Course Code	Course Name	Course Structure	
ECECE68	Speech and Audio Signal Processing	L-T-P	3-0-2

COURSE OUTCOME (CO): After completing the course, the students shall be able to:
CO1: Understand fundamental concepts of OSI, TCP/IP models and network architecture
CO2: Analyse internetworking principles and LAN technologies
CO3: Understand Internet and Transport Protocols and gain knowledge on Internetwork operations
CO4: Design multistage switching structures involving time and space switching stages
CO5: Implement routing and congestion control algorithms

UNIT	COURSE CONTENT	LECTURE NO.	PRACTICALS
Unit-I: (O9)	Introduction to Speech and Audio Signals	01	Experiment 1: Write a MATLAB/Python function for visualizing Audio Signals - Reading from a File and Working on it.
	Acoustic theory of speech production	02	
	Short-Time Speech Analysis	03	
	Time domain analysis (Short time energy, short time zero crossing Rate, ACF)	04-05	Experiment 2: Write a MATLAB/Python function for characterizing the Audio Signal: Transforming to Frequency Domain.
	Parametric representation of speech: AR Model, ARMA model	06-07	
	LPC Analysis (LPC model, Auto correlation method)	08-09	

Unit-II: (09)	Frequency domain analysis (Filter Banks, STFT, Spectrogram)	10-11	Experiment 3: Write a MATLAB/Python function for generating Monotone Audio Signal.
	Cepstral Analysis	12	
	MFCC	13	
	Fundamentals of Speech recognition and Text-to-speech Conversion	14	Experiment 4: Write a MATLAB/Python function for feature Extraction from Speech.
	Speech coding	15	
	Speech enhancement	16	
	Speaker Verification, Language Identification	17-18	
Unit-III: (08)	Signal Processing Models of Audio Perception: Basic anatomy of hearing System	19-20	Experiment 5: Write a MATLAB/Python function for recognition of Spoken Words.
	Auditory Filter Banks	21	
	Psycho-acoustic analysis: Critical Band Structure, Absolute Threshold of Hearing	22	
	Simultaneous Masking	23	Experiment 6: Write a MATLAB/Python function for speech Recognition: Converting Speech to Text.
	Temporal Masking	24	
	Quantization Noise Shaping	25	
	MPEG psychoacoustic Model	26	

Unit-IV: (09)	Audio compression methods: Sampling rate and bandwidth requirement for digital audio	27-28	Experiment 7: Write a MATLAB/Python function to Create an ARIMA Model for Time Series Forecasting.
	Redundancy removal and perceptual irrelevancy removal	29	
	Transform coding of digital audio: MPEG2-AAC coding standard	30-31	Experiment 8: Write MATLAB/Python program for Mel-frequency cepstral coefficients (MFCC).
	MDCT and its properties	32	
	Pre-echo and pre-echo Suppression	33	
	Loss less coding methods	34-35	
Unit-V: (07)	Spatial Audio Perception and rendering: The physical and psycho-acoustical basis of sound localization and space perception	36-37	Experiment 9: Write MATLAB/Python function to compute modified Discrete Cosine Transform (MDCT).
	Spatial audio standards	38	
	Audio quality analysis: Objective analysis methods- PEAQ	39-40	Experiment 10: Use machine learning/ deep-learning to design a mini project of your choice with application of speech/audio signals.
	Subjective analysis methods - MOS score	41	
	MUSHRA score	42	

Suggested Readings:
1) Ben Gold, Nelson Morgan, Speech and Audio Signal Processing: Processing and Perception of Speech and Music, John Wiley, 2001
2) A.R. JAYAN, Speech and Audio Signal Processing, PHI Learning Pvt. Ltd., 2017
3) L R Rabiner and R W Schafer "Digital Processing of Speech Signals" Pearson, 2003
4) Khalid Sayood "Introduction to Data Compression" Elsevier, 2006

EVALUATION SCHEME FOR CONTINUOUS ASSESSMENT:

Sr. No.	Component	Continuous Assessment	Marks
1.	TCA (15)	Class tests	5
2.		Attendance/Response in Class	10
3.	PCA (15)	Lab Test/Viva	5
4.		Lab Files, Attendance/Performance in Lab	1 mark per turn
5.			
6.		Total	30 marks