

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE801	Speech Processing	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test 1	Test 2	Ave. Of Test 1 and Test 2						
ETE801	Speech Processing	20	20	20	80	-	-	-	100	

Course Pre-Requisites:

- ETC405 Signals and Systems
- ETC602 Discrete Time Signal Processing

Course Objective:

- To introduce the models of speech production and acoustic phonetics
- To teach time and frequency domain techniques for estimating speech parameters
- To teach predictive techniques for speech coding
- To introduce speech recognition and speech synthesis applications

Course Outcomes: Students will be able to:

- Demonstrate basic knowledge in speech production mechanism, phoneme classification, digital models for speech production, Homomorphic speech processing and LPC analysis
- Demonstrate applications of signal processing theory for estimation of speech parameters in time and frequency domain including pitch and formants
- Analyze application of speech processing in speech compression, speech recognition, and speech synthesis
- Enhance their written and oral technical communication skills related to speech processing subject and will be better prepared for higher study and lifelong learning

Module No.	Topics	Hrs.
1.	Speech Production, Acoustic Phonetics and Auditory Perception	10
	1.1 Anatomy and physiology of speech organs, articulatory phonetics, acoustic phonetics, acoustic theory of speech production, discrete time model for speech production	
	1.2 Ear physiology and psychoacoustics	
2	Speech Analysis in Time Domain	06
	2.1 Time energy, average magnitude, and zero-crossing rate, speech vs silence discrimination	
	2.1 Short-time autocorrelation, pitch period estimation using short-time autocorrelation, median smoothing	
3	Speech Analysis in Frequency Domain:	06
	3.1 Time dependent Fourier representation for voiced and unvoiced speech signals, linear filtering interpretation, spectrographic displays	
	3.2 Pitch period estimation based on FFT and harmonic peak detection method, estimation of formants using log spectrum	
4	Homomorphic Speech Processing	08
	4.1 Cepstral analysis of speech, mel frequency cepstral coefficients (MFCC), perceptual linear prediction (PLP)	
	4.2 Pitch period estimation in cepstral domain, evaluation of formants using cepstrum	
5	LPC and Parametric Speech Coding	12
	5.1 Review of lattice structure realization, forward and backward error filters, normal equations & its solutions, Levinson-Durbin algorithm, covariance method, Berg's algorithm	
	5.2 Channel Vocoders, linear prediction (LP) based vocoders, residual excited LP (RELP) based Vocoders, voice Excited LP (VELP) based vocoders, multi-pulse LP (MPLP) based vocoders, code excited LP (CELP) based vocoders	
6	Speech Processing Applications	10
	6.1 Speech recognition systems, deterministic sequence recognition for ASR, statistical sequence recognition for ASR (Hidden Markov Model (HMM))	
	6.2 Text to speech system (TTS), concatenative synthesis, synthesis using formants, LPC synthesizer	
	Total	52

Recommended Books:

1. Rabiner and Schafer, “*Digital Processing of Speech Signals*”, Pearson Education, Delhi, 2004.
2. Shaila D. Apte, “*Speech and Audio Processing*”, Wiley India, New Delhi, 2012.
3. Douglas O’Shaughnessy, “*Speech Communications: Human & Machine*”, Universities Press, Hyderabad, Second Edition, 2001.
4. Ben Gold and Nelson Morgan, “*Speech and Audio Signal Processing*”, Wiley India (P) Ltd, New Delhi, 2006.
5. Thomas F. Quatieri, “*Discrete-Time Speech Signal Processing: Principles and Practice*”, Prentice Hall, 2001.
6. J. L. Flanagan, “*Speech Analysis Synthesis and Perception*”, Second edition, Springer-Verlag (1972).

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.