(20EC7324) SPEECH AND AUDIO SIGNAL PROCESSING
(Program Elective-IV)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	0	0	3

Pre-Requisites: Digital Signal Processing

Course Objectives:
- To familiarize the basic mechanism of speech production and the basic concepts of methods for speech analysis and parametric representation of speech
- To give an overall picture about various applications of speech processing
- To impart ideas of Perception of Sound, Psycho-acoustic analysis, Spatial Audio Perception and rendering
- To introduce Audio Compression Schemes
- To familiarize with Spatial Audio Perception and rendering

UNIT-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).

UNIT-II: Speech Analysis
Frequency domain analysis (Filter Banks, STFT, Spectrogram), Cepstral Analysis, MFCC. Fundamentals of Speech recognition and Text-to-speech conversion, Speech coding, speech enhancement, Speaker Verification, Language Identification

UNIT-III: 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.

UNIT-IV: 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, Lossless coding methods.

UNIT-V: 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

Course Outcomes:

After successful completion of the course, the students can be able to

S. No	Course Outcome	BTL
1	Know basic concepts of speech production	L1
2	Understand the speech analysis, speech coding and parametric representation of speech and apply it in practical applications	L2
3	Develop systems for various applications of speech processing	L3
4	Implement audio compression algorithms and standards	L3
5	Familiarize with Spatial Audio Perception and rendering	L2

Correlation of COs with POs & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-
CO2	2	3	2	-	-	-	-	-	-	-	-	-	2	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	3	-

Text Books:

1. Speech and Audio Signal Processing: Processing and Perception of Speech and Music – Ben Gold & Nelson Morgan, John Wiley & Sons, 2nd Edition, 1999
2. Digital Processing of Speech Signals – L. R. Rabiner and R. W. Schaffer, PHl, 2004

Reference Books:

1. Speech Processing and Synthesis Toolboxes – Donald G. Childers, John Wiley & Sons, 1999
2. Fundamentals of Speech Recognition – L.R. Rabiner and B. H. Juang, PHI, 1999.
3. Speech Communications: Human & Machine – Douglas O'Shaughnessy, IEEE Press, 2nd Edition, 1999
4. Discrete-Time Speech Signal Processing: Principles and Practice - Thomas F. Quatieri, 1st Edition, PHI