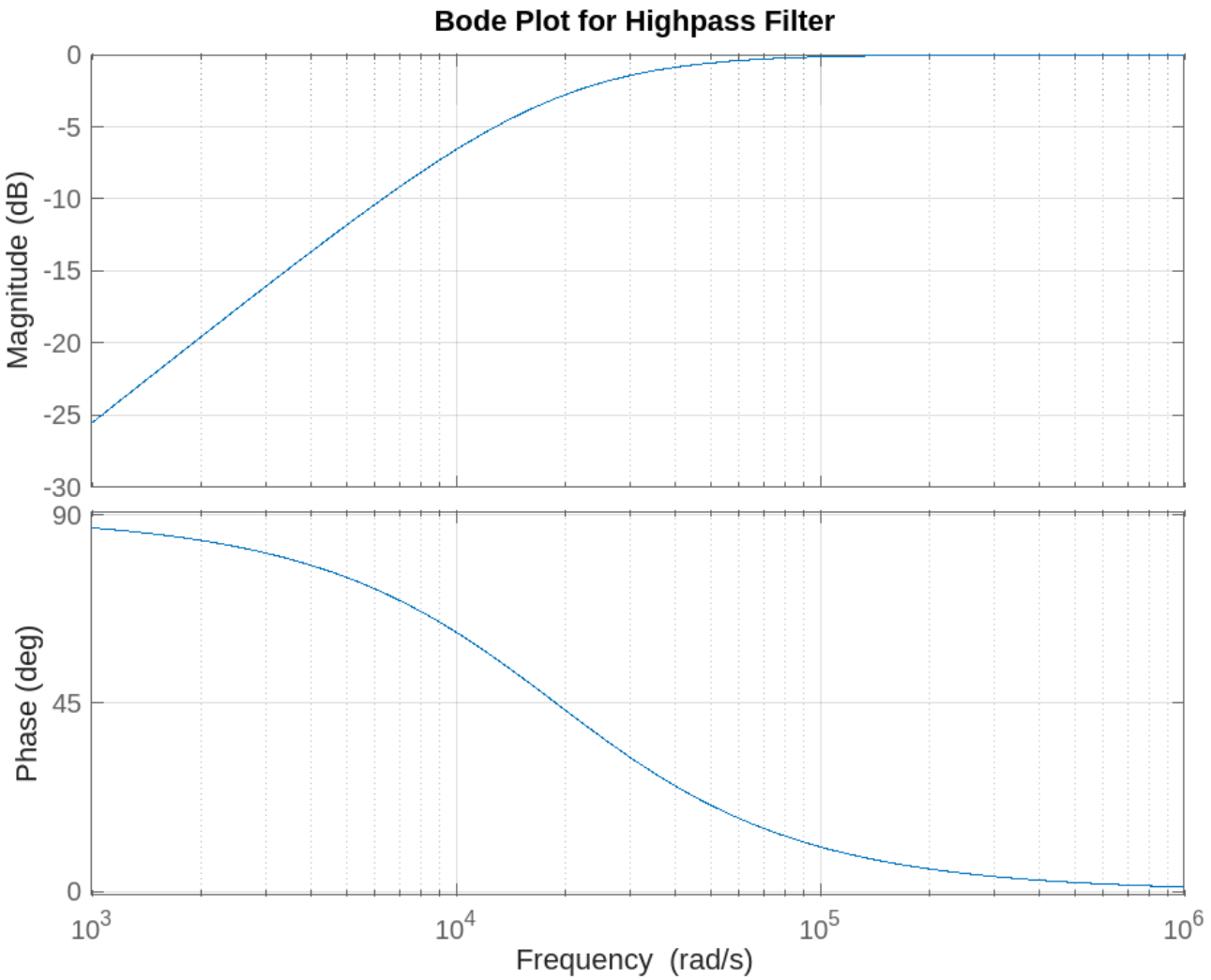


Figure 3: Bode plot for a highpass filter