Registration No. : | | | | | | | | | | |

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B. Tech

PCBM 4302

Fifth Semester Examination – 2013

SIGNALS AND SYSTEMS

BRANCH : ICE, ETC, AEIE, EIE, EC, CSE, BIOMED, IEE, IT

QUESTION CODE : C- 428

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Justify the statement-folding and shifting operations are not commutative.

   (b) For a purely real and even sequence $x(n)$ compute its DFT.

   (c) Define twiddle factor.

   (d) Define the normalized cross-correlation coefficient and mention its range.

   (e) Compute the continuous time Fourier Transform of $e^{j\Omega_0 t}$.

   (f) Compute the DFT of 1.

   (g) State the multiplication property in DFT domain.

   (h) State the Parseval's relation in Z transform domain.

   (i) State the Parseval's relation in DFT transform domain.

   (j) State the multiplication property in Z domain.

2. (a) Compute the circular convolution of the following two sequences using DFT/IDFT method : 5

$$x_1(n) = \{1, -1, 2\}, \quad x_2(n) = \{-2, 0.5\}$$

(b) Prove that $\sum_{n=0}^{N-1}|x(n)|^2 = \frac{1}{N}\sum_{K=0}^{N-1}|X(K)|^2$ where $X(K)$ is the DFT of $x(n)$. 5

3. (a) Find the Fourier transform of the continuous time signal $x(t) = t\sin(\Omega_0 t)$. 5

(b) Determine the response of the first order discrete time system governed by the difference equation $y(n) = -0.5\,y(n-1) + x(n)$ when the input is unit step and the initial condition $y(-1) = \frac{1}{3}$. 5

4. Determine the unit step response of the system described by the difference equation $y(n) = 0.9\,y(n-1) - 0.81\,y(n-2) + x(n)$ under the following conditions $y(-1) = y(-2)$ using one sided Z-transform. 10

5. (a) Prove the convolution and correlation properties of the Z-transform using only its definitions. 5

(b) Prove that $r_{yy}(l) = r_{hh}(l) * r_{xx}(l)$ where $r_{yy}(l)$ = autocorrelation of o/p signal, $r_{hh}(l)$ = autocorrelation of impulse response, $r_{xx}(l)$ = autocorrelation of input $x(n)$. 5

6. (a) Three systems with impulse responses $h_1(n) = \delta(n-1)$, $h_2(n) = h_1(n)$ and $h_3(n) = u(n)$ are connected in cascade. What is the overall impulse response of the system ? Does the order of interconnection affect the overall system ? 5

(b) Determine the response $y(n)$, $n \geq 0$ of the system described by the second order difference equation $y(n) = 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$ to the input $x(n) = 4^n u(n)$. 5

7. (a) Determine if the following system described by $y(n) = x(n^2)$ is causal or noncausal, time variant or time invariant, static or dynamic, stable or unstable and linear or nonlinear. 5

(b) State and prove circular time and circular frequency shift properties of DFT. 5

8. Write short notes on any **two** of the following : 5×2

(a) Energy and power signals

(b) Causal and noncausal signals

(c) Aliasing

(d) Gibb's Phenomena.