

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – II • EXAMINATION – WINTER 2012****Subject code: 1724105****Date: 02-01-2013****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) What are phonemes? Discuss all different bases for their classification. **07**
 (b) Draw vowel triangle and explain its importance. **07**

- Q.2** (a) Write a short note on coarticulation. **07**
 (b) Glottal flow source of a voiced sound given is by $u[n] = g[n]*p[n]$, **07**

where $p[n] = \sum_{k=-\infty}^{\infty} \delta[n-kP]$, 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.

OR

- (b) A 10 kHz sinusoidal signal is sampled at 80 kHz and 64 samples are collected and used to compute the 64-point DFT of this signal. At what DFT indices would you expect to see any peaks in the DFT? **07**

- Q.3** (a) Define short-time autocorrelation function and explain the pitch detection method using it. Also explain the need of spectrum flattening. **07**
 (b) Derive the equation of Filter Bank Summation (FBS) constraint. **07**

OR

- Q.3** (a) Write and explain the algorithm for end-point detection of a given speech signal using short-time energy and short-time zero crossing rate. **07**
 (b) Explain filtering view of short-time Fourier transform. **07**

- Q.4** (a) Discuss three shortcomings of linear prediction. For each limitation, mention whether or not homomorphic processing can avoid it. **07**
 (b) Explain the use of pre-emphasis for speech analysis. **07**

OR

- Q.4** (a) Explain spectral estimation via LPC in detail. **07**
 (b) Explain challenges in pitch detection and list its applications. **07**

- Q.5** (a) Determine and sketch the complex cepstrum of the sequence $h[n] = \delta[n] + \alpha\delta[n-n_0]$. Assume $|\alpha| < 1$. **07**
 (b) Write a short note on homomorphic systems for convolution. **07**

OR

- Q.5** (a) Determine the complex cepstrum of $x_1[n] = a^n u[n]$, $|a| < 1$. **07**
 (b) Define complex cepstrum and mention its properties by considering the most general form of rational z-transform. **07**
