SPEECH PROCESSING
B.E., VIII Semester, Electronics & Communication Engineering/ Telecommunication Engineering
[As per Choice Based Credit System (CBCS) Scheme]

Course Code	17EC832	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40 (8 Hours / Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course enables students to:
- Introduce the models for speech production
- Develop time and frequency domain techniques for estimating speech parameters
- Introduce a predictive technique for speech compression
- Provide fundamental knowledge required to understand and analyse speech recognition, synthesis and speaker identification systems.

Module-1

Fundamentals of Human Speech Production: The Process of Speech Production, Short-Time Fourier Representation of Speech, The Acoustic Theory of Speech Production, Lossless Tube Models of the Vocal Tract, Digital Models for Sampled Speech Signals. **L1, L2**

Module-2

Time-Domain Methods for Speech Processing: Introduction to Short-Time Analysis of Speech, Short-Time Energy and Short-Time Magnitude, Short-Time Zero-Crossing Rate, The Short-Time Autocorrelation Function, The Modified Short-Time Autocorrelation Function, The Short-Time Average Magnitude Difference Function. **L1, L2**

Module-3

Frequency Domain Representations: Discrete-Time Fourier Analysis, Short-Time Fourier Analysis, Spectrographic Displays, Overlap Addition(OLA), Method of Synthesis, Filter Bank Summation(FBS) Method of Synthesis, Time-Decimated Filter Banks, Two-Channel Filter Banks, Implementation of the FBS Method Using the FFT, OLA Revisited, Modifications of the STFT. **L1, L2**

Module-4

The Cepstrum and Homomorphic Speech Processing: Homomorphic Systems for Convolution, Homomorphic Analysis of the Speech Model, Computing the Short-Time Cepstrum and Complex Cepstrum of Speech, Homomorphic Filtering of Natural Speech, Cepstrum Analysis of All-Pole Models, Cepstrum Distance Measures. **L1, L2, L3**

Module-5

Linear Predictive Analysis of Speech Signals: Basic Principles of Linear Predictive Analysis, Computation of the Gain for the Model, Frequency Domain Interpretations of Linear Predictive Analysis, Solution of the LPC Equations, The Prediction Error Signal, Some Properties of the LPC Polynomial A(z), Relation of Linear Predictive Analysis to

| Lossless Tube Models, Alternative Representations of the LP Parameters. | **L1, L2, L3** |

Course outcomes: Upon completion of the course, students will be able to:
- Model speech production system and describe the fundamentals of speech.
- Extract and compare different speech parameters.
- Choose an appropriate speech model for a given application.
- Analyse speech recognition, synthesis and speaker identification systems

Text Book:

Theory and Applications of Digital Speech Processing-Rabiner and Schafer, Pearson Education 2011

Reference Books:

1. **Fundamentals of Speech Recognition**- Lawrence Rabiner and Biing-Hwang Juang, Pearson Education, 2003.

2. **Speech and Language Processing–An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition**- Daniel Jurafsky and James H Martin, Pearson Prentice Hall 2009.