

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC463	SPEECH AND AUDIO SIGNAL PROCESSING	3-0-0-3	2016
<b>Prerequisite:</b> EC301 Digital Signal Processing			
<b>Course objectives:</b> <ul style="list-style-type: none"> <li>To familiarize the basic mechanism of speech production and the basic concepts of methods for speech analysis and parametric representation of speech.</li> <li>To give an overall picture about various applications of speech processing</li> <li>To impart ideas of Perception of Sound, Psycho-acoustic analysis, Spatial Audio Perception and rendering.</li> <li>To introduce Audio Compression Schemes.</li> </ul>			
<b>Syllabus:</b> Speech production, Time domain analysis, Frequency domain analysis, Cepstral analysis, LPC analysis, Speech coding, Speech recognition, Speech enhancement, Text to speech conversion. Signal Processing Models of Audio Perception, Psycho-acoustic analysis, Spatial Audio Perception and rendering, Audio compression methods, Parametric Coding of Multi-channel audio, Transform coding of digital audio, audio quality analysis.			
<b>Expected outcome:</b> The students will be able to <ol style="list-style-type: none"> <li>Understand basic concepts of speech production, speech analysis, speech coding and parametric representation of speech and apply it in practical applications</li> <li>Develop systems for various applications of speech processing</li> <li>Learn Signal processing models of sound perception and application of perception models in audio signal processing.</li> <li>Implement audio compression algorithms and standards.</li> </ol>			
<b>Text Books:</b> <ol style="list-style-type: none"> <li>Douglas O'Shaughnessy, Speech Communications: Human &amp; Machine, IEEE Press, Hardcover 2/e, 1999; ISBN: 0780334493.</li> <li>Nelson Morgan and Ben Gold, Speech and Audio Signal Processing: Processing and Perception Speech and Music, July 1999, John Wiley &amp; Sons, ISBN: 0471351547</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>Donald G. Childers, Speech Processing and Synthesis Toolboxes, John Wiley &amp; Sons, September 1999; ISBN: 0471349593</li> <li>Rabiner and Juang, Fundamentals of Speech Recognition, Prentice Hall, 1994.</li> <li>Rabiner and Schafer, Digital Processing of Speech Signals, Prentice Hall, 1978.</li> <li>Thomas F. Quatieri, Discrete-Time Speech Signal Processing: Principles and Practice, Prentice Hall; ISBN: 013242942X; 1/e</li> </ol>			
Course Plan			
Module	Course contents	Hours	End Sem. Exam Marks
I	Speech Production: Acoustic theory of speech production. Speech Analysis: Short-Time Speech Analysis, Time domain analysis (Short time energy, short time zero crossing Rate, ACF). Parametric representation of speech: AR Model, ARMA model. LPC Analysis (LPC model, Auto correlation method).	5	15%

<b>II</b>	Frequency domain analysis (Filter Banks, STFT, Spectrogram), Cepstral Analysis, MFCC. Fundamentals of Speech recognition and Text-to-speech conversion	8	<b>15%</b>
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	Speech coding, speech enhancement, Speaker Verification, Language Identification	7	<b>15%</b>
<b>IV</b>	Signal Processing Models of Audio Perception: Basic anatomy of hearing System. Auditory Filter Banks, Psycho-acoustic analysis: Critical Band Structure, Absolute Threshold of Hearing, Simultaneous Masking, Temporal Masking, Quantization Noise Shaping, MPEG psycho-acoustic model.	6	<b>15%</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Audio compression methods: Sampling rate and bandwidth requirement for digital audio, Redundancy removal and perceptual irrelevancy removal, Transform coding of digital audio: MPEG2-AAC coding standard, MDCT and its properties, Pre-echo and pre-echo suppression, Loss less coding methods.	7	<b>20%</b>
<b>VI</b>	Spatial Audio Perception and rendering: The physical and psycho-acoustical basis of sound localization and space perception. Spatial audio standards. Audio quality analysis: Objective analysis methods- PEAQ, Subjective analysis methods - MOS score, MUSHRA score	6	<b>20%</b>
<b>END SEMESTER EXAM</b>			

### Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.