Question Paper

Exam Date & Time: 06-Jun-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.S. DEGREE MAKE-UP EXAMINATION-MAY/JUNE 2018
DATE: 6 JUNE 2018
TIME: 9.30 AM TO 12.30 PM
Signals and Systems [EE 243]

Marks: 100 **Duration: 180 mins.**

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

1) (6)

A) Given the sequence $x(n)=|n|$ *for* $-3 \le n \le 3$, sketch and label the following (i) $x(n)$; (ii) $x(2n)$; (iii) $x(2-2n)$;

B) (4)

Find discrete-time periodic signal $x[n]$ if its DTFS co-efficient is given by $X[k] = \cos\left(\frac{8\pi}{21}k\right)$

C) (10)

Find the response of the system $y(n) = x(n) * h(n)$

Given: $x(n)=\{-u[n]+2u[n-3]-u[n-6]\}$ and $h(n)=\{u[n+1]-u[n+10]\}$

2) (4)

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

(i) $x(n)=3e^{j\pi\frac{n}{4}}$ (ii) $x(t)=\cos\left(\frac{\pi}{4}t\right)+\sin\left(\frac{\pi}{8}t+\frac{\pi}{3}\right)-\cos\left(\frac{\pi}{2}t+\frac{\pi}{6}\right)$

B) (6)

A continuous- time signal is defined as

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

Plot the followings: (i) $x(t)$; (ii) $x(-t+2)$

C) (10)

Using time domain method determine Zero-Input Response (ZIR) and Zero State Response (ZSR) of a LTI system described by the difference equation.
$y[n]+\frac{1}{4}y[n-1]-\frac{1}{8}y[n-2]=x[n]+x[n-1]$.
Given $y[-1]=4, y[-2]=-2$ & $x[n]=(-1)^n u[n]$

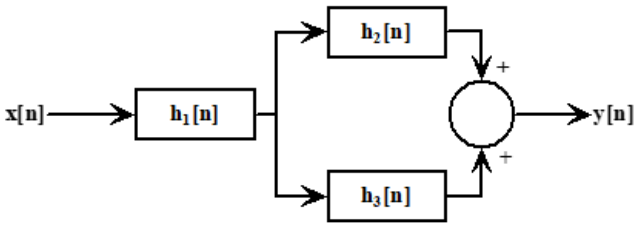
3) (8)

A) Determine whether each system is (i) Linear (ii) Causal (iii) Time-invariant(iv)Memoryless

(i) $y(t) = \sin[x(t+5)]$
(ii) $y[n] = x[-n]$

B) (6)

A LTI discrete-time system is shown below with the interconnection of three different LTI systems. Determine the resultant impulse response of the system. Given, $\boldsymbol{h_1[n]} = ((\mathbf{1/2})^{\boldsymbol{n}})\boldsymbol{u[n]}$, $\boldsymbol{h_2[n]} = \boldsymbol{\delta[n]}$ & $\boldsymbol{h_3[n]} = \boldsymbol{u[n-1]}$



C) (6)

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

(i) $x(t) = \frac{\mathrm{d}}{\mathrm{dt}}[(e^{-3t}u(t)) * (e^{-t}u(t-2))]$

(ii) $x(t) = \frac{d}{dt}e^{-2|t|}$

4) (4)

Determine the Fourier Series coefficients of : $x(t) = 3\cos(\pi t/2 + \pi/4)$

A)

B) (10)

Use the table of transform and properties to find the inverse FT of the following signals:

(i) $X(j\omega) = \frac{e^{j4\omega}}{(2+j\omega)^2}$

(ii) $X(j\omega) = \frac{2}{j(\omega-3)+2} + \frac{2}{j(\omega+3)+2}$

C) (6)

Find the even and odd components of the signal: $x(t) = \begin{cases} t & 0 \le t < 1 \\ 2-t & 1 \le t < 2 \end{cases}$

Also Sketch the even and odd signals.

