

EEE 342 Feedback Control Systems

Spring 2024-2025

Lab-2 Preliminary Work Manual

The goal of the preliminary work is to obtain Bode plot of our DC motor's transfer function. For the sake of simplicity, you can consider the following transfer function for our DC motor.

$$G_p(s) = \frac{20}{0.5s + 1}$$

where $G_p(s)$ represents the transfer function from a voltage input to output velocity.

1. Plot the Bode of the above transfer function by using the following code sample. Note that you are not allowed to use 'bode' method of Matlab. This sample code plots the magnitude and phase graphs of the given transfer function.

```
1 w = logspace(-1,2,100);
2 for k = 1:100
3     s = 1i * w(k);
4     G(k) = 20 / (0.5*s+1);
5 end
6 subplot(2,1,1)
7 semilogx(w,20*log10(abs(G)));
8 grid on
9 subplot(2,1,2)
10 semilogx(w,angle(G)*180/pi)
11 grid on
```

2. In this part, you need to generate your own Bode plot by applying sinusoidal inputs to the above transfer function and observing the sinusoidal output for magnitude and phase differences (you need to design a for loop and obtain each corresponding output in time domain).

- Use 'logspace' method of Matlab to generate 10 logarithmically separated point between 0.1 rad and 100 rad.
- Apply a sinusoidal input to the given transfer function for each of the above angular frequencies. Use the fact that

$$y(t) = A \times |G(jw)| \times \cos(wt + \angle G(jw)) \quad \text{when} \quad x(t) = A \times \cos(wt)$$

- Find magnitude and phase differences between the input and output signals by using 'fft' method of Matlab. The following lines introduce this operation.

```
1 X = fft(x);
2 [K,index] = max(abs(X));
3 P = angle(X(index))
```

- Plot magnitude and phase graphs with respect to angular frequency using 'x' markers with 'semilogx' command on top of the Bode plot generated in the first question for comparison.

This is a technical report, therefore you need to type equations by using mathematical tools of the text editor you are using, and use the appropriate template with introduction and conclusion sections. Also, your report should include all the Matlab codes you used for this work. Note that you need to do your preliminary works individually.