

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2014****Subject code: 1724105****Date: 23-06-2014****Subject Name: Speech Signal Processing and Applications****Time: 02:30 pm - 05:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 (a) What can be interpreted from spectrogram? Draw narrowband and wideband spectrogram with annotation. **07**

(b) What are the advantages and disadvantages of short and long windows? In DFT, what is the effect of the window? **07**

Q.2 (a) Explain semivowel, diphthongs and Nasals with example. **07**

(b) Consider the periodic impulse train $x[n] = \sum_{k=-\infty}^{\infty} \delta[n - kP]$ **07**

(a) Compute and sketch the autocorrelation $R_n(k)$ of the windowed sequence $x[n]$ when the window applied to $x[n]$ is a rectangular over interval $0 \leq n \leq N_w$ with length $N_w = 4P$.

(b) How does your result from part (a) change if the pitch period increases by one sample on each period and the window length is long enough to cover the first three impulses of $x[n]$? Observe that the first three impulses occur at 0, $P+1$ and $2P+2$.

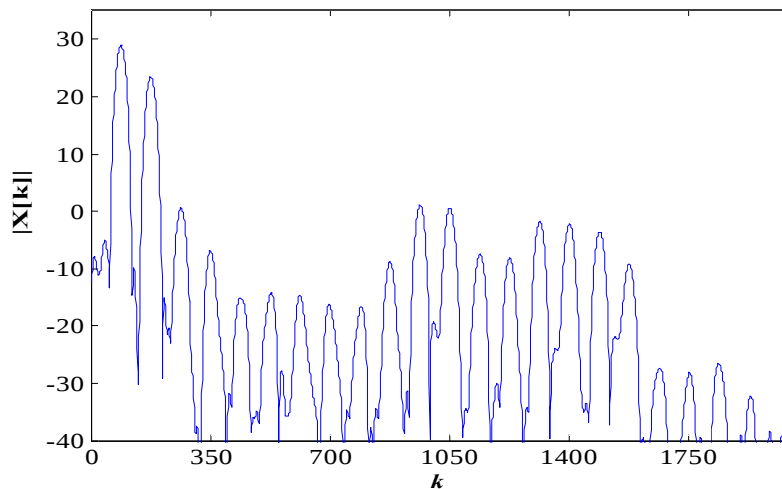
OR

(b) Consider the following figure which shows the magnitude spectrum obtained using 4096-point DFT of some sound segment. Note that the spectrum is shown only for half the range of FFT bin due to symmetry. **07**

(a) Is it a wide-band spectrum or a narrow-band spectrum?

(b) Is the sound segment voiced or unvoiced?

(c) Assuming the sampling rate of 8 kHz, estimate the pitch period in milliseconds. What is the pitch period in samples? What is pitch in Hz?



Q.3 (a) Explain Voice Onset Time in plosive. Draw its figure and explain it. **07**

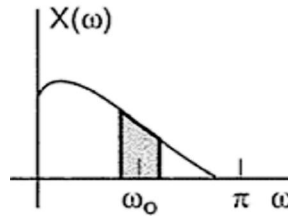
(b) Explain Filter Bank Summation method. **07**

OR

- Q.3** (a) Explain coarticulation in detail. **07**
 (b) Explain the challenges in pitch detection and list its applications. **07**
- Q.4** (a) Compare Linear Prediction and homomorphic filtering methods. **07**
 (b) Explain the spectral estimation using LPC. **07**

OR

- Q.4** (a) Explain Covariance method of LPC. **07**
 (b) Draw and explain characteristic system for homomorphic deconvolution. Also explain inverse of the characteristic system for homomorphic deconvolution. **07**
- Q.5** (a) Show that discrete STFT can be expressed as the outputs of a set of analysis filters. Also Draw its block diagram representation and graphically show STFT of signal $X(\omega)$ as shown in figure below by assuming rectangular window. **07**



- (b) Explain speaker verification system. **07**
- OR**
- Q.5** (a) Explain difference between complex cepstrum of voiced speech and unvoiced speech. **07**
 (b) Explain Isolated digit recognition system. **07**
