EC-410C	SPEECH PROCESSING (ELECTIVE - VI)	L	T	P	C
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COURSE OBJECTIVES:

1. To acquire the fundamentals of the digital signal processing that allows them to assimilate the concepts related to the speech processing.
2. To introduce the fundamentals of speech signal processing.
3. To present basic principles of speech analysis.
4. To give an overview of speech processing applications including speech enhancement, speech recognition and speaker recognition.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. understand the mechanism of human speech production and digital models of speech signals.
2. apply standard digital signal processing tools to analyze speech signals in terms of their Time and frequency domain representations.
3. understand Linear Predictive analysis of speech signal and different pitch period estimation methods.
4. understand the Homomorphic processing of speech signal and applications of speech processing, including speech enhancement.
5. understand the applications of speech processing including speaker recognition and speech recognition.

UNIT I *Text Book - 1* **(11)**

Introduction : Introduction, Fundamentals of Digital Speech Processing, The Mechanism of speech production, Acoustic phonetics: vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates, Applications of Speech Signal Processing, Digital Models for Speech Signals: Vocal Tract, Radiation, Excitation, The complete Model.

UNIT II *Text Book - 2* **(11)**

Speech Analysis : Short-Time Speech Analysis : Windowing , Spectra of Windows , Time-Domain Parameters: signal analysis in Time Domain, Short-Time average magnitude, Short-Time Average zero-crossing rate (ZCR) and Short-Time auto correlation function Short-Time Average Magnitude Difference Function, Frequency Domain (Spectral) Parameters : Short-Time Fourier Transform Analysis, Spectral Displays, Formant Estimation and Tracking.

UNIT III *Text Book - 1* **(10)**

Linear predictive coding (LPC) of Speech : Introduction, Basic principles of Linear predictive Analysis, Solution of the LPC Equation: Cholesky Decomposition Solution for covariance method, Durbin's Recursive Solution for the Autocorrelation Equations, Frequency domain interpretation of mean squared prediction error, Applications of LPC parameters: pitch detection using LPC parameters and Formant analysis using LPC parameters. Pitch Period Estimation using Parallel Processing Approach ,Pitch Period Estimation using Autocorrelation Function.

UNIT IV *Text Book - 1,2* **(10)**

Homomorphic Speech processing : Homomorphic Speech processing: Introduction, Homomorphic systems for Convolution, The complex cepstrum of speech, The Homomorphic Vocoder.

Speech enhancement : Introduction, Background, Nature of interfering sounds, speech enhancement techniques: spectral subtraction, Multi-Microphone Adaptive Noise Cancellation.

UNIT V *Text Book - 1* **(10)**

Speech Recognition : Basic pattern recognition approaches, Preprocessing, Parametric Representation, speech recognition systems: Isolated Digit Recognition system and continuous Digit Recognition system.

Speaker Recognition : Verification vs recognition, Speaker Recognition Systems: speaker verification system and speaker identification system.

LEARNING RESOURCES:

TEXT BOOK(s):

1. L.R. Rabiner and R.W. Schafer - Digital Processing of Speech Signals, Pearson, 2009.
2. Douglas O' Shaughnessy - Speech Communications: Human & Machine, Second Edition, Oxford University Press, 2004.

REFERENCE BOOK(s):

1. Thomas F. Quatieri - Discrete Time Speech signal Processing principles and practice, Third Edition, Pearson Education, 2009.
2. Dr.Shaila D.Apte - Speech and Audio Processing, First Edition, WILEY Precise Textbook, 2015.