Stellenbosch University Faculty of Engineering

Module Framework

This document should be read with the following documents:

- ***Stellenbosch University Calendar Parts 1 and 11.***
- ***Faculty of Engineering Assessment Rules***
- ***Faculty of Engineering General Stipulations for Undergraduate Modules[1]***

Module: 46779 (E) **Systems and Signals 414** 2017	Lecturer(s): **Prof JA du Preez** **Room: E307,** **dupreez@sun.ac.za** Internal moderator: Dr HA Engelbrecht	Approved by Programme Coordinator:  Date: 27 January 2017

1 Assessment Details

- Major assessment dates and venues are provided at firga.sun.ac.za and my.sun.ac.za
- Method of assessment as indicated in the Calendar Part 11
- Note that awarding a pass mark is subject to meeting each the ECSA Exit Level Outcomes assessed in this module, as stated in Faculty of Engineering's Assessment Rules

Calculation of final marks (according to formulas in the Faculty of Engineering's Assessment Rules):

Assessment Method: Flexible: w_{SM} = 10%; w_{A1} = 40%; w_{A2} = 50%

SM=average(Tut tests), A1=test during test week, A2=test in first examination period

Note that both A1 and A2 are compulsory.

2 Language of Tuition

- The language of tuition in this module is according to the Faculty's approved Language Implementation Plan. Please refer to the website of the Engineering Faculty for the particulars.

3 Module Objectives

Aim: Mastering the basic aspects of digital signal processing

A student who has successfully completed this module can:

- Understand sampling and its implications.
- Convert between the different domains for discrete-time signals (z-plane, h[n], DFS, DFT, etc).
- Clearly understand time-frequency duality.
- Understand the implications of a signal/system representation in any of the above-mentioned domains.
- Use the above-mentioned concepts to design elementary filters.
- Understand and use a few basic structures to implement discrete-time filters.
- Determine the effect of a system on a given input signal.
- Understand and apply the deterministic auto and cross-correlation relationships between the input and output signals of an LTI system, for example to detect a signal hidden by noise and to identify a system.
- Understand the FFT algorithm.
- Calculate IFFT's, FFT's of two real N-point sequences as well as the FFT of a 2N-point sequence using a single N-point FFT.
- Understand how the multiplication of FFT's leads to circular convolution, and how to linearise this.
- Calculate convolutions using the overlap-and-add technique.
- Implement the above-mentioned techniques by means of computer programs.

[1] Available on SUNLearn for modules offered by Faculty of Engineering, in the block titled "General Programme Information" on the side of the screen

4 Module Content and Schedule

Prescribed textbook(s): .G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Edition, Prentice Hall, 2007, ISBN 0-13-187374-1.		
Week	Topic	Contact Session/Assignments
1	Introduction	
2-3	Discrete-time systems and signals, characterisation	Practical 1: Sampling Tutorial 1
4	Discrete Fourier transforms	Practical 2: The DFT Tutorial 2
5	Discrete convolution and correlation	Practical 3: Correlation Tutorial 3
6	Linear constant-coefficient difference equations	Tutorial 4
7-8	z-Transforms	Practical 4: Poles and Zeros
9-10	Test week and recess	
11	Frequency-domain techniques and filter concepts	Practical 5: Comb filters
12	Frequency domain analysis of LTI systems	
13	Two-dimensional signals	Tutorial 5

5 ECSA Knowledge Area Credits

Mathematical Sciences	Natural Sciences	Engineering Sciences	Design and Synthesis	Complementary Studies
0	0	12	3	0

Engineering Science:
Content: Science of the anaysis and manipulation of discrete-time signals
Assessment: Assessed in tests.

Design and Synthesis:
Content: Design and synthesise discrete time processing algorithms, such as digital filters.
Assessment: Assessed in tests.

