Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/M.Tech (ECE)/SEM-1/MCE-103/2012-13

2012
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 1 and any *four* questions from the rest.

1. a) What is Inverse System ? Explain with suitable example.

   b) Write down the applications of Cepstrum.

   c) Define minimum phase and maximum phase system with proper examples.

   d) Write down the advantages of FIR filter with respect to IIR counterpart.

   e) State Parseval's energy and power relations.

   f) Consider the system $y(n) = 0.9\, y(n-1) + bx(n)$. Determine b so that $|H(0)| = 1$.

   g) What is Homomorphic Deconvolution ? 7×2

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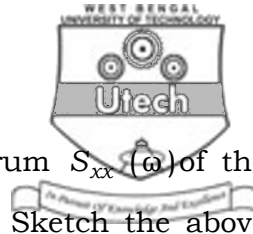
2. a) Determine the energy density spectrum $S_{xx}(\omega)$ of the signal $x(n) = a^n u(n)$, $-1 < b < 1$. Sketch the above sequence assuming $a = 0.8$ and corresponding energy density spectrum $S_{xx}(\omega)$ 6

   b) Determine the fourier transform of the signal $x(n) = b^{|n|}$, $-1 < b < 1$. 6

   c) State Correlation theorem of Fourier transform. 2

3. a) Consider the FIR filter $y(n) = x(n) - x(n-4)$. Sketch its magnitude and phase response. Hence find the response of the system to input
   $$x(n) = \cos\left(\frac{\pi}{2} n\right) + \cos\left(\frac{\pi}{4}n\right), \quad -\infty < n < \infty. \qquad 4+4$$

   b) Determine the steady-state and transient response of the system $y(n) = \frac{1}{2}[x(n) - x(n-2)]$ to the input signal $x(n) = 5 + 3\cos\left(\frac{\pi}{2}n + 60°\right)$, $-\infty < n < \infty$ 6

4. a) The system $y(n) = \frac{1}{2} y(n-1) + x(n)$ is excited with the input $x(n) = \left(\frac{1}{5}\right)^n u(n)$. Determine the sequences $r_{xx}(1)$, $r_{hh}(1)$, $r_{xy}(1)$ and $r_{yy}(1)$. 4×2.5

   b) Determine the impulse response of a causal system which produces the response $y(n) = \left\{1 \quad -1 \ 3 \ -1 \ 6\right\}$
   $\uparrow$
   when excited by the input signal $x(n) = \left\{1 \ 1 \ 2\right\}$ 4
   $\uparrow$
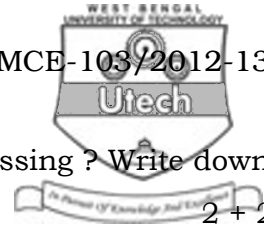
5. a) What is Multirate Digital Signal Processing ? Write down few of its applications. 2 + 2

b) A discrete-time signal $x(n)$ is passed through a decimator with decimation factor L. Evaluate the frequency response of the decimator output signal $y(n)$. 6

c) Why are images produced during upsampling operation ? 4

6. a) Explain with suitable diagram the operation of Quadrature Mirror Filter Bank. 4

b) Derive the expression of Distortion and Aliasing transfer function and establish the conditions of near perfect reconstruction. 7

c) How efficient poly-phase structure of interpolator is obtained ? Explain with proper figure. 3

7. Write down the short notes on any *four* topics : $4 \times 3\frac{1}{2}$

a) Discrete Time Fourier Series

b) Relationship between correlation and convolution

c) Parametric method for power spectrum estimation

d) Continuous wavelet transform

e) Deconvolution

f) Region of convergence (ROC).