Module Code	**EEU44C05**
Module Name	Digital Signal Processing
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Dr. W. Dowling
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	On successful completion of this module, students should be able to: 1. Design FIR filters using the window and frequency sampling methods. 2. Design IIR filters to meet detailed gain specifications, via the bilinear transformation. 3. Design decimation and interpolation systems for discrete-time signals. 4. Design discrete-time systems to filter analogue signals. 5. Implement linear convolution of arbitrarily-long sequences via the FFT algorithm. 6. Characterise wide-sense stationary random signals and the outputs that result from LTI filtering of such signals. **Graduate Attributes: levels of attainment** To act responsibly - Enhanced To think independently - Attained To develop continuously - Enhanced To communicate effectively - Enhanced

[1] TEP Glossary

Module Content	Please provide a brief overview of the module of no more than 350 words written so that someone outside of your discipline will understand it. Digital Signal Processing (DSP) is concerned with the processing of signals that are represented as sequences of finite-precision numbers. This course is an introduction to the theory and applications of digital signal processing. The DSP laboratory exercises are an integral part of the course and contribute to an enriched understanding of the theoretical material covered in the lectures. • **Sampling and reconstruction of analogue signals** Review of continuous-time signal and system analysis using Fourier and Laplace transforms; Ideal impulse sampling and reconstruction of bandlimited signals; digital to analogue conversion, practical considerations • **Discrete-time sequences** Discrete-time signals and systems, linearity, time-invariance, stability, causality; discrete-time convolution, linear constant-coefficient difference equations, magnitude and phase response; the discrete-time Fourier transform (DTFT) and its properties • **The z-transform and its properties** The z-transform, region of convergence for the z-transform, inverse z-transform, z-transform properties • **FIR filter design** Generalized linear-phase causal FIR filters; FIR linear-phase filter design using the window method; frequency-sampling design of FIR filters • **IIR filter design** IIR filter design using the bilinear transformation; Filter design by impulse invariance • **Realization of digital filters** Signal flow graph representation of linear constant-coefficient difference equations; basic network structures for implementing FIR and IIR digital filters • **The Discrete Fourier Transform** The discrete Fourier transform (DFT); properties of the DFT; circular convolution; linear convolution via the DFT and the overlap-add method; the radix-2 decimation-in-time fast Fourier transform (FFT) algorithm • **Changing the sampling rate using discrete-time processing** Sampling rate reduction by an integer factor; increasing the sampling rate by an integer factor; changing the sampling rate by a non-integer factor

	• **Discrete-Time Random Process** Mean and variance of a random variable; autocorrelation and autocovariance functions; cross-correlation and cross-covariance functions; wide-sense stationary random signal; ergodic process; power density spectrum; response of linear systems to random signals
Teaching and Learning Methods	The module is taught using a combination of lectures, tutorials and supporting laboratories. 3 lectures and 1 tutorial per week. 3 Matlab-based laboratories.
Assessment Details[2] **Please include the following:** • **Assessment Component** • **Assessment description** • **Learning Outcome(s) addressed** • **% of total** • **Assessment due date**	see table below
Reassessment Requirements	The overall module mark at the Supplemental examinations will be determined solely on the basis of the written examination.
Contact Hours and Indicative Student Workload[2]	**Contact hours: 44** **Independent Study (preparation for course and review of materials): 60**

Assessment Details:

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Annual Examination	2-hour written examination	1-6	80	Exam week
In-class test	45-minute written test	1-4	20	8

[2] TEP Guidelines on Workload and Assessment

	Independent Study (preparation for assessment, incl. completion of assessment): 21
Recommended Reading List	Oppenheim, A.V. and Schafer, R.W., *Discrete-Time Signal Processing,* 3rd ed., Prentice Hall, 2009.
Module Pre-requisite	3C1 Signals and Systems 3E3 Probability and Statistics 3E1 Engineering Mathematics V
Module Co-requisite	
Module Website	
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No
Module Approval Date	21 September 2021
Approved by	W. Dowling
Academic Start Year	
Academic Year of Date	