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 and any *four* from the rest.

1. a) What are meant by stable and unstable systems. Explain with examples. 3

   b) Obtain the value of the following summation : $\sum_{n=-\infty}^{\infty} \delta(n-2) \sin 2n$. Determine whether the sequence $x(n) = a^n \; u(-n-1)$ is causal or not. 3

   c) Explain the statement– 'Aperiodic finite energy signals have continuous spectra'. 3

   d) What are the applications of Wavelet Transforms. 3

   e) Explain the necessity of Equalizer in the context of communication theory. 2

2. Determine the energy and power of the signal $x(n)=\left(\frac{1}{3}\right)^n u(n)$ and classify whether it is an energy or power signal. What is convolution. Explain the properties of convolution. Determine the convolution sum of the two sequences $x(n) = \{3, 2, 1, 2\}$ and $\left\{\underset{\uparrow}{1}, 2, 1, 2\right\}$ 14

3. If $x_1(n)$ and $x_2(n)$ are discrete time signals, prove that $x_1(n) \circledast x_2(n) \xrightarrow{D.T.F.T.} X_1(\omega)\, X_2(\omega)$. Evaluate the DTFT $X(\omega)$, $X_R(\omega)$, $X_I(\omega)$, the amplitude $|X(\omega)|$ and phase spectrum $\angle X(\omega)$ of the D.T. Signal $x(n)=a^n u(n)$, $0 < a < 1$. State the Wiener-Khintichne theorem. 14

4. Evaluate the system response to complex exponential signals. Determine the magnitude and phase of H (ω) for the three-point moving average system $y(n) = \frac{1}{3}[x(n+1)+x(n)+x(n-1)]$.

   Why the output of an LTI system cannot contain the frequency components not contained in the input signal ? 14

5. Evaluate the four–point DFT of the sequence $x(n) = \{2, 0, 3, 4\}$ and obtain the corresponding magnitude and phase response. Explain the advantages of Digital filters. What is the effect of finite word length in digital filters ? 14

6. Explain the steepest descent (SD) method of adaptive filters. What is the disadvantage of the SD method ? What is the necessity of Kalman filter ? 14

7. Write short notes on any *two* of the following : 2 × 7

   a) Power estimation using DFT.

   b) Interpolator – Time & Frequency domain characterization

   c) Radix - 2 Fast Fourier Transform

   d) Chirp-2 Transform.