



Institiúid Teicneolaíochta Chorcaí
Cork Institute of Technology

MATH8002: Discrete Time Maths TM425

Module Details

Short Title:	Discrete Time Maths TM425 APPROVED		
Full Title:	Discrete Time Mathematics for Electronic Engineering T425		
Module Id:	3400		
Official Code:	MATH8002	NFQ Level:	8
		ECTS Credits:	5

Coordinator:	KEVIN J KELLY
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Description:	This module introduces the student to discrete transform theory (Z-transforms and Discrete Fourier Transforms) and to coding theory.
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Learning Outcomes:

On successful completion of this module the learner will be able to...

1. encode and decode a message using a linear block code and, where relevant, detect and correct errors.
2. find the Z-transform of each of a range of sequences/discrete functions and sampled functions.
3. solve various first and second order difference equations numerically and by using Z-transforms.
4. find the Discrete Fourier Transform of a 4-point sequence, 8-point sequence.
5. understand and use decimation-in-time and decimation-in-frequency methods for finding Fast Fourier Transforms.

Pre-requisite learning

Module Recommendations

This is prior learning (or a practical skill) that is strongly recommended before enrolment in this module. You may enrol in this module if you have not acquired the recommended learning but you will have considerable difficulty in passing (i.e. achieving the learning outcomes of) the module. While the prior learning is expressed as named CIT module(s) it also allows for learning (in another module or modules) which is equivalent to the learning specified in the named module(s).

3373	MATH7013	Maths for Electronic Eng TM325
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Incompatible Modules

These are modules which have learning outcomes that are too similar to the learning outcomes of this module. You may not earn additional credit for the same learning and therefore you may not enrol in this module if you have successfully completed any modules in the incompatible list.

No incompatible modules listed

Module Requirements

This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.

No requirements listed



Module Content & Assessment

Indicative Content

• Introduction to Error Control Coding

Introduction to error control - Binary Symmetric Channel, crossover probability, error detection, error correction, message, codeword, received word, weight of a word, distance between two words. Repetition codes and parity codes - examples, distance of code, maximum number of errors guaranteed to be (i) detected (ii) corrected. Introduction to linear block codes - generator matrix, parity check matrix, encoding, decoding table, syndrome, error detection and correction.

• Z-transforms

Discrete functions and sequences. Definition of a Z-transform. Z-transform of common sequences. Radius of convergence. Table of Z-transforms. Linearity property. Z-transform of a sequence of samples from a continuous function. The inverse transform - use of table and partial fractions. First shift property (delaying). Second shift property (advancing).

• Difference Equations

Definition, real-life examples (e.g. compound interest, tiling problem), order, boundary conditions, standard form, input sequence, output sequence. Solution by recursion. Solution by Z-transforms. Discrete-time linear systems. Discrete transfer function. Poles and zeros. Block diagrams.

• Discrete Fourier Analysis

Background - review of the complex form of the Fourier Series. Examples of non-periodic signals - top-hat function, one-sided negative exponential function. Definition of the Fourier Transform pair - Fourier Integral, Fourier Transform. Continuous Fourier spectra - frequency spectrum, magnitude spectrum, phase spectrum. Definition of the Discrete Fourier Transform (DFT) and of the inverse transform. Use of definition to find DFT and inverse transform of 4-point sequences. Matrix representation of N-point DFT, 4-point DFT, 6-point DFT, 8-point DFT. Amplitude spectrum, phase spectrum. Algorithms for fast transform (FFT). Decimation-in-time. Cooley-Tukey Algorithm. Decimation-in-frequency.

Assessment Breakdown	%
Course Work	30%
End of Semester Formal Examination	70%

	Outcome addressed	% of total	Assessment Date
Formal End-of-Semester Examination	2,3,4,5	70%	Semester End

Coursework Breakdown				
Type	Description	Outcome addressed	% of total	Assessment Date
Short Answer Questions	Test 1 - Coding Theory	1	5	Week 3
Short Answer Questions	Test 2 - Z-transforms	2	5	Week 6
Other	Mid-semester Examination	1,2,3	15	Week 8
Short Answer Questions	Test 3 - Fast Fourier Transforms	4,5	5	Week 11

The institute reserves the right to alter the nature and timings of assessment



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Module Workload & Resources

Workload		Full-time mode		
Type	Description	Hours	Frequency	Average Weekly Learner Workload
Lecture	Lecture	4	Every Week	4.00
Independent & Directed Learning (Non-contact)	Revision of lectures, exercise sheets	3	Every Week	3.00
Total Weekly Learner Workload				7.00
Total Weekly Contact Hours				4.00

Workload		Part-time mode		
Type	Description	Hours	Frequency	Average Weekly Learner Workload
Lecture	Lectures	3	Every Week	3.00
Independent & Directed Learning (Non-contact)	No Description	1	Every Week	1.00
Independent & Directed Learning (Non-contact)	No Description	3	Every Week	3.00
Total Weekly Learner Workload				7.00

Resources

Recommended Book Resources

- **A.Croft, R.Davison and M.Hargreaves 2000, *Engineering Mathematics: A Foundation for Electronic, Electrical, Communications and Systems Engineers*, Addison-Wesley [ISBN: 0-130-26858-5]**

Supplementary Book Resources

- **G.James 2003, *Advanced Modern Engineering Mathematics*, Prentice Hall [ISBN: 0-130-45425-7]**
- **S.Singh 2000, *The Code Book: The Secret History of Codes and Code-breaking*, Fourth Estate [ISBN: 1857028899]**

Other Resources

- **Website: *Math Software for Engineers, Educators and Students* , Maplesoft
<http://www.mapleapps.com>**
- **Website: Eric Weisstein *MathWorld* , Wolfram
<http://mathworld.wolfram.com>**