Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

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

SUBJECT: SIGNALS AND SYSTEMS (EE 243)

(BRANCH: ELECTRICAL & ELECTRONICS)

Friday, 21 April 2017

Time: 3 Hours **Max. Marks: 100**

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

1A. Let $x[n]=0 \;\; for \;\; n<-2 \;\; and \;\; n>4$, sketch and label the following
(i) $x[-n]$; (ii) $x[-n+2]$; (iii) $x[-2-n]$;

1B. Determine whether the following signal is energy or power signal. Also determine the energy and power of the signal.

$$x[n]=\left(\frac{2}{3}\right)^{|n|}$$

1C. Find the response of the system $y(n) = x(n) * h(n)$
Where $x(n)=\{-u[n]+2u[n-3]-u[n-6]\}$ and $h(n)=\{u[n+1]-u[n-10]\}$

(6+4+10)

2A. Check whether the following signals are periodic. If periodic determine the fundamental period

(i) $x(t)=\left\{\cos\left(2t-\frac{\pi}{3}\right)\right\}^2$ (ii) $x(n) = \cos\frac{\pi}{2}n \cos\frac{\pi}{4}n$

2B. A continuous- time signal is defined as

$$x(t)=\begin{cases} 0 & ; t<-2 \\ 2(t+2\ ) & ; -2\le t<-1 \\ 1 & ; -1\le t<0 \\ -(t-1) & ; 0\le t\le 2 \\ -1 & ; 2\le t<3 \\ 0 & ; \ t>3 \end{cases}$$

Plot the followings: (i) $x(t)$; (ii)$x(-2t+1)$; (iii) $x\left(\frac{t}{3}-1\right)$

2C Find the output of the system described by the difference equation,

$$y[n]-\frac{1}{9}y[n-2]=x[n-1] \;\; with \;\; y(-1)=1, y(-2)=0 \;\; and \;\; x[n]=u[n]$$

(4+8+8)

3A. Check whether each system is (i) Linear (ii) Causal (iii) Time-invariant

(i) $y[n] = x[-n]$ and (ii) $y(t) = x(t-2) + x(2-\mathrm{t})$

3B. A cascade of three LTI systems is shown in Fig.Q.3B.

Given : $h_2[n] = u[n] - u[n-2]$

Overall impulse response, $h[n] = h_1[n] * h_2[n] * h_2[n] =$ {1 5 10 11 8 4 1} starting at n=0.

(i) Find $h_1[n]$.

(ii) Also find the response of the overall system to the input $x[n] = \delta[n] - \delta[n-1]$.

3C. Use the table of transform and properties to find the FT of the following signals:

(i) $x(t) = \frac{4t}{(1+t^2)^2}$

(ii) $x(t) = e^{-2t+1} u\left(\frac{t-4}{2}\right)$

(6+8+6)

4A. Using the definition of FS to determine the time domain signals represented by the following FS coefficients :

(i) $X(k) = j\delta(k-1) - j\delta(k-1) + j\delta(k+3) + j\delta(k-3)$; $\omega_0 = 3\pi$

(ii) $X(k) = \left(\frac{1}{2}\right)^{|k|}$; $\omega_0 = 1$

4B. Use the table of transform and properties to find the inverse DTFT of the following signals:

(i) $X(e^{j\Omega}) = \left(\frac{e^{-j3\Omega}}{1+\frac{1}{2}e^{-j\Omega}}\right) * \left(\frac{\sin\left(\frac{21\Omega}{2}\right)}{\sin\left(\frac{\Omega}{2}\right)}\right)$

(ii) $X(e^{j\Omega}) = \cos(2\Omega) + 1$

4C. Find the inverse Z-transform using partial fraction expansion

$$X(z) = \frac{z^3 + z^2 + \frac{3}{2}z + \frac{1}{2}}{z^3 + \frac{3}{2}z^2 + \frac{1}{2}z} \quad ; \quad \text{ROC: } |z| < \frac{1}{2}$$

(4+10+6)

5A.

