ECE-448: Speech Signal Processing -- Monsoon 2018

Assignment 4
DEADLINE: Before 11.59PM on 14th Sep 2018

INSTRUCTIONS:

1. You need to upload a single ZIP file in the moodle. The ZIP file should contain a pdf with your answers which may include screenshots, text etc.

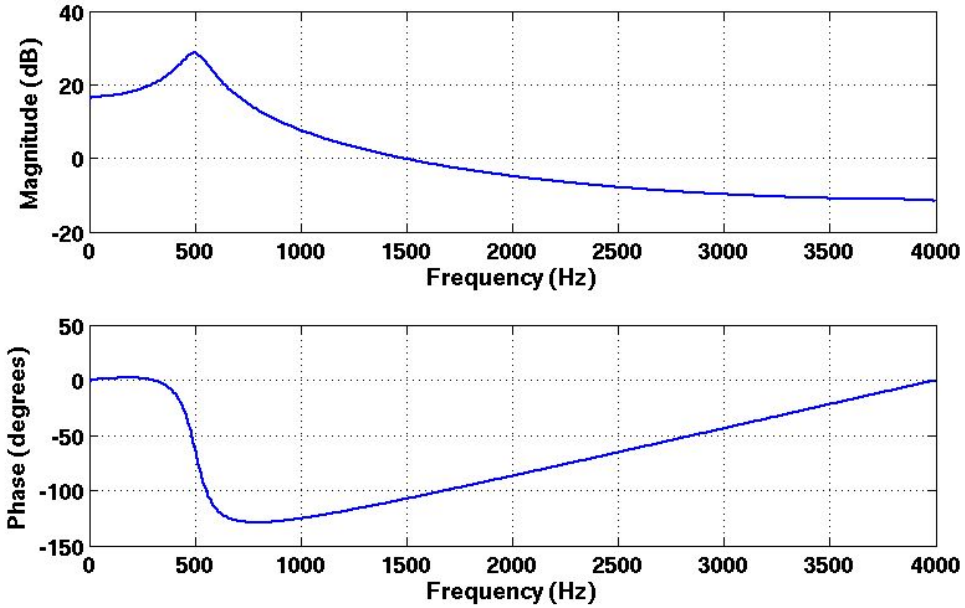
2. At the top-right of the first page of your submission, include the assignment number, your name and roll number.

3. IMPORTANT: Make sure that the assignment that you submit is your own work. Do not copy any part from any source including your friends, seniors or the internet. Any breach of this rule could result in serious actions including an F grade in the course.

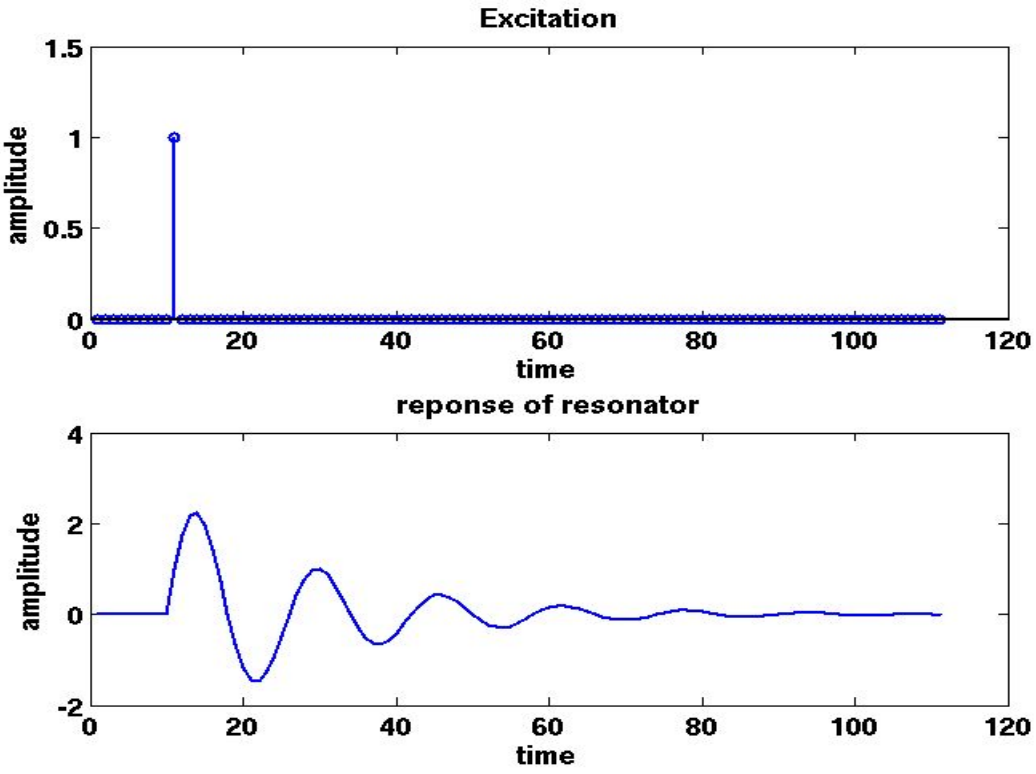
4. Your grade will depend on the correctness of answers. In addition, due consideration will be given to the clarity and details of your answers.

Questions:

1. A) Create a digital resonator with frequency f1=300hz and bandwidth of 50 hz. Plot its magnitude response and phase response as shown in below example figure.



1. B) Plot the resonator response for a unit sample sequence as shown in below example figure.



1. C) Cascade three resonators of f1=300hz, f2=1245hz, f3=1892hz with following bandwidths Bw1=50hz, Bw2=110hz, Bw3=160hz. For this resonator, plot the impulse response (magnitude and phase as shown in 1.A), plot the resonator response for a unit sample sequence (as shown in 1.B)

LP Residual:

2. A) Write short notes on linear prediction (LP) analysis of speech. Explain clearly how linear prediction coefficients are extracted from a given speech signal using autocorrelation method.

2. B) What is LP Residual? How is it extracted from a speech signal?

2. C) Record your full name and create a wav file. Plot the following

- **i. A small segment of your speech signal vs time**
- **ii. The segment projected upon hamming window**
- **iii. Autocorrelation sequence of the above signal**

2. D) Plot

- **i. Speech segment selected in 2(c)(i) vs time**
- **ii. LP Residual of the above signal**
- **iii. Autocorrelation sequence of the LP Residual**

2. E) Using the plot in 2(d)(iii) calculate pitch value of the speech segment.

Note: Plots for 2(c) and 2(d) should be in a single figure each, neatly aligned and labelled.

Formant Extraction:

3. a) How is vocal tract system response estimated using LP analysis?
b) Plot the following

- **i. Speech segment chosen in 2(c)(i) vs time**
- **ii. Vocal tract system response obtained of the above segment using LP analysis.**

c) From the plot obtained in 3(b)(ii) extracted the formant values corresponding to the speech segment.

Normalized Error:

4. a) What is normalized error in the context of LP Analysis? What does is signify?
b) Plot

- **i. a voiced speech segment from the recorded wav file vs time**
- **ii. Normalized error for that segment**

c) Repeat 4(b) for an unvoiced segment IMPORTANT NOTE: For this Assignment you SHOULD NOT use any inbuilt or user-defined functions in matlab which directly does LP Analysis