Subject Code	FH6401
Subject Title	Speech Processing
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	N/A
Objectives	This subject aims to achieve the following goals: • To introduce to students how speech sounds are articulated and how to characterize speech sounds acoustically • To provide students with the knowledge of related tools for acoustic analysis and hands-on experience of using such tools • To train students with basic programming skills for large-scale speech analysis and speech perception experiments, with Generative AI tools as learning aids • To give an overview of the major technologies that are involved in speech recognition and synthesis • To introduce to students the state-of-the-art development in the industry of speech recognition and synthesis
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Understand the articulatory and acoustic features of speech production by human; (b) Understand the complexity of speech and the challenges facing speech engineers; (c) Apply acoustic phonetics knowledge in analysis of human speech data; (d) Understand the principles of automatic speech recognition and synthesis; (e) Design simple programs for speech analysis and perception; (f) Solve problems using systematic approaches.
Subject Synopsis/ Indicative Syllabus	• Phonetics - Speech sounds and phonetic transcription - Articulatory phonetics - Acoustic phonetics and speech analysis

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Advanced speech analysis and speech perception

Programming with a scripting language
Large-scale speech analysis with scripts
Perception experiments with scripts

Speech technology

Fundamentals of text-to-speech (TTS)
Fundamentals of automatic speech recognition (ASR)
Applications

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<tr><td>Teaching/Learning Methodology</td><td>This subject will be taught with a combination of teaching methods, including lectures, tutorials and lab sessions. Lectures will cover concepts, algorithms and models with illustrative examples. Tutorials are designed to help students further their understanding of the materials covered in lectures, and lab sessions are intended to help students learn to apply the acquired knowledge to practical use. In addition to the above, students are also expected to complete assignments, lab exercises and attend quizzes and tests.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td></tr>
<tr><td>1. Two assignments</td><td>10% each
(20% in total)</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Five lab exercises</td><td>5% each
(25% in total)</td><td></td><td></td><td>✓</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>3.Mid-term test</td><td>15%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>4.Final quiz</td><td>40%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr>
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All the above assessment methods are appropriate for evaluating students' understanding of course materials and their programming skills and problem solving skills. Individual assignments provide assessment on a regular basis, which also serve as a means of self-monitoring for students. Lab exercises will emphasize the ability to apply knowledge to real-world problems. With the widespread availability of generative artificial intelligence (GenAI) tools as
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	learning aids, students will have the opportunity to utilize a GenAI tool to learn how to write Praat scripts. In-class tests and quizzes will assess students' overall understanding of the concepts and algorithms learnt in class and their mastery of basic programming skills.	
Student Study Effort Required	Class contact:	
	▪ Lecture	29 Hrs.
	▪ Tutorial/Lab	10 Hrs.
	Other student study effort:	
	▪ Study lecture notes and textbook materials	32 Hrs.
	▪ Homework and Programming Assignments	30 Hrs.
	▪ Preparation for Test and Final quiz	12 Hrs.
	Total student study effort	113 Hrs.
Reading List and References	**Textbooks** Ladefoged, Peter, and Keith Johnson. A Course in Phonetics. Seventh ed. Stamford, CT: Wadsworth, 2015. Print. Dan Jurafsky and James H. Martin. Speech and Language Processing (2nd edition), Prentice Hall, 2008. **Optional readings** Keith Johnson. Acoustic & Auditory Phonetics (2nd edition), Blackwell Publishing, 2003. Lawrence R. Rabiner, B. H Juang. Fundamentals of speech recognition, Englewood Cliffs, N.J. : PTR Prentice Hall, 1993. Paul Taylor. Text-to-Speech Synthesis, Cambridge University Press, 2009. **Recommended journals and conference proceedings** *Journal of Acoustic Society of America* *Journal of Phonetics* *Speech Communication* *Proceedings of Annual Meeting of the Association for Computational Linguistics (ACL)* *Proceedings of the biannual* IEEE *workshop on Automatic Speech Recognition and Understanding (*ASRU*)* *Proceedings of the International Conference on Acoustics, Speech and Signal Processing (ICASSP)*	