

## ELEC2400 - Matlab Computer Laboratory # 3

- All the MATLAB computer laboratories involve tasks being given which you must solve in MATLAB.
- The assessment for the laboratory requires you to hand in, **by 5pm on the Friday of the week you do the lab**, a file with the title `labx.m` (where `x` is the number of the lab in the title of this sheet).
- This file should be a MATLAB script file which when run, is your MATLAB solution to the tasks given.
- The file should be handed in via the blackboard link in the “tutorials” section of the course home page at [www.ee.newcastle.edu.au/brett/elec2400/tuts.html](http://www.ee.newcastle.edu.au/brett/elec2400/tuts.html)
- If your name is ‘Felix Student’, and your student number is ‘6309070’, then the first 3 lines of your file `labx.m` should be

```
% Name: Felix Student
% Student Number: 6309070
clear all; close all;
```

- Precede each `plot` command with a `figure` command to open up a new figure window for each plot.
- Try to divide your solution file into sections that pertain to the individual questions on this sheet. This is best done by using a comment in your file `labx.m` such as:

```
% Solution to question 2(a) follows:
```

1. Suppose the DFT  $X_N(\omega)$  of a sequence of samples  $x_k = x(k\Delta)$  is defined as

$$X_N(\omega) = \sum_{k=1}^N x_k e^{-j\omega k}.$$

Write a MATLAB function file `dft(x,w)` which accepts a vector `x` defining a signal, and a vector `w` specifying a frequency axis, and returns a vector `X` that is the above DFT calculation performed at the frequency points specified by `w`. (Hint: would the `polyval` and `fliplr` functions be useful?)

2. Write a script file that tests the above function on the following signal

$$x(t) = \sin 4t + 2 \cos 6t, \quad t \in [0, 10]s.$$

Choose an appropriate sampling period  $\Delta$ , and write your script such that it presents the magnitude  $|X_N(\omega)|$  in such a way as to show two clear spectral peaks.

3. Provide some MATLAB code that would, on the basis of  $X_N(\omega)$ , calculate an estimate of the magnitude of the sin/cosine term responsible for the largest ‘spike’ in  $|X_N(\omega)|$ . (Hint: type `help max` at the MATLAB prompt)
4. Augment the above so it also estimates the frequency of the sin/cosine term responsible for the largest ‘spike’;
5. Write a script file that takes the samples of the signal  $x(t)$  that you have generated, and use them to simulate the response of the system

$$H(s) = \frac{1}{0.2s + 1}$$

to  $x(t)$  (use the `lsim` function you are already familiar with). Call this new signal  $y(t)$ .

Now imagine that you were in a situation where you did not know what  $H(s)$  was, all you had available were the data records which were samples of  $x(t)$  and  $y(t)$ . Continue your script file so that it uses your `dft` function to estimate  $|H(j\omega)|$  **using only** the input-output data  $x(t)$  and  $y(t)$ .

Present your resultant estimate on a Bode magnitude plot. Make sure your x-axis units are in rad/s.