



SEVENTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION

NOV/DEC 2017

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. Starting from the wave equations derive the expression for the transfer function of uniform lossless tube model.
- 1B. A segment of a speech signal is obtained using Rectangular window, whose spectrum is given in figure Q1B.
Find the corresponding pitch and first formant frequencies.
- 1C. With the help of a typical glottal wave form define different phases of glottal cycle.
(5+3+2)
- 2A. i) Explain how Short Time Average Zero Crossing Rate (STAZCR) for speech signal is calculated.
ii) Explain the method of speech versus silence discrimination using energy and zero crossing rate.
- 2B. i) Assume that STAMF has to be calculated on a speech signal sampled at 12.8KHz using a Hamming window with length of 31.25ms. Find the minimum rate of STAMF calculation required.
ii) If it is computed at a rate of 200 times/second, find the amount of overlapping between two successive frames.
- 2C. Find the auto correlation of a rectangular window of length 6 samples.
(5+3+2)
- 3A. Consider the following signal $x[n] = \cos(w_0 n) + \cos(w_1 n) + \cos(w_2 n)$ truncated by a rectangular window $w[n]$ of length L. Verify the ability to distinguish the frequency components in the signal for the following two cases and comment on the results. Case 1) L=25 2) L=100. Given $w_0 = 0.2\pi$, $w_1 = 0.22\pi$, $w_2 = 0.6\pi$.
- 3B. Consider a speech signal sampled at 14KHz. Find the minimum total sampling rate required to obtain a STFT representation in the following cases.
i) If a Rectangular window of length 30ms is used.
ii) If a Hamming window of length 30ms is used.
- 3C. Briefly explain the effect of length of window on the spectrum of speech signal.
(5+3+2)
- 4A. Explain the auto correlation method of LPC analysis.
- 4B. How the synthesis of speech in Residual Excited Linear Predictive vocoder is different from that in basic LPC voder? Which one provides better quality of speech? Explain your answer.

- 4C. Consider a first order linear predictor whose output is given by $y(n) = \alpha s(n-1)$.
 Let $e(n) = s(n) - y(n)$ be the error signal. Derive the expression for the optimum value of α by minimizing the mean squared error.
- 5A. Explain briefly how MFCC feature vectors along with HMM can be used to build a speech recognition system.
- 5B. How dynamic time warping can be used to compare two speech segments of different lengths?
- 5C. Mention the different elements in a HMM.

(5+3+2)

(5+3+2)

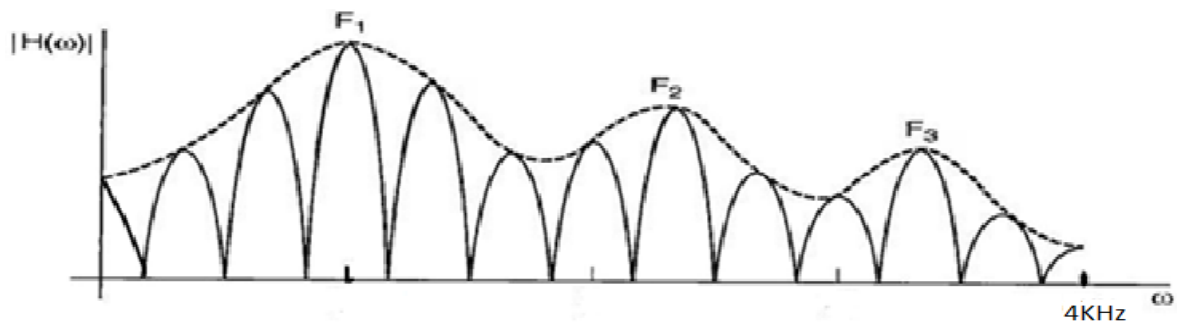


Figure Q1.B