CVM UNIVERSITY
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FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Engineering

Semester II

Course Code: 102430206

Course Title: Speech Signal Processing

Type of Course: Program Elective III

Course Objectives: For humans, speech is a natural way of communicating the ideas. This course is a fundamental course on how to process digital speech signal to extract useful information. The course builds upon the theory of digital signal processing and extends the concepts applied to speech signal in particular. The course also discusses the applications of speech signal processing

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	30 / 15	20 / 10	70 / 35	30 / 15	150 / 75

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	Speech Communication: Introduction, discrete-time speech signal processing, speech communication, review of signals and linear systems.	4
2	Speech Production and acoustic phonetics: Anatomy and physiology of speech organs, speech sounds and classification, International Phonetic Alphabet (IPA), Articulatory Phonetics: Manner of articulation and place of articulation, vowel triangle, Acoustic Phonetics: spectrograms, wide-band and narrow-band spectrograms, acoustic characteristics of speech sounds, coarticulation and prosody.	6
3	Time-domain models for speech processing: Introduction to short-time speech analysis, windowing, short-time energy and average magnitude, short-time Zero-Crossing Rate (ZCR), speech vs. silence discrimination using energy and zero crossings, short-time autocorrelation function, short-time Average Magnitude Difference Function (AMDF).	6
4	Short-time Fourier analysis: Short-time Fourier transform (STFT), spectral displays, time-frequency resolution tradeoffs, Linear filtering interpretation, short-time synthesis, filter bank summation method.	4
5	Linear Predictive Analysis: Basic principles of Linear predictive analysis, autocorrelation method and covariance method, computation of gain for the model, prediction error signal, frequency domain interpretation of LP analysis, frequency domain interpretation of mean squared prediction error, applications of LPC parameters.	8

6	Speech Coding: Fundamentals of coding, liner prediction and harmonic noise models in speech coding, modeling excitation for voiced and unvoiced speech, Code-Excited linear prediction coding.	**6**
7	Speech processing Applications: speech enhancement, speech recognition, speaker recognition.	**6**

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						**R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create
R	**U**	**A**	**N**	**E**	**C**	
20%	20%	10%	20%	20%	10%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1	Speech Communication: Human and machine, D. O'Shaughnessy , Uniiversity Press
2	Digital Processing of Speech Signals, L. Rabiner and R. Schafer, Pearson Education.
3	Discrete-time Speech Signal Processing, T. Quatieri, Pearson Education.

Course Outcomes (CO):

Sr.	**Course Outcome Statements**	**%weightage**
CO-1	To get familiar with speech genration and speech communication basics.	**25**
CO-2	To get familiar with time- and frequency-domain methods of speech signal processing.	**25**
CO-3	To understand LPC and speech coding.	**35**
CO-4	To apply speech processing concept to various applications.	**15**

List of Practical / Tutorials:

1	To study the effects of windowing.
2	To study the difference between stationary and non-stationary signals.
3	To extract a slice of speech signal and compute its spectrum for different window length
4	To simulate periodic glottal pulse train.
5	To synthesize vowel using source filter model.
6	To compute wideband and narrowband spectrogram of a given speech signal
7	To compute short-time energy and ZCR of a given speech signal.
8	To compute short-time autocorrelation function and plot pitch contour for given utterance.
9	To compute short-time AMDF and plot pitch contour for given utterance.
10	To detect pitch using harmonic product spectrum.
11	To study LPC and cepstral analysis method.

Supplementary learning Material:	
1	MATLAB with signal processing toolbox

2	Sakshat Virtual Labs, IIT Guwahati

Curriculum Revision:	
Version:	**1**
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22