Module Code	5C04
Module Name	Speech Technology
ECTS Weighting[2]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Prof Naomi Harte
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 the functioning of the human vocal system and how this determines the acoustic phonetic properties of a language. LO2. Specify and use the short-time analysis of speech to analyse time-domain properties of a speech signal, e.g. pitch. LO3. Apply formant analysis of speech to compare cohorts of speakers. LO4. Explain the elements of the human auditory system. LO5. Relate the use of non-uniform frequency bands to properties of human hearing, e.g. Mel. LO6. Observe and interpret the acoustic-phonetic properties of speech via a spectrogram. LO7. Design a spectrogram analysis to explore and uncover specific time-frequency properties of a speech signal. LO8. Analyse the major components in machine learning-based speech technology as used in e.g. speech recognition, speaker identification, speech synthesis or other relevant applications. LO9. Evaluate how humans exploit both verbal and non-verbal speech cues in conversations. LO10. Critique the performance of modern speech technology, e.g. speech recognition, for minority users. LO11. Assess and explore current state-of-the art in speech technology through relevant literature in the domain e.g. AI Bias, multimodality, low-resource languages. LO12. Design a speech technology application using deep learning. **Graduate Attributes: levels of attainment** To act responsibly - Attained

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

	To think independently - Attained To develop continuously - Attained To communicate effectively - Attained
Module Content	Speech is fundamental to our human existence. It is our default form of communication. This module introduces the student to the foundations of human speech production and perception. The student gains an understanding of the acoustic-phonetic properties of all spoken languages, and how analysis in both frequency and time can reveal the underlying properties of the speech, from the gender of the speaker, to what words were spoken. The student will relate this underpinning theory to the workings of modern-day speech technology, from speech recognition systems like Alexa or Siri, to speech synthesis or deep fakes of someone's voice. They will learn how speech is much more than something we hear in conversations, but also how the non-verbal cues we observe are seamlessly integrated and essential to human speech-based interaction. Students have the opportunity to build an AI-based speech application in e.g. speech recognition. They will also gain insights into the limitations and barriers to use for AI-based speech technology. The curriculum has been carefully designed to allow the module be taken by students from Engineering, Computer Science and Linguistics.
Teaching and Learning Methods	e.g., lectures, seminars, online learning via VLE, field trips, laboratories, practice-based etc… This module is very much research-led and based on the extensive multidisciplinary experience in the field of speech technology of the module co-ordinator Prof. Naomi Harte. The module is built around a number of themes. Each theme is grounded with lecture material presented in face-to-face lectures, but student learning is further enabled through carefully aligned pre-class activities, class discussion boards on Blackboard, focussed discussions in-class and collaborative development of approaches to a speech technology design assignment. The curriculum has further been designed to take account of a variety of backgrounds and allow alignment with personal learning priorities for the students. Through a process of co-creation with

	students at the start of the Semester, the 25% module weighting for CA can be spread across 3 different submissions for credit. Students commit to a variable and personalised weighting for each component, at a level of 5% 10% or 15%, deciding how to spread the 25% over the 3 components. 3 attainment levels are pre-defined for each component. This commitment is recorded at the outset and drives personalised learning for each student.

Assessment Details[3]
Please include the following:

- **Assessment Component**
- **Assessment description**
- **Learning Outcome(s) addressed**
- **% of total**
- **Assessment due date**

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Exam	In-person end-of-semester written Exam	All	75	Exam Period
CA1*	Formant and spectral analysis	LO2,3,6,7	5-15%	Week 6
CA2*	Literature review, with practical exploration of technology shortcomings	LO10, LO11	5-15%	Week 8
CA3*	Speech Recognition system development	LO12	5-15%	Week 12

*Note that the total across the 3 assessments will be 25%. Using co-creation, students commit to a level of attainment in each to warrant the individual weighting. This allows personalised learning in the module.

Reassessment Requirements	Based on a repeat exam, if student's programme permits repeating of a failed module.

Contact Hours and Indicative Student Workload[3]	**Contact hours: 3 hours/week in Semester = 33 hours**
	Independent Study (preparation for course and review of materials): 2 hours per week in Semester = 22 hours
	Independent Study (preparation for assessment, incl. completion of assessment): Average of 2 hours per week over entire Semester = 48 hours.

[3] TEP Guidelines on Workload and Assessment

Recommended Reading List	
Module Pre-requisite	Basics of Digital Signal Processing an advantage but not required.
Module Co-requisite	
Module Website	Via Blackboard
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No
Module Approval Date	
Approved by	
Academic Start Year	
Academic Year of Date	