Question Paper

Exam Date & Time: 28-Apr-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNAIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.S.(ENGG.)
END - SEMESTER THEORY EXAMINATIONS APRIL-2018
DATE :28.04.2018
TIME :9:30AM-12:30PM

Signals and Systems [EE 243]

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

Answer 5 out of 8 questions.
Missing data, if any, may be suitably assumed
Table of transforms may be supplied

1)

1A) A continuous- time signal is defined as (6)

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

Plot the followings: (i) $x(t)$; (ii) $x(-2t+1)$;

1B) Find discrete-time periodic signal $x[n]$ if its DTFS co-efficient is given by (4)

$$X[k] = \cos\left(\frac{10\pi}{19}k\right) + j\,2\sin\left(\frac{4\pi}{19}k\right)$$

1C) Find the response of the system $y(n) = x(n) * h(n)$ (10)

Given: $x(n) = a^n\{u[n-2] - u[n-13]\}$, and $h(n) = 2\{u[n+2] - u[n-12]\}$

Where $|a|<1$

2)

2A) Check whether the following signals are periodic. If periodic determine the fundamental period (4)

(i) $x(t) = \cos t + \sin\sqrt{2}t$ (ii) $x(n) = \cos\frac{2\pi}{5}n + \cos\frac{2\pi}{7}n$

2B) (6)

Let $x[n] = (-0.5,\ 0.5\ ,\ 1\ ,\ \underset{\uparrow}{\mathbf{1}}\ ,\ 1\ ,1\ ,\ 0.5)$

sketch and label the following

(i) $x[3-n]$; (ii) $x[n-3]$; (iii) $x[2n]$;

2C) A discrete time LTI system is described by the difference equation, (10)

$y[n]-y[n-1]-2y[n-2]=x[n]$ *with* $y(-1)=-2, y(-2)=8$ *and* $x[n]=6u[n]$

Find the total response of the system.

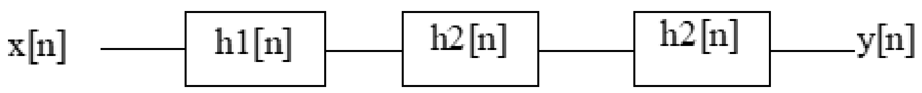
3) Check whether each system is (i) Linear (ii) Causal (iii) Time-invariant (6)

3A)

(i) $y(t) = x(t+5) + x^2(t)$

(ii) $y[n] = x[-n+2]$

3B) A cascade of three LTI systems is shown in Fig.Q.3B. (8)



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: (6)

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

(ii) $x(t) = e^{-t+2}u(t-2)$

4) Determine the Fourier Series representation of : $x(t) = 2\sin(2\pi t - 3) + \sin(6\pi t)$ (4)

4A)

4B) Use the table of transform and properties to find the inverse DTFT of the following signals: (10)

(i) $X(e^{j\Omega}) = j\sin(4\Omega) - 2$

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

4C) (6)

Find the inverse Z-transform using partial fraction expansion

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

5) (6)

5A)

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

Evaluate

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

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

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

5B) Determine the energy or power as applicable for the following signals. (4)

(i) $x[n] = e^{j(\frac{\pi n}{2} + \frac{\pi}{6})}$ (ii) $x[n] = (\frac{1}{3})^n u[n]$

5C) Find the continuous convolution integral for the signals $y(t) = x(t) * h(t)$ where $x(t) = u(t+1) - u(t-1)$ and $h(t) = \begin{Bmatrix} -1, & -1 \le t < 0 \\ 1, & 0 \le t < 1 \end{Bmatrix}$ (10)

6) (6)

6A) Using the defining equation find the time domain signal $x[n]$ for given magnitude and phase spectra of discrete-time signal described as

$$\left|X(e^{j\Omega})\right| = \begin{cases} 1; & \frac{\pi}{2} < |\Omega| < \pi \\ 0; & otherwise \end{cases} \quad \text{and} \quad Arg\{X(e^{j\Omega})\} = -4$$

6B) Determine Z-transform and ROC of the signals $x[n]$ using properties (8)

(i) $x[n] = \left(n\left(\frac{-1}{2}\right)^n u[n] \right) * \left(\left(\frac{1}{4}\right)^{-n} u[-n] \right)$

(ii) $x[n] = 4(2)^n u(-n)$

6C) (6)

Find the time domain signal $x(t)$ corresponding to the FS coefficients $X(k) = (\frac{1}{2})^{|k|} e^{\frac{jk\pi}{20}}$
Assume fundamental period T=2.

7) An L.T.I system is described by the differential equation (10)

7A) $y''(t) + 5y'(t) + 6y(t) = x(t);$ Find the output of the system if

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

7B) Find the even and odd components of the signal: $x(t) = e^{jt}$ (4)

7C) For each of the following impulse responses, determine whether the corresponding system is **memoryless**, **casual** and **stable**. Justify the answers. (6)

(i) $h(t) = u(t+1) - u(t-1)$

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

8) Find the inverse Z-transform using power series expansion (6)

8A)

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

technique.

8B) A LTI system has relationship (2)

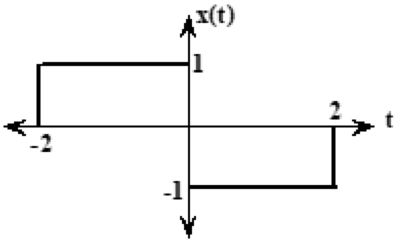
$y[n] = \sum_{k=-\infty}^{\infty} x[k]\, g[n-2k]$ where $x[n]$ is the input and $y[n]$ is the output and

$g[n] = u[n] - u[n-4]$. Determine $y[n]$ when $x[n] = \delta(n-1)$

8C) Find the forced response of the system described by the difference equation using unilateral Z transform: (8)

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

8D) Find the Fourier Transform of the following signal: (4)



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