5) (4)

Determine the Fourier Series coefficients of : $x(t) = 3\cos(\pi t/2 + \pi/4)$

A)

B) (6)

A trapezoidal pulse $\mathrm{x(t)}$ is defined by

$$\mathrm{x(t)} = \begin{cases} \mathrm{t+5}, & -5 \le \mathrm{t} \le -4 \\ 1, & -4 \le \mathrm{t} \le 4 \\ \mathrm{-t+5}, & 4 \le \mathrm{t} \le 5 \\ 0, & \text{otherwise} \end{cases}$$

(i) Sketch the signal x(t)

(ii) Determine the total energy of $\mathrm{x(t)}$.

C) (10)

Find the continuous convolution integral for the signals $\mathrm{y(t)} = \mathrm{x(t)} * \mathrm{h(t)}$ where $\mathrm{x(t)} = \mathrm{u(t+2)} - \mathrm{u(t-2)}$ and $\mathrm{h(t)} = \mathrm{u(t)} - \mathrm{u(t-2)}$

6) (5)

Using properties ,find the inverse DTFT of $\mathrm{X(e^{j\Omega})} = (\cos 4\Omega)\left[\frac{\sin\frac{3\Omega}{2}}{\sin\frac{\Omega}{2}}\right]$

A)

B) (10)

Determine Z-transform and ROC of the signals $x[n]$ using properties

(i) $x[n] = \left(n\left(\frac{5}{8}\right)^n u[n]\right)$

(ii) $x[n] = 2(0.5)^{n-1}u(n) + 2^n u(-n-1)$

C) (5)

Find the time domain signal $x(t)$ corresponding to the FS coefficients $X(k) = -j\delta[k-2] + j\delta[k+2] + 2\delta[k-3] + 2\delta[k+3]; \omega = \pi$

7) (8)

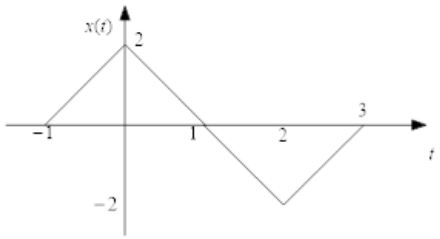
A) An L.T.I system is described by the differential equation

$y''(t) + 5y'(t) + 4y(t) = x'(t)$; Find the output of the system if

$x(t) = e^{-2t}u(t)$; $y(0) = 0; y'(0) = 1$

B) (6)

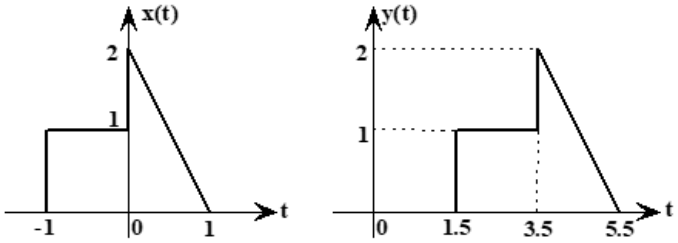
For the signal $x(t)$ shown in Figure below evaluate the following quantities explicitly computing $X(j\omega)$.



(a)$\int_{-\infty}^{\infty} X(j\omega)d\omega$; (b) $\int_{-\infty}^{\infty} |X(j\omega)|^2 d\omega$; (c) $\int_{-\infty}^{\infty} X(j\omega)e^{j2\omega}d\omega$

C) (6)

Two wave forms, shown below are defined as $y(t) = x(at + b)$ and $x(t) = y(ct + d)$. Evaluate a, b, c & d



8) (10)

Find the inverse Z-transform

A)

$$X(z) = \frac{z^2}{z^2 - 1.5z + 0.5} \quad ROC: 0.5 < |z| < 1$$

B) (10)

Using unilateral z transform determine the forced response of the system described by the difference equation:

$$y[n] - \frac{5}{6}y[n-1] + \frac{1}{6}y[n-2] = x[n], \quad x[n] = (2)^n u[n]$$

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