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10EC44

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Signals & Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Sketch EVEN and ODD components of the signal x(t) shown in Fig. Q1 (a). **(04 Marks)**

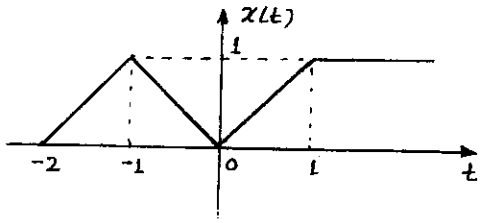

Fig. Q1 (a)

b. Determine whether the following signal x(n) is ENERGY or POWER signal:

$x(n) = n; \quad 0 \le n \le 5$

$= 10 - n; \quad 5 \le n \le 10$

$= 0$; ew (elsewhere / otherwise) **(04 Marks)**

c. Determine whether the following signals are periodic or not. If periodic find the fundamental period:

i) $x(n) = \cos\left(\frac{\pi n}{8}\right)\sin\left(\frac{\pi n}{4}\right)$

ii) $x(t) = x_1(t) + x_2(t) + x_3(t)$ with fundamental periods of 3.2, 9.6 and 12.8 secs for x_1, x_2 and x_3 respectively. **(06 Marks)**

d. A continuous time signal x(t) is shown in Fig. Q1 (d). Sketch

i) $x(t)u(1-t)$

ii) $x(t)[u(t) - u(t-1)]$

iii) $x(t)[u(t+1) - u(t)]$ **(06 Marks)**

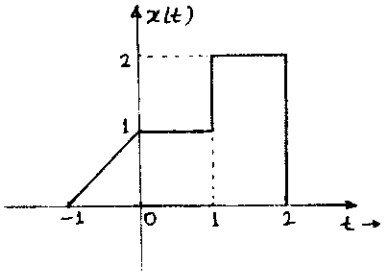

Fig. Q1 (d)

2 a. Determine and sketch the convolved output of the system whose input x(t) and impulse response h(t) are given as follows:

$x(t) = e^{-3t}\{u(t) - u(t-2)\}; \qquad h(t) = e^{-t}u(t)$ **(10 Marks)**

b. State and prove the Associative property of convolution sum. **(04 Marks)**

c. Find the unit step response of the following systems given by their impulse responses:

i) $h(t) = e^{-|t|}$ ii) $h(n) = \left(\frac{1}{2}\right)^n u(n)$ **(06 Marks)**

3 a. Determine whether the following systems defined by their impulse responses are causal and stable

i) $h(t) = e^{-3t}u(t-1)$

ii) $h(n) = 4^{-n}u(2-n)$ **(06 Marks)**

b. Find the total response of the system given by differential equation,
$y''(t) + 3y'(t) + 2y(t) = 2x(t)$ with $y(0) = -1$, $y'(0) = 1$ and $x(t) = \cos(t)u(t)$ **(10 Marks)**

c. Realize Direct Form – I and Direct Form – II block diagrams for the system given by the difference equation: $y(n) + \frac{1}{4}y(n-1) - y(n-3) = 5x(n-1) + 3x(n-2)$. **(04 Marks)**

4 a. State and prove the following properties of DTFS:

i) Frequency shift

ii) Convolution

iii) Perseval's theorem. **(12 Marks)**

b. Consider the periodic waveform:
$x(t) = 4 + 2\cos 3t + 3\sin 4t$

i) Find the complex Fourier coefficients.

ii) Using Parseval's theorem, find the power spectrum.

iii) Find the total average power. **(08 Marks)**

PART – B

5 a. Find DTFT of the following signals:

i) $x(n) = \{1, 2, \underset{\uparrow}{3}, 2, 1\}$

ii) $x(n) = (0.5)^{n+2}u(n)$

iii) $x(n) = n(0.5)^{2n}u(n)$ **(08 Marks)**

b. Using convolution theorem, find the inverse DTFT of $X(e^{j\Omega})$, given $X(e^{j\Omega}) = \frac{1}{(1 - ae^{-j\Omega})^2}$, $|a| < 1$. **(08 Marks)**

c. Find inverse Fourier transform of $X(\omega) = \frac{j\omega}{(j\omega + 2)^2}$. **(04 Marks)**

6 a. Find the frequency response and impulse response of the system having the output y(t) for the input x(t) as given below:
$x(t) = e^{-t}u(t)$; $y(t) = e^{-2t}u(t) + e^{-3t}u(t)$ **(06 Marks)**

b. Find the Fourier Transform representation for the periodic signal $x(t) = 3 + 2\cos \pi t$ and draw the spectrum. **(06 Marks)**

c. Specify the Nyquist rate and Nyquist intervals for the following signals:

i) $x_1(t) = \sin C(200t)$

ii) $x_2(t) = \sin C^2(200t)$

iii) $x_3(t) = \sin C(200t) + \sin C^2(200t)$ **(08 Marks)**

7 a. Find Z-transform of given x(n). Sketch ROC, poles and zeros of x(z)

$$x(n) = 3\left(-\frac{1}{2}\right)^n u(n) - 2\left[3^n u(-n-1)\right]$$ **(04 Marks)**

b. Determine the signal x(n) whose z-transform is given by, $x(z) = \log(1 - az^{-1})$; $|z| > |a|$ by using properties of z-transform. **(04 Marks)**

c. Find inverse z-transform of the following:

i) $x(z) = \frac{z}{3z^2 - 4z + 1}$; ROC : $|Z| > 1$: Use partial fraction expansion method

ii) $x(z) = \frac{z}{2z^2 - 3z + 1}$; ROC : $|Z| < \frac{1}{2}$: Use long division method. **(08 Marks)**

d. Find $x(\infty)$ if x(z) is given by,

i) $\frac{z+2}{(z-0.8)^2}$ ii) $\frac{z+1}{3(z-1)(z+0.9)}$ **(04 Marks)**

8 a. A causal system has input x(n) and output y(n). Find the impulse response of the system if,

$$x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$$

$$y(n) = \delta(n) - \frac{3}{4}\delta(n-1).$$ **(08 Marks)**

b. A LTI discrete time system is given by the system function $H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$

Specify the ROC of H(z) and determine h(n) for the following conditions:

i) the system is stable

ii) the system is causal **(06 Marks)**

c. Solve the following difference equation using unilateral z-transform for the given input and initial conditions.

$y(n) + 3y(n-1) = x(n)$ with $x(n) = u(n)$ and $y(-1) = 1$. **(06 Marks)**

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