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

Total number of printed pages – 3

B. Tech

PCBM 4302

Fifth Semester Back Examination – 2014

SIGNALS AND SYSTEMS

BRANCH(S) : AEIE, BIOMED, CSE, EC, EIE, ETC, IEE, IT

QUESTION CODE : L 262

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) Determine whether the following signal is periodic or not.

$$x(n)=\cos\left[(n/8)-\pi\right]$$

If so determine the fundamental period. Define fundamental period of a discrete time signal.

(b) Define normalized autocorrelation and cross correlation of a discrete time signal.

(c) State the stability of the system having system function

$$H(z) = \frac{1}{1-2z^{-1}},\ |z| > 2.$$

(d) State and proof circular frequency shift property of DFT.

(e) What do you mean by twiddle factor ?

(f) Determine the whether the signal given by $x(n) = \cos\frac{n\pi}{3}$ is energy signal or power signal.

(g) Find the exponential Fourier series representation of the signal

$x(t) = \sin^2(t)$

P.T.O.

(h) Prove that DFT of $x(n) = \cos\left(\frac{2\pi}{N}k_0 n\right), 0 \le n \le N-1$ is

$$X(k) = \frac{N}{2}\left[\delta(k-k_0)+\delta(k+k_0)\right]$$

(i) Find out the step response of a system if the impulse response of the system is $h(n) = u(n-5)$. Use Z-transform.

(j) Write a short note on Dirichlet's conditions.

2. Determine the response of the system described by the difference equation $y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$ for the forcing function $x(n) = 4^n u(n)$. 10

3. (a) Determine the range of values of *a* and *b* for which the LTI system with impulse response $h(n) = \begin{cases} a^n, & n \ge 0 \\ b^n, & n < 0 \end{cases}$ is stable. 5

(b) Determine the response of the system with impulse response $h(n) = a^n u(n)$ to the input signal $x(n) = u(n) - u(n-10)$. 5

4. Determine the Fourier transform of the signal given by 10

$$x(t) = \begin{cases} 1+\frac{t}{T}, & \text{for } t = -T \text{ to } 0 \\ 1-\frac{t}{T} & \text{for } t = 0 \text{ to } T \end{cases}$$

5. (a) State and prove the time-shifting property and scaling property of z-transform and hence, find the z-transform of $x(n) = n\left(\frac{1}{3}\right)^{n-1} u(n-1)$. 5

(b) Determine the inverse z-transform given that 5

$$X(z) = \frac{4-\frac{7}{4}z^{-1}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}, \quad \text{ROC}: \frac{1}{4} < |z| < \frac{1}{2}$$

6. (a) State the Parseval's Theorem and proves it in the DFT-domain. 5

(b) Determine the linear convolution between following two sequences using DFT/IDFT method : 5

$x(n) = \{1, \ 3, \ 2\}$ and $h(n) = \{2, \ -3\}$

7. (a) Find the Fourier series of the waveform shown in Figure 1 below : 5

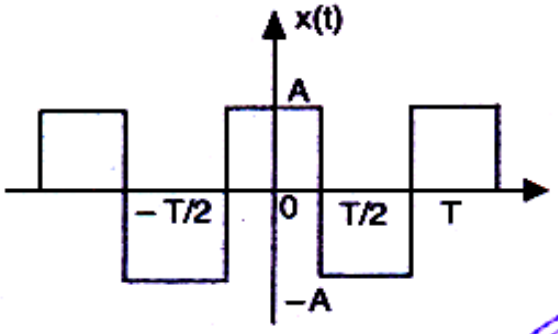

Figure 1

(b) Find the normalized autocorrelation sequence of the following signals : 5

(i) $x(n) = a^n u\,(n-1),\ 0 < a < 1,$

(ii) $x(n) = \left\{ 2,\ \underset{\uparrow}{-3},\ 0,\ 4 \right\}$

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

(a) Derive the formula for normalized cross correlation and auto correlation coefficients $\rho_{xy}(l)$ and $\rho_{xx}(l)$.

(b) DFT as a Linear Transformation.

(c) Causality and Stability of LTI system.

(d) Gibbs Phenomenon.