EE445
DIGITAL SIGNAL PROCESSING
Module Overview 2021-2022

Prof. Edward Jones
edward.jones@nuigalway.ie

Delivery of Module (1)

- Delivery is planned as a mixture of online and on-campus activity ("blended/flipped" learning)
- Lectures will generally be "asynchronous" with pre-recorded lectures for you to study in your own time (or during the scheduled slots for EE445 which are not being used for on-campus activity)
- On-campus sessions will generally focus on tutorial/problem-solving activity, past exam papers, clarification of material, examples and problems from the notes
- The on-campus sessions and recorded lectures complement each other

Delivery of Module (2)

- Three hours/week timetabled but not all will be used in any given week; initially, we will use Monday 1500-1700 in ENG-2002 and see how it goes.
- Attendance will be monitored using Qwickly. **This is also important for Covid-19 contact tracing.**
- **We may adapt depending on prevailing Covid-19 situation and guidance from the university ….**

Notes

- Blackboard page for EE445
- Notes and other relevant material (assignment info, past exam papers etc.) will be online

  NB: These notes do not contain all of the material covered in the course!
- Additional material, examples, comments, explanations, observations etc. will be covered in the lectures and in the on-campus sessions

  You need to fully engage in order to gain a full appreciation of the material being covered!

Blackboard

- If you have already registered for your course, but cannot see the EE445 Blackboard page, **there may be a problem with your registration**
- **Academic staff have been instructed not to add students to Blackboard manually because this doesn't "properly" register you**
- **Check with registration to make sure that you are fully registered for the module**
- E-mail reghelp@nuigalway.ie

Module Objectives

- The course aims to teach students the important tools for analysis of signals in discrete-time form, as well as the analysis and design of discrete-time systems
- Course draws heavily on material from some other courses – particularly *Signals and Communications* and *Electrical Circuits and Systems*
- We will also make reference to other modules you are studying, e.g. digital design or embedded systems courses, when we're talking about implementation aspects of DSP

Course Overview (1)

- Introduction to DSP (recap of some material from *EE357 Signals and Communications*)
- The z-Transform (like the Laplace transform)
- Frequency-Domain Analysis (i.e. Fourier Transform – but for *digital* signals) – basic concepts ("theory")
- Digital Filter Structures - given a transfer function, what are the options for implementation? (a bit like circuit design ..)

Course Overview (2)

- Resonators and Oscillators ("special" filters)
- Spectral Analysis (more about Fourier Analysis – focusing on more "practical" issues associated with doing this on a computer instead of with pencil and paper)
- Filter Design – getting a transfer function (like the Filter Design part of Section 3 of EE357, only digital ..)

Learning Outcomes (1)

1. Analyse a discrete-time system through calculation of its time-domain properties; in particular, calculate its impulse response, or the system output to any arbitrary input signal.
2. Describe signals and systems in terms of their z-transforms, and use appropriate techniques to analyse and manipulate them.
3. Determine the characteristics of a signal or system in the frequency domain, by means of the Fourier Transform, and determine the frequency content in the signal.
4. Given a discrete-time system description, determine an appropriate structure for implementation (e.g. cascade, parallel), and carry out system design.

Learning Outcomes (2)

5. Analyse and design specialised digital filters, including resonators and oscillators.
6. Choose appropriate parameters for spectral analysis using the DFT, across a number of applications.
7. Analyse the computational requirements of time-domain and frequency-domain approaches to implementing digital filters.
8. Given a required digital filter specification, choose an appropriate design procedure from a number of alternatives, carry out this procedure to determine the required filter transfer function, and verify that the specification has been met.

Written Examinations

- 2-hour exam
- 80% of total mark
- Past papers will be made available on EE445 Blackboard page

Assignments

- 2 assignments in Semester 1
- Counted as Continuous Assessment in overall module mark – 20% of total
- Computer-based - MATLAB
- Matlab will also be used extensively in lectures to illustrate concepts
- Further details on assignments will be provided in due course

Matlab (1)

- Matlab is accessible off-campus for the time being via a Campus Wide Licence (CWL) – details to follow.
- I'll follow up with an e-mail on how to download.
- You can also download a free 30-day trial from https://uk.mathworks.com/campaigns/products/trials.html

Matlab (2)

- Resources for Learning Matlab
  - Matlab "Getting Started" Guide is a good place to start
  - Extensive online documentation with package
  - Books in NUI Galway library
- Information about online tutorial resources at:

  http://www.mathworks.com/academia/student_center/tutorials/launchpad.html

Recommended Textbooks

- **EE445 Lecture Notes - Essential**
- "Digital Signal Processing: A Practical Approach" (2nd Edition), E. Ifeachor & B. Jervis, Addison-Wesley – good "all-rounder" textbook
- "Introductory Digital Signal Processing with Computer Applications" (2nd Edition), P. Lynn & W. Fuerst, John Wiley & Sons – covers basic concepts very well ("intuitively"), but limited scope
- "Discrete-Time Signal Processing" (2nd Edition), A. Oppenheim & R. Schafer, Prentice-Hall – good on the theoretical basis for DSP
- "Understanding Digital Signal Processing", Richard G. Lyons, Prentice-Hall – lots of practical "tips and tricks", very good if you're doing a DSP project