The University of New South Wales

School of Electrical Engineering and Telecommunications

ELEC3104: Digital Signal Processing

Assignment, Session 1, 2017

ATTACH THIS PAGE TO THE FRONT OF YOUR ASSIGNMENT

1. Assignment is **due on the 9th May, Tuesday, Week 10 at the Lecture**
2. This assignment will be marked by your peers at the lecture, attendance is compulsory.
3. The paper contains **5** questions.
4. The questions are worth **100** marks in total.
5. The questions are NOT of equal value.
6. You should hand write the answers for the assignment on A4 sized paper.
7. **You should attach this cover sheet (this page) to the front of your assignment.**

ANSWERS MUST BE **HAND WRITTEN** IN INK. EXCEPT WHERE THEY ARE EXPRESSLY REQUIRED, PENCILS MAY ONLY BE USED FOR DRAWING, SKETCHING OR GRAPHICAL WORK.

Details (Please fill before submission)

Name:

Student ID:

For Marking Purposes only (**Do no write in this section prior to submission**)

Q1 Mark:	Q4 Mark:
Q2 Mark:	Q5 Mark:
Q3 Mark:	**Total Mark (out of 100):**

To be filled by Marker

Marker's Name:

Marker's Student ID:

Question 1. (5 marks)

Is it possible to evaluate the Fourier transform of the Fourier transform of a real valued signal? i.e., if $\mathcal{F}\{\cdot\}$ denotes the Fourier transform operation and $x(t)$ is a real valued signal, is it possible to evaluate $\mathcal{F}\{\mathcal{F}\{x(t)\}\}$? If not, explain why not and if so, what is $\mathcal{F}\{\mathcal{F}\{x(t)\}\}$ in terms of $x(t)$?

Question 2. (20 marks)

Show that for any periodic signal of period *T*, the Fourier transform is equal to the Fourier series coefficients at the harmonics (integer multiples) of the fundamental frequency (*1/T)* and zero at all other frequencies.

Question 3. (35 marks)

Determine an expression for the frequency spectrum (based on DTFT) of a signal in terms of its DFT coefficients and using this relationship show that if I take the N-point DFT of a signal, set the coefficients corresponding to some frequencies to zero, and taken an IDFT to recover a time domain signal - I have not implemented a brickwall filter (i.e., an ideal filter with unity gain in the pass band, no transition band and a zero gain in the stop band).

Question 4. (10 marks)

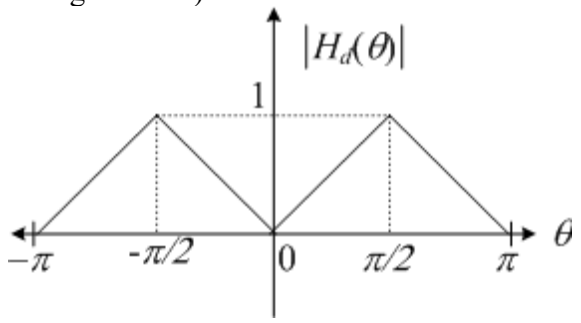
A transmission channel is characterised by a causal transfer function

$$H(z) = \frac{(2.2 + 5z^{-1})(1 - 3.1z^{-1})}{(1 + 0.81z^{-1})(1 - 0.6z^{-1})}$$

You need to correct for any distortion induced by this channel in the magnitude spectra of signals passing through it by connecting a causal discrete-time system, $G(z)$ at the receiving end of the channel. Determine $G(z)$ and draw its Direct Form II structure.

Question 5. (30 marks)

A FIR (finite impulse response) filter with the magnitude response given below and a linear phase response is desired. Design such a filter of order 8 using the windowing method (with a Hamming window)



End of paper