<table>
<thead>
<tr>
<th>Module Code</th>
<th>EE5C4</th>
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<tbody>
<tr>
<td>Module Name</td>
<td>Speech and Audio Engineering</td>
</tr>
<tr>
<td>ECTS Weighting²</td>
<td>5 ECTS</td>
</tr>
<tr>
<td>Semester taught</td>
<td>Semester 1</td>
</tr>
<tr>
<td>Module Coordinator/s</td>
<td>Associate Professor Naomi Harte</td>
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</tbody>
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**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:

- **LO1.** Describe, in terms of signal processing, the functioning of the human vocal and auditory systems
- **LO2.** Explain the frequency characteristics of speech signals
- **LO3.** Explain non-uniform frequency bands and metrics such as mel scales and dBA
- **LO4.** Explain the role of binaural hearing in distinguishing the direction of an acoustic source
- **LO5.** Apply machine learning techniques to develop a speech processing application in speech recognition, speaker identification or other similar domain
- **LO6.** Analyse the function of feature extraction in speech and audio signal processing
- **LO7.** Assess and explore speech technology through relevant literature in the domain

**Graduate Attributes: levels of attainment**

To act responsibly - Attained
To think independently - Attained
To develop continuously - Attained
To communicate effectively - Attained

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1. *An Introduction to Module Design* from AISHE provides a great deal of information on designing and re-designing modules.
2. *TEP Glossary*
Module Content

Speech is the most important and pervasive form of communication. Speech Engineering requires an understanding of the physiology of the human vocal and auditory systems. This understanding informs the signal processing methods that characterise speech signals. These methods include lossless tube models of speech production; time and frequency domain representations of speech; and window characteristics and time/frequency resolution trade-offs. Statistical signal processing methods such as autocorrelation and linear prediction of speech provide the basis of methods for speech synthesis and language processing. The module will introduce the underlying principles in speech technology such as speaker verification and speech synthesis, including how machine learning underpins much speech applications.

Teaching and Learning Methods

For 2020/21, the taught component of this module uses a mixture of pre-recorded lectures made available in Blackboard and real-time sessions. These will be live and online during timetabled slots for 5C4. The students are expected to engage in extensive reading of both course texts and relevant literature.

Assessment Details

Please include the following:
- Assessment Component
- Assessment description
- Learning Outcome(s) addressed
- % of total
- Assessment due date

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Assessment Description</th>
<th>LO Addressed</th>
<th>% of total</th>
<th>Week due</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>Paper analysis and speech analysis exercises</td>
<td>All</td>
<td>25</td>
<td>10,12</td>
</tr>
<tr>
<td>Exam</td>
<td>Exam</td>
<td>All</td>
<td>75</td>
<td>As per exam timetable</td>
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Reassessment Requirements

Exam based

Contact Hours and Indicative Student Workload

Contact hours: Approx 30 hours online

3 TEP Guidelines on Workload and Assessment
### Independent Study (preparation for course and review of materials):
Approx 70 hours for online lecture listening and self guided study through Semester.

### Independent Study (preparation for assessment, incl. completion of assessment):
Approx 30 hours for papers and assignment.
Approx 20 hours of focused study for the exam

### Recommended Reading List

- **Main text:**
  - Theory and Applications of Digital Speech Processing
  - Lawrence R. Rabiner, Ronald W. Schafer

- **Extra reading in library:**
  - Fundamentals of Speech Recognition Lawrence Rabiner, B H Juang
  - Speech Synthesis and Recognition, 2nd Edition John N.Holmes, Wendy J.Holmes
  - Applied Speech and Audio processing, Ian McLaughlin, Cambridge University Press, 2009
  - Speech and Audio Signal Processing: Processing and Perception of Speech and Music, 2nd Edition

- Other papers will be given as assigned reading during the course.

### Module Pre-requisite
Note that EE4C5 or an equivalent level of Digital Signal Processing is required before a student can start this course.

### Module Co-requisite

### Module Website
On Blackboard

### Are other Schools/Departments involved in the delivery of this module?
If yes, please provide details.

### Module Approval Date

### Approved by

### Academic Start Year

### Academic Year of Date