29/04/2023

BAŞKENT UNIVERSITY

ENGINEERING FACULTY

Electrical-Electronics Engineering Department
Homework Nu.1

Course Code : EEE 202, EEM-202	**Course Name : Circuit Theory – II**	
Student Name	**Samet Bayat**	
Student Number	**22293730**	**Due date : 9 th of May, 2023**

Important Note : Submit your homework to the class teacher by the end of the course on the 8 th of May, 2023. Use MATLAB software to plot the BODE PLOT (Amplitude response and Phase response). Those students who can not come to the class may send the homework as an e-mail attachment to the address mucuncu@baskent.edu.tr

Question : Construct the Bode Plot for the transfer function $H(s)$ given below.

$$H(s = \frac{100000}{(s+1)(s^2+20s+10000)}$$

Here, answer the following questions by **only inspecting** the Bode plot ;

a. What is the amplitude value (dB) for $w = 1$, 10, 100 rad /sec,

b. What is the maximum value of the amplitude and at what frequency.

c. What is the phase value (degree) for $w = 0.1$, 1, 10, 1000 rad/sec.

Bode Plot HW.1

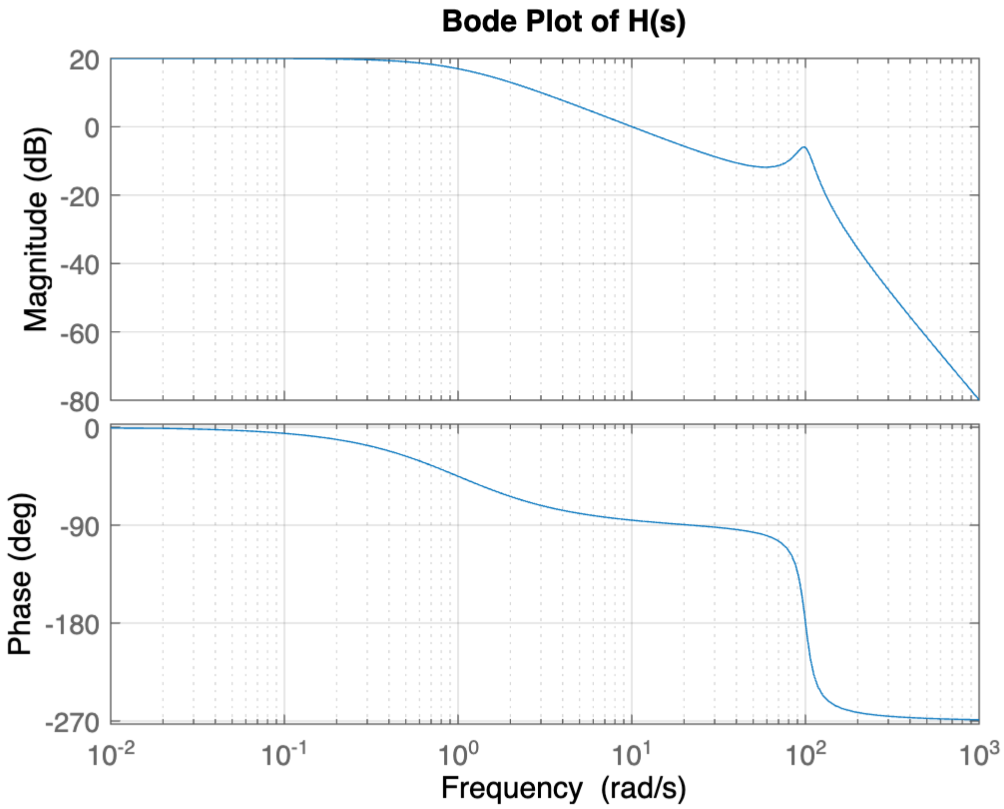
SAMET BAYAT 22293730

$$H(s) = \frac{100000}{(s+1)(s^2+20s+10000)}$$

```
numerator = [1e5];
denominator = [1 21 10020 1e4];
%(s+1)(s^2+20s+1e4) = s^3 + 21s^2 + 10020s + 1e4
H = tf(numerator, denominator)
```

```
H =
 
                100000
  ------------------------------
  s^3 + 21 s^2 + 10020 s + 10000
 
Continuous-time transfer function.
Model Properties
```

```
bode(H)
title('Bode Plot of H(s)');
grid on
```



```
%.a
[mag, ~] = bode(H, [1, 10, 100]);
mag_dB = mag2db(mag);

fprintf('--> %.2fdB\n', [mag_dB]);
```

```
--> 16.99dB
--> 0.04dB
--> -6.02dB
```

```
%.b
[mag_peak, mag_peak_freq] = getPeakGain(H);
mag_peak_dB = mag2db(mag_peak)
```

```
mag_peak_dB = 20
```

```
%.c
[~, phase] = bode(H, [0.1, 1, 10, 1000]);
phase_deg = squeeze(phase)
```

```
phase_deg = 4×1
   -5.7221
  -45.1146
  -85.4467
 -268.7854
```

The amplitude value refers to the magnitude or strength of a signal. In the context of signals and systems, the amplitude is usually measured in decibels (dB), which is a logarithmic unit of measurement that expresses the relative power of a signal.

In general, the amplitude of a signal can vary depending on the frequency of the signal. In particular, some frequencies may have a higher amplitude than others, and this is known as the frequency response of the system.

A -> Pure inspections shows that, for

$\omega = 1$ -> 20 or if we count 3dB point 20-3 = 17dB.
$\omega = 10$ -> 0dB.
$\omega = 100$ -> -5dB or -6dB.

B -> Pure inspections shows that, for

20dB at frequency -> 10^{-2} (rad/s).

C -> Pure inspections shows that, for

$\omega = 0.1$ -> close to 0 degree or around -5 degrees.
$\omega = 1$ -> around -45 degrees.
$\omega = 10$ -> around -90 degrees.
$\omega = 1000$ -> around -270 degrees.