If $X(e^{j\Omega})$ is DTFT of signal $x[n] = \left\{-1, 0, \underset{\uparrow 0}{1}, 1, 0, 2\ -1, 0, -1\right\}$, Evaluate

(i) $\int_{-\pi}^{\pi} X\left(e^{j\Omega}\right) d\Omega$,

(ii) $X(1) = X\left(e^{j0}\right)$

(iii) $X\left(e^{j\pi}\right)$

5B. Find discrete-time periodic signal $x[n]$ if its DTFS co-efficient is given by
$X(k) = \cos\left(\frac{6\pi}{17}k\right)$

5C. Find the continuous convolution integral for the signals $y(t) = x(t) * h(t)$ where
$x(t) = u(t+2) - u(t-2)$ and $h(t) = u(t) - u(t-2)$

(6+4+10)

6A. Consider the analog signal $x(t) = 4\cos(100\pi t)$

(i) What is the Nyquist rate of this signal?

(ii) Suppose the signal is sampled at Fs = 75Hz, What is the discrete time signal obtained after sampling?

(iii) What is the frequency of a sinusoid that yields samples identical to those obtained in part (ii)?

6B. Determine Z-transform of the signals $x[n]$ using properties

(i) $x[n] = n\cos(\pi n)u[-n]$

(ii)

$$x[n] = \left(n\left(\frac{-1}{6}\right)^n u[n]\right) * \left(\left(\frac{1}{2}\right)^{-n} u[-n]\right)$$

6C. The frequency domain representation of a continuous time signal $x(t)$ is given as

$$X(j\omega) = \begin{cases} \cos\left(\frac{\omega}{2}\right) + j\sin\left(\frac{\omega}{2}\right); & |\omega| \le \pi \\ 0 \quad ; & otherwise \end{cases}$$

; determine the time domain signal $x(t)$

6D. Determine the bilateral Laplace transform and the corresponding ROC of the following signal: $x(t) = e^{\frac{-t}{2}}u(t) + e^{-t}u(t) + e^{t}u(-t)$

(8+4+2)

7A. An L.T.I system is described by the differential equation

$y''(t) + 2y'(t) + y(t) = x'(t)$; Find the particular solution of the system if $x(t) = 2e^{-t}u(t)$.

7B. What is the circular convolution of the following sequences?
$x_1[n] = \{2,1,2,1\}$ *and* $x_2[n] = \{1,2,3,4\}$

7C. Let $x[n]$ be the sequence $x[n] = 2\delta[n] + \delta[n-1] + \delta[n-3]$.The 5 point DFT of x[n] is computed and the resulting sequence is $Y(k) = X^2(k)$. If y[n] is the 5 point inverse DFT of $Y(k)$, find y[n].

(6+8+6)

8A. Find the Z-transform of the following signals and determine ROC.

(i) $x[n] = 7\left(\frac{1}{3}\right)^n \cos\left[\frac{2\pi n}{6} + \frac{\pi}{4}\right]u[n]$

(ii) $x[n] = 2^n u[-n-1]$

8B. A LTI system has relationship

$y[n] = \sum_{k=-\infty}^{\infty} x[k]\, g[n-2k]$ where $x[n]$ is the input and $y[n]$ is the output and $g[n] = u[n] - u[n-4]$. Determine $y[n]$ when $x[n] = \delta(n-1)$

8C. Two wave forms shown in Fig. Q. 8C are defined as an $y(t) = x(at+b)$ and $x(t) = y(ct+d)$, Evaluate a, b, c and d.

(10+3+7)

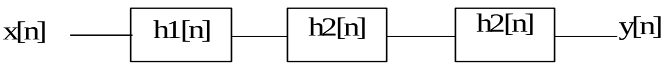

Fig.Q.3B

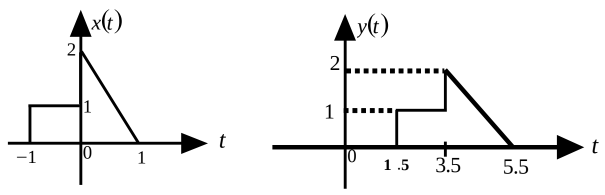

Fig. Q. 8C