

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – II • EXAMINATION – WINTER • 2013****Subject code: 1724105****Date: 02-01-2014****Subject Name: Speech Signal Processing and Applications****Time: 10.30 am – 01.00 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) Explain effect of windowing and spectral sampling in DFT using suitable example. Also mention which window has highest spectrum leakage. **07**
- (b) Classify Phonemes. Explain diphthongs, semivowels with example. **07**
- Q.2** (a) Explain speech processing model. Briefly explain source-filter model of speech production. **07**
- (b) Glottal flow source of a voiced sound given is by $u[n] = g[n]*p[n]$, where, P is pitch period and $g[n]$ is glottal pulse. Determine DTFT of the windowed segment $x[n, \tau] = w[n, \tau] \{h[n] * (g[n] * p[n])\}$, where $h[n]$ is the vocal tract transfer function and $w[n, \tau]$ is a window centered at τ . Sketch a typical DTFT, with τ fixed, of a voiced sound. **07**
- OR**
- (b) 1. The following are three different signals $x_i[n]$ that are the sum of two sinusoids: $x_1[n] = \cos(\pi n/4) + \cos(17\pi n/64)$
 $x_2[n] = \cos(\pi n/4) + 0.8 \cos(21\pi n/64)$
 $x_3[n] = \cos(\pi n/4) + 0.001 \cos(21\pi n/64)$
 We wish to estimate the spectrum of each of these signals using a 64-point DFT with a 64-point rectangular window $[n]$. Indicate which of the signals' 64-point DFTs you would expect to have two distinct spectral peaks after windowing. Justify your answer. **04**
2. A 128-millisecond portion of an analog signal is sampled at a rate of 8 kHz and the resulting L samples are saved for further processing. What is L ? The 256-point DFT of these samples is computed. What is the frequency spacing in Hz of the computed DFT values? **03**
- Q.3** (a) What is co-articulation and prosody? Briefly explain them. **07**
- (b) Define short-time energy and short-time zero crossing rate. Explain the application of these parameters. **07**
- OR**
- Q.3** (a) What is pitch? Explain pitch detection method using AMDF. Which are the challenges in pitch detection? **07**
- (b) Explain the difference of Narrowband and Wideband spectrogram. **07**
- Q.4** (a) What is the need of STFT? Explain any one approach of STFT. **07**
- (b) Explain application of LPC in spectral estimation. **07**
- OR**
- Q.4** (a) Explain Filter Bank Summation method. **07**
- (b) Explain Autocorrelation method of LPC for speech signal. **07**
- Q.5** (a) Write a short note on homomorphic systems for convolution. **07**
- (b) Explain speech recognition system. **07**
- OR**
- Q.5** (a) Explain speaker verification system. **07**
- (b) What is speech coding? Explain need of speech coding. Explain how LPC can be used for speech coding. **07**
