**Module Title:** Signals and Systems  
**Code:** EE3C01

<table>
<thead>
<tr>
<th>Level:</th>
<th>Credits: 5</th>
<th>Prerequisites:</th>
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<td>Junior Sophister</td>
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<tr>
<th>Lecturer:</th>
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<th>Lectures/week: 3</th>
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<tbody>
<tr>
<td>Assistant Prof. W. Dowling</td>
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<td>Tutorials/week: 1</td>
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<tr>
<th>Terms:</th>
<th>Duration (weeks): 12</th>
<th>Lectures/week: 3</th>
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<td>Semester 1</td>
<td>Total: 33</td>
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<th>Tutorials/week: 1</th>
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**Aims/Objectives**

The Signals and Systems module is taken by Junior Sophister B, C, CD, D stream and Bioengineering students. It provides a foundation for the Signal Processing, Control, and Communications Engineering modules covered later in the undergraduate curriculum.

The module presents the mathematical techniques used for continuous-time signal and system analysis. The analytical framework for discrete-time signals and systems is then developed. The final part of this module is an introduction to control systems.

**Syllabus**

**Continuous-Time Signals and Systems**

- Linearity, time-invariance, impulse response of a linear time-invariant (LTI) system; the convolution integral; properties of LTI systems; unit step response
- Periodic functions; Fourier series; properties of the Fourier series
- Laplace Transform; properties of the Laplace transform; transfer function of LTI system; poles, zeros and stability of an LTI system
- The Fourier transform and its properties
- Frequency response; steady state response; lowpass and highpass filtering
- Representation of a continuous-time signal by its samples; the sampling theorem; reconstruction of a continuous-time signal from its samples

**Discrete-Time Signals and Systems**

- The unit-impulse response of an LTI discrete-time system; the convolution sum; properties of discrete-time LTI systems; unit step response
- Fourier series representation of discrete-time periodic signals; properties of discrete-time Fourier series
- The discrete-time Fourier transform (DTFT); properties of the DTFT
- The z-transform; region of convergence for the z-transform; inverse z-transform; properties of the z-transform
- Causality; Stability; LTI systems characterized by linear constant-coefficient difference equations
- FIR and IIR filters

**Introduction to Control Systems**

- Linear Feedback Systems, closed-loop system function
- Root-locus analysis of linear feedback system
### Recommended Text(s)

### Learning Outcomes
On completion of this module the student should be able to:

1. Represent both continuous-time and discrete-time periodic signals as a Fourier series.
2. Use the Fourier transform and the Laplace transform to analyze continuous-time signals and systems
3. Use the discrete-time Fourier transform and the z-transform to analyze discrete-time signals and systems
4. Determine the impulse response, step response and frequency response of both continuous-time and discrete-time systems
5. Determine the response of the LTI system to any input signal
6. Determine the stability of a feedback system

### Teaching Strategies
The module is taught using a combination of lectures and tutorials.

### Assessment Mode(s)
90% of the final mark is determined via the annual two-hour written examination, and the remaining 10% via an in-class test.

The overall module mark at the Supplemental examinations will be determined solely on the basis of the written examination.