6 ECSA Exit Level Outcomes

ELO 1. Problem solving: Identify, formulate, analyse and solve complex engineering problems creatively and innovatively.	
How is the Outcome Assessed?	Assessment is by way of the Flexible Assessment system in the Faculty of Engineering, with a final mark calculated from two tests and other assignments / class tests during tutorials and/or practicals.
What is Satisfactory Performance?	Using the assessment material and opportunities, the student must show that he/she applied a systematic problem solving method to a complex engineering problem which required specialized engineering knowledge at a level consistent to that which a graduate would participate in an employment situation shortly after graduation. In his approach, the student must show that he/she understands and can follow a systematic technique which includes the following steps: • analysis of the problem; • identification of the criteria for an acceptable solution, necessary information, and required engineering skills and knowledge; • generation and formulation of possible approaches to the solution of the problem; • modelling, analyses and evaluation of possible solution(s) and selection of the best solution;

	• formulation and presentation of the solution in an appropriate form.
What is the consequence of unsatisfactory performance?	Unsatisfactory performance in assessment 2 combined with the semester mark grants access to assessment 3; unsatisfactory performance in assessment 3 leads to a final mark < 50 and the student must repeat the module.
ELO 2. Application of scientific and engineering knowledge: Apply knowledge of mathematics, natural sciences, engineering fundamentals and an engineering speciality to solve complex engineering problems.	
How is the Outcome Assessed?	Assessment is by way of the Flexible Assessment system in the Faculty of Engineering, with a final mark calculated from two tests and assignments and/or tutorials and/or practicals.
What is Satisfactory Performance?	Using the assessment material and opportunities, the student must show that he/she has applied mathematical, scientific and engineering knowledge systematically to a problem at a level consistent to that which a graduate would participate in an employment situation shortly after graduation. The student must show that he/she: Used mathematical techniques and/or numerical analysis and/or statistical knowledge and methods on engineering problems by: a. applying formal analysis and modelling of engineering components, systems or processes; b. communicating concepts, ideas and theories with the aid of mathematics; c. reasoning about and conceptualizing engineering components, systems or processes using mathematical concepts.
What is the consequence of unsatisfactory performance?	Unsatisfactory performance in assessment 2 combined with the semester mark grants access to assessment 3; unsatisfactory performance in assessment 3 leads to a final mark < 50 and the student must repeat the module.
ELO 3. Engineering Design: Perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes.	
	n/a
ELO 4. Investigations, experiments and data analysis: Demonstrate competence to design and conduct investigations and experiments.	
	n/a
ELO 5. Engineering methods, skills and tools, including Information Technology: Demonstrate competence to use appropriate engineering methods, skills and tools, including those based on information technology.	
	n/a
ELO 6. Professional and technical communication: Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large.	
	n/a
ELO 7. Sustainability and Impact of Engineering Activity: Demonstrate critical awareness of the impact of engineering activity on the social, industrial and physical environment.	
	n/a
ELO 8. Individual, Team and Multidisciplinary Working: Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.	
	n/a
ELO 9. Independent Learning Ability: Demonstrate competence to engage in independent learning through well-developed learning skills.	
	n/a
ELO 10. Engineering Professionalism: Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.	
	n/a
ELO 11. Engineering Management: Demonstrate knowledge and understanding of engineering management principles and economic decision-making.	
	n/a

7 Other Module Specific Information

- All lectures, tutorials and practicals are compulsory, except if a different arrangement was agreed with the lecturer *before* the actual event. This rule also applies for students who repeat the subject.
- Tutorial periods can be used for unannounced tests.
- All tutorial and practical tasks and assignments must be handed in on schedule.
- A student who misses any assessment opportunity (e.g. tutorial, practical, report, assignment, test, etc.) without a valid excuse can be assigned a flexible assessment mark of less than 50%, irrespective of any calculated mark.
- Unannounced tests can be conducted in the course of the semester. These tests can contribute to the assessment mark.
- Only approved pocket calculators may be used in tests and examinations.