**The University of Huddersfield**

**School of Computing and Engineering**

# **Coursework Cover Sheet and Feedback Form**

**How to submit assignment report:** Via Turnitin.

**In submitting this assignment, students should be aware of the following**:

* Unless there are extenuating circumstances, work handed in after the hand-in date will receive a mark no greater than 50%; if handed in after the cut-off date (1 week after the hand-in date) the mark will be 0%.
* Student Handbook of Regulations: Section 5 covers procedures for students wishing to claim extenuating circumstances. Sections 4 and 6 define plagiarism and the procedures and penalties for dealing with it. **IMPORTANT NOTE:** Tutors marking coursework may use the JISC plagiarism service to check for plagiarism, and will use it where possible in all cases where plagiarism is suspected.
* You are advised to keep copies of all your assignments in case of difficulties.

**The signature below confirms** that you have read and understood the regulations concerning hand-in deadlines, penalties for late submission, plagiarism and extenuating circumstances procedures and that the work submitted is your own.

**This assignment will NOT be marked unless the following section is fully completed**

|  |  |  |  |
| --- | --- | --- | --- |
| Student Name: | | Course and Year | |
|  | | **MSc ECS&I 2018-2019** | |
| **Signature:** | | **Student Number:** | |
|  | |  | |
|  | |  | |
| Module Title | | Module Number | Module Tutor |
| Signal Analysis & Processing | | NME3523 | Prof. L. Gelman |
|  | |  |  |
| Assignment Title | | Ass. Weight | Date Stamp: |
| **Signal Analysis & Processing** | | **0.25** |
|  | |  |
| Hand-In Date | Date Submitted | Word Count |
| **8 April 2019** | **8 March 2019** |  |

**PERFORMANCE FEEDBACK** *(to be completed by the Module Tutor)*

**Question/Criterion Weight Overall Grade** …………….................

1 12 marks

2 20 marks **Tutors Signature:**

3 20 marks

4 12 marks

5 12 marks

6 12 marks

7 12 marks **Date Returned:** .................................

**Written Feedback**

***(Tutor inserts criteria)***

|  |
| --- |
| **Question 1/Criterion 1**: Correctness of answers, depth of analysis and quality of explanations/analytical justifications |
| **Question 2/Criterion 2**: Correctness of the results, effectiveness of use of MATLAB, quality of justification of the sampling frequency selection, completeness of comments/explanations of MATLAB programs |
| **Question 3/Criterion 3**: Correctness of the results, effectiveness of use of MATLAB, completeness of comments/explanations of MATLAB programs |
| **Question 4/Criterion 4**: Correctness of an answer, depth of analysis and quality of analytical justification of signal determination |
| **Question 5/Criterion 5**: Correctness of an answer and depth of analysis and explanation |
| **Question 6/Criterion 6**: Correctness of an answer and depth of analysis and explanation |
| **Question 7/Criterion 7**: Correctness of an answer and depth of analysis and explanation |
| Further General Feedback: |

MSc Engineering Control Systems and Instrumentation

Signal Analysis and Processing (NME3523)

**Assignment**

(*Contributes 25% to overall module mark*)

**Handed out:** 8 March 2019

**Hand-in date:** 8 April 2019 (Via Turnitin)

**Question 1**

Consider a discrete-time system that is characterized by the difference equation:

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where  is a discrete time,  is the digital input signal,  is the digital output signal.

Is the system governed by the given difference equation:

1. static or dynamic?
2. time-invariant or time-variant?
3. linear or nonlinear?
4. causal or non-causal?
5. stable or unstable?

Explain your answers for each question and prove your conclusions analytically for questions (b), (c) and (e).

**Question 2**

Using Matalb, simulate the combined digital signal consisting of 3 sine waves with frequencies f0, 2f0 and 3f0, where f0 is an analogue frequency, f0=20Hz; constant amplitudes of these waves are: A0=1, A1=0.2, A2=0.1 respectively and all waves have random initial phases, that are uniformly distributed in range (0-2). Analogue duration of the combined signal is 10s.

Select the suitable sampling frequency for signal simulation and justify the sampling frequency selection.

Provide the developed by you Matlab program realising the simulation.

**Question 3**

Using Matlab, estimate the discrete Fourier transform (DFT) of the combined digital signal, that was simulated in Question 2, with frequency resolution 0. 1Hz in the frequency range 0-70Hz and to provide DFT’s results at three frequencies: f0, 2f0 and 3f0.

Provide the developed by you Matlab program that is realising the estimation.

The created Matlab programs in Questions 2 and 3 should be properly commented/explained.

**Question 4**

Determine by a hand calculation the cross-correlation for the time shift (or lag). for the following wide sense stationary discrete-time signals:

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Before correlation calculation, determine signal type (e.g. energy signal or power signal) and justify analytically signal determination.

**Question 5**

For what value range of parameter *b,* is the filter, governed by the filter difference equation below, stable? Determine this range analytically by a hand calculation.

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**Question 6**

Explain by appropriate plots how the real Morlet wavelet transform can detect a “brick wall” discontinuity: i. e. when a constant positive signal , drops to a constant negative signal,  and plot a final qualitative result

The real Morlet wavelet function and its power spectral density are shown below.



**Question 7**

Describe analytically the relationship between the Wigner distribution and the instantaneous auto correlation function of a signal and provide the written explanation.

**Useful mathematical formulae:**

The roots of the equation  are:

