



SEVENTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION

DECEMBER 2020/JANUARY 2021

SUBJECT: DIGITAL SPEECH PROCESSING (ECE-4007)

TIME: 3 HOURS

MAX. MARKS: 50

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

- 1A. Describe a simple digital source-system model that can best approximate human speech production system. Explain how to obtain the all-pole models for voiced and unvoiced cases.
- 1B. What are “Diphthong”, “Glide”, “Liquid” and “Nasal” sounds? Classify based on articulatory phonetics and give examples. (5+5)
- 2A. Figure Q2A shows the magnitude spectrum of a steady state vowel sound segment which has been extracted using rectangular window. Note that three formants and main lobe of magnitude spectrum of rectangular window are shown. (a) Suppose that Nyquist sampling rate is 6000 samples/sec, determine pitch period in milliseconds. How long is rectangular window in milliseconds? (b) If the first formant frequency $F_1=500\text{Hz}$, determine the pitch period in milliseconds and in time samples.
- 2B. Define and state the significance of short-time analysis of speech in general. Define ‘short-time energy’, ‘short-time average magnitude’, and ‘short-time average zero crossing rate’ functions. With the suitable examples explain how these parameters can be used to distinguish speech from silence in a high SNR speech. (5+5)
- 3A. Give the important properties of autocorrelation function and define short-time autocorrelation function for speech signals. With the help of suitable examples explain the effect of window size (window length). Also discuss the modified autocorrelation function and its significance in speech analysis.
- 3B. Define STFT. With help of necessary block diagrams describe the linear filtering interpretations of STFT. (5+5)
- 4A. With the suitable mathematical analysis and block diagrams describe the homomorphic filtering of speech for vocal tract system impulse response estimation.
- 4B. With the help of neat block diagram, explain the principle of LPC vocoder. What are its limitations? (5+5)
- 5A. With the help of neat block diagram, explain the working principle of Adaptive Transform Coders (ATC). What are ‘edge effects’ and ‘side information’ in ATC?

5B. With the neat block diagram explain the task oriented speech recognition by machine. What are the various approaches to automatic speech recognition by machine? Explain.

(5+5)

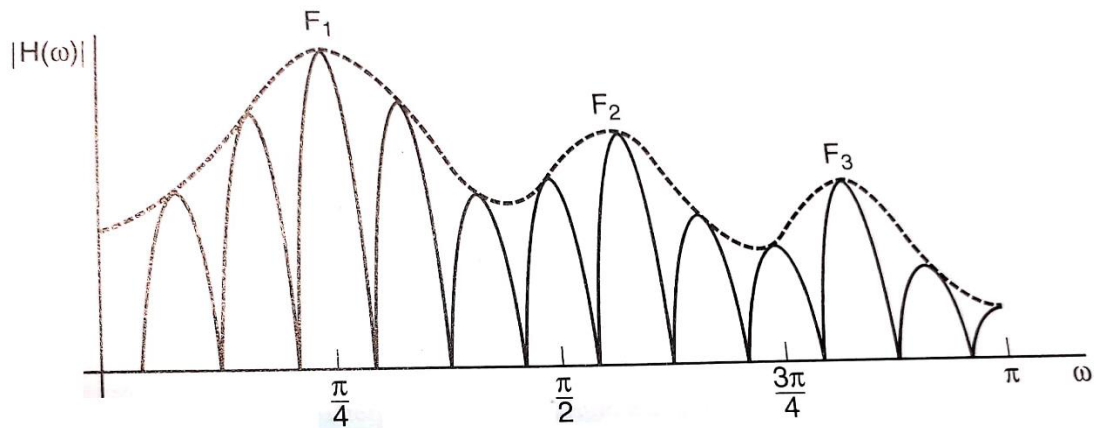


Figure Q2A: Spectrum of voiced speech segment.