



Institiúid Teicneolaíochta Chorcaí
Cork Institute of Technology

ARTI8001: Digital Signal Processing

Module Details

Short Title:	Digital Signal Processing APPROVED
Full Title:	Fundamentals of Discrete Time signal processing including spectral analysis, nonrecursive (FIR) and recursive (IIR) filter design, software implementation, MATLAB programming and adaptive filtering
Module Id:	2638

Official Code:	ARTI8001	NFQ Level:	8	ECTS Credits:	5
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Coordinator:	JOSEPH CONNELL
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Description:	An introduction to the hardware and software required to implement digital signal processing plus signal analysis and discrete time system design including spectral analysis, filter design, MATLAB programming and adaptive filtering
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Learning Outcomes:

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

1. Predict the spectral attributes of periodic and aperiodic digital sequences using Fourier analysis and interpret the results
2. Classify difference equations under the headings of linearity, time invariance, stability, causality and recursion, implement them in a variety of forms and write matching software
3. Devise DEs for nonrecursive systems based on the window method and for recursive systems based on analogue approximations, employing the Bilinear Transformation, and also pole-zero placement.
4. Compare two methods of adapting FIR filters, i.e. steepest descent and least mean-square (LMS) and assess their speed, tracking trajectory, bias of estimate, stability and complexity of implementation
5. Employ a numeric computation and visualisation software package to analyse theoretical and real signals, synthesise complex signals and display signal and system characteristics

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).

Completion of courses in Transform theory and discrete time maths

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

- **DSP hardware**
circuitry and operation required to digitise an analogue signal
- **Sampling theory**
Mathematical model of sampling process in time and frequency domains
- **spectral analysis**
spectral content determination using the DFT and then implemented using the FFT
- **Nonrecursive filter design**
design of Difference Equations based on input samples only using the window method
- **Recursive filter design**
design of Difference Equations based on input and output samples using analogue approximations and pole-zero placement
- **Software Implementation**
flow diagrams of difference equations and efficient software for their implementation
- **MATLAB programming**
Introduction to MATLAB as a DSP tool for signal/system analysis
- **Adaptive Filtering**
Design of adaptive systems using the LMS algorithm for signal tracking and system identification

Assessment Breakdown	%
Course Work	40%
End of Semester Formal Examination	60%

	Outcome addressed	% of total	Assessment Date
Formal End-of-Semester Examination		60%	Semester End

Coursework Breakdown				
Type	Description	Outcome addressed	% of total	Assessment Date
Performance Evaluation	Verify the sampling process and display spectral analysis in MATLAB	1,5	10	Week 4
Performance Evaluation	design an FIR filter and verify its operation in MATLAB	1,2,3,5	10	Week 7
Performance Evaluation	design an adaptive system and verify its tracking capability in MATLAB	1,4,5	10	Week 10
Performance Evaluation	design an IIR filter and verify its operation in MATLAB	1,2,3,5	10	Week 12

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	delivery of theoretical background	2	Every Week	2.00
Lab	implementation of theory in MATLAB	2	Every Week	2.00
Independent & Directed Learning (Non-contact)	problem sheets	3	Every Week	3.00
Total Weekly Learner Workload				7.00
Total Weekly Contact Hours				4.00

Resources

Recommended Book Resources

- John G. Proakis, Dimitris G. Manolakis 1992, *Digital Signal Processing: Principles, Algorithms and Applications*, Macmillan [ISBN: 0-02-396815-X]
- James A. Cadzow 1987, *Foundations of Digital Signal Processing and Data Analysis*, Macmillan [ISBN: 0-02-318010-2]
- Bernard Widrow, Samuel D. Stearns 1985, *Adaptive Signal Processing*, 1985 Ed., Prentice Hall [ISBN: 0-13-004029-0]