



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.Tech(ECE)/SEM-1/MCE-103/2011-12**

**2011**

**ADVANCED DIGITAL SIGNAL PROCESSING**

Time Allotted : 3 Hours

Full Marks : 70

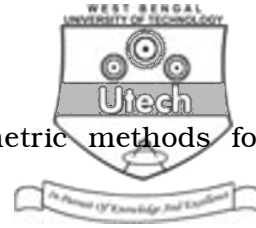
*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

Answer Question No. 1 any *four* from the rest.

1. Answer any *seven* questions :  $7 \times 2 = 14$

- a) What is the difference between Fourier series and Fourier transform ?
- b) What do you mean by Minimum-phase and Maximum-phase system ?
- c) Explain Parseval's theorem for discrete time sequences.
- d) What is periodogram ?
- e) What is meant by radix-2 FFT ?
- f) Differentiate between DIT and DIF algorithm.



- g) Write two limitations of non-parametric methods for power spectrum estimation.
- h) What are the errors in quadrature mirror filter ( QMF ) bank ?
- i) Write two properties of wavelet.
- j) What do you mean by "Fast wavelet transform" ?
2. a) Briefly explain the relationship between Fourier transform and z-transform.
- b) Determine the Fourier transform of the signal

$$x [ n ] = \begin{cases} A - M \leq n \leq M \\ 0, \text{ elsewhere} \end{cases}$$

Draw the magnitude and phase spectrum. 6 + 8

3. a) Determine the output sequence of the system with impulse response

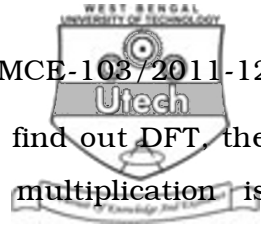
$$h ( n ) = ( 1/2 )^n u ( n )$$

when the input is the complex exponential sequence

$$x ( n ) = Ae^{j\pi n/2} \quad -\infty < n < \infty$$

- b) Evaluate the frequency response of the system described by the system function

$$H ( z ) = \frac{1}{1 - 0.8z^{-1}} \cdot \quad \quad \quad 7 + 7$$



4. a) Show that when algorithm is used to find out DFT, the number of complex addition and multiplication is reduced.
- b) Find the discrete Fourier Transforms ( DFT ) of a sequence  $x [ n ] = \{ 1, 1, 1, 1, 1, 1, 0, 0 \}$  using decimation in time ( DIT ) algorithm. 2 + 12

5. a) What do you mean by the term "window" in designing FIR filter ?
- b) Design an ideal low pass filter with a frequency response

$$H_d ( e^{j\omega} ) = e^{-j2\omega} \text{ for } -\pi/4 \leq \omega \leq \pi/4$$

$$= 0 \text{ for } \pi/4 < | \omega | < \pi$$

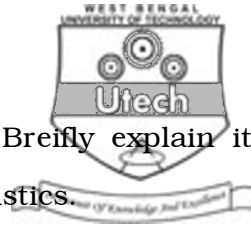
Find the values of  $h [ n ]$  for the following window function :

$$w [ n ] = \begin{cases} 1 & 0 \leq n \leq 4 \\ 0, & \text{otherwise} \end{cases}$$

Determine the frequency response of the designed filter.

2 + 12

6. a) Derive the relationship between autocorrelation function and spectral density.
- b) Briefly explain the parametric method of power spectrum estimation. Also determine the mean and variance of this method. 4 + 4 + 6



7. a) What do mean by "interpolation" ? Briefly explain its time and frequency domain characteristics.
- b) Suppose the poly phase matrix for a three-channel perfect reconstruction FIR QMF bank is

$$P(z^3) = \begin{pmatrix} 1 & 1 & 2 \\ 2 & 3 & 1 \\ 1 & 2 & 1 \end{pmatrix}$$

Determine the analysis and the synthesis filters in the QMF bank. 2 + 6 + 6

8. Write short notes on any *two* of the following : 7 + 7
- a) Chirp z-transform
- b) Denoising using wavelets
- c) The steepest-descent Method for adaptive FIR filter design.

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