Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

IV SEMESTER B.S. DEGREE EXAMINATION – APRIL/ MAY 2017

SUBJECT: SIGNAL PROCESSING (EC 244)

(BRANCH: EC)

Friday, 21 April 2017

Time: 03 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed.**

1A. Consider the signal, $x[n]=u[n+4]+2u[n]-2u[n-2]-u[n-4]$, where u[n] is the unit step function. (i) Obtain the plots for x[n], x[2n-1], x[2-n], even and odd components of x[n]. (ii) Compute the energies for the signals x[n], x[2n-1], x[2-n], even and odd components of x[n].

1B. Determine whether the following systems are (i) causal or non-causal (ii) linear or non-linear (iii) time invariant or time-variant and (iv) stable or unstable.

(a) $y(t)=x(t)\cos(\omega_c(t+1))$ (b) $y[n]=|x[n]|-\frac{1}{2}x[n-1]$ **(10+10)**

2A. Consider continuous-time LTI system having impulse response $h(t)=u(t+2)-u(t-2)$ Using convolution evaluate the output of the system for the input $x(t)=e^{-2t}u(t-3)$

2B. Impulse responses of certain LTI systems are (i) $h(t)=e^{-0.1t}u(t+3)$ and (ii) $h[n]=n\left(\frac{1}{2}\right)^n u[n]$. Determine whether or not these systems are causal and stable. **(10+10)**

3A. What are the building blocks of continuous-time LTI systems? Obtain the direct form-I and direct form-II implementations for the LTI system defined by $y(t)+2\frac{dy(t)}{dt}-4\frac{d^2y(t)}{dt^2}=\frac{dx(t)}{dt}$

3B. Consider a discrete-time LTI system having the impulse response $h[n]=u[n]+u[n-4]-2u[n-8]$. Using convolution, compute and plot the step response of the system. **(10+10)**

4A. Compute and plot the appropriate Fourier representation of the following signals (i) $x[n]=2+\sin\left(\frac{4\pi}{21}n\right)+\cos\left(\frac{10\pi}{21}n\right)$, (ii) $x[n]=\sum_{k=-\infty}^{\infty}\delta[n-4k]$

4B. Determine the time-domain signal x(t) corresponding to the FS coefficients $X[k]=\left(\frac{1}{2}\right)^{|k|}e^{jk\pi/20}$. Assume the fundamental period, T_0=2sec. **(10+10)**

5A. Using Fourier properties, obtain the appropriate Fourier representation for the following signals.

(i) $x[n] = \cos\left(\frac{\pi}{2}n\right)\left(\frac{1}{2}\right)^n u[n-2]$, (ii) $x(t) = \frac{1}{1+jt}$

5B. State and prove the following. (i) Convolution property of Fourier Transform and (ii) Parseval's theorem for continuous-time energy signals. **(10+10)**

6A. The impulse response of a discrete-time system is given by $h[n] = \frac{1}{4}\sin c\left(\frac{n}{4}\right)$. Apply properties of Fourier representations and obtain output to the input $x[n] = 2 + \cos\left(\frac{\pi}{8}n\right) + \cos\left(\frac{\pi}{2}n\right)$.

6B. Compute the Nyquist sampling rate and Nyquist sampling interval for the following signals. (a) $x(t) = \cos(2\pi t) + \cos(5\pi t)$ (b) $x(t) = \sin c(t)$. Also plot the spectrum of sampled signal $x_\delta(t)$ by assuming Nyquist sampling rate. **(10+10)**

7A. Define Z-transform. List the properties of region of convergence (ROC). Determine the z-transform and plot poles and zeros of $x[n] = 7\left(\frac{1}{3}\right)^n u[n] - 6\left(\frac{1}{2}\right)^n u[n]$.

7B. A causal discrete-time system has input $x[n] = \delta[n] + \frac{1}{4}\delta[n-1] - \frac{1}{8}\delta[n-2]$ and output $y[n] = \delta[n] - \frac{3}{4}\delta[n-1]$. Using Z-transform find its impulse response.

(10+10)

8A. Distinguish between finite impulse response (FIR) and infinite impulse response (IIR) filters. Give frequency response plot (frequency in radians) of ideal low-pass, high-pass and band-pass digital filters. Assume frequency range $-3\pi \le \omega \le 3\pi$.

8B. Define discrete Fourier transform (DFT). Compute 4-point DFT of the sequence, $x[n] = \{1,\ 1,\ -1,\ -1\}$. **(10+10)**