USN | | | | | | | | | | 06EC44

Fourth Semester B.E. Degree Examination, May/June 2010
Signals and Systems

Time: 3 hrs.   Max. Marks:100

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

PART – A

1 a. Give the classification of signals. **(08 Marks)**

b. Determine and sketch the even and odd part of the signals shown in Fig.Q1(b). **(12 Marks)**

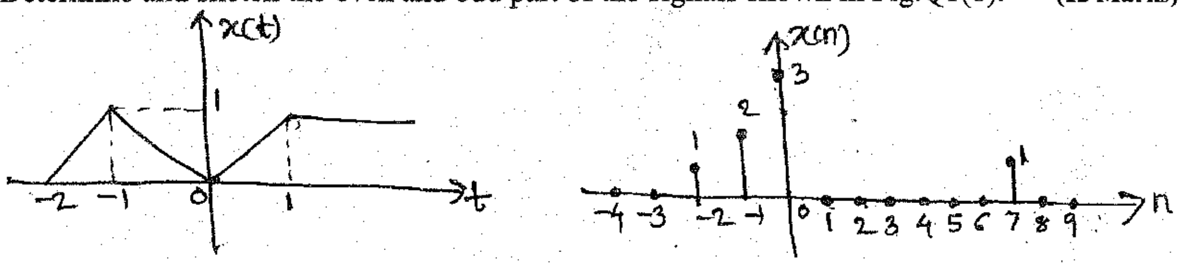

Fig.Q1(b)

2 a. Derive the expression for convolution integral. **(05 Marks)**

b. Verify which of the following systems are linear, causal and invertible:

i) $y(t) = ax(t) + b$ ii) $y(t) = x^2(t)$ iii) $y(n) = \sqrt{x(n)}$ iv) $y(n) = x(4n + 1)$. **(10 Marks)**

c. For a discrete LTI (DLTI) system to be BIBO stable,

Show that $S \triangleq \sum_{K=-\infty}^{\infty} |h(k)| < \infty$ **(05 Marks)**

3 a. By direct evaluation of convolution sum, determine the step response of a discrete system whose unit impulse response $h(n) = (½)^{-n} u(-n)$. Sketch the response and hence verify whether the system is stable and causal. **(08 Marks)**

b. Obtain x(t) * y(t) for the signals

$x(t) = u(t) - u(t-2)$

$y(t) = t\,[u(t) - u(t-1)]$

Sketch the convolved signal $x(t) * y(t)$. **(08 Marks)**

c. Draw block diagram representations for causal LTI systems whose input output relation is

i) $y(n) = \frac{1}{3}y(n-1) + \frac{1}{2}x(n)$ ii) $y(n) = \frac{1}{3}y(n-1) + x(n-1)$

iii) $y(t) = -\frac{1}{2}\frac{dy(t)}{dt} + 4x(t)$ iv) $\frac{dy(t)}{dt} + 3y(t) = x(t)$ **(04 Marks)**

4 a. Give the significance of time and frequency domain representation of signals. Give examples. **(04 Marks)**

b. Find the CT exponential FS of the signal shown in Fig.Q4(b). **(10 Marks)**

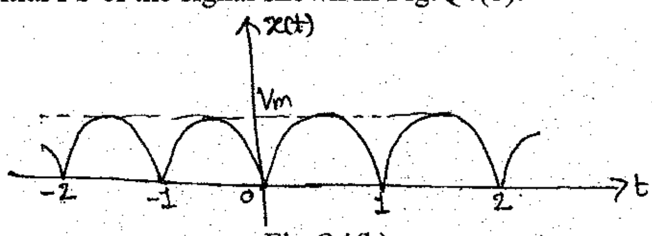

Fig.Q4(b)

c. State and prove the periodic time shift and periodic time convolution properties of DTFS (Discrete time Fourier series). **(06 Marks)**

PART – B

5 a. Obtain the DTFT of the following DT aperiodic sequences:
i) $x(n) = \delta(n) - 3\delta(n-3) + 2\delta(n-4)$ ii) $x(n) = (1/2)^n u(n) - (1/3)^n u(-n-3)$
iii) $x(n) = nu(n) - u(n-1)$ iv) $x(n) = \cos w_0 n\, u(n)$ **(04 Marks)**

b. State and prove the Parseval's relation for DTFT. What is the significance of this relation? **(06 Marks)**

c. Using the time differentiation property of CTFT, find the spectrum of the following signals as shown in Fig.Q5(c). Plot the spectrum. **(10 Marks)**

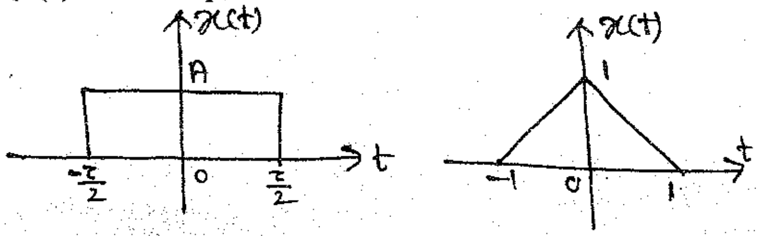

Fig.Q5(c)

6 a. A particular discrete-time system has input x(n) and output y(n). The Fourier transforms of these signals are related by the equation $Y(e^{jw}) = ZX(e^{jw}) + e^{-jw}X(e^{jw}) - \frac{dX(e^{jw})}{dw}$.
Is the system linear? Clearly justify your answer. What is y(n) if $x(n) = \delta(n)$? Is the system causal? **(06 Marks)**

b. Consider a causal and state LTI system S having frequency response $H(w) = \frac{jw+4}{6-w^2+5jw}$.
i) Obtain the differential equation for the system.
ii) Determine the impulse response h(t) of S
iii) What is the output of S when the input is $x(t) = e^{-4t}u(t) - te^{-4t}u(t)$ **(10 Marks)**

c. If $x(t) \leftrightarrow X(f)$
Show that $x(t)\cos w_0 t \leftrightarrow ½\,[X(f - f_0) + X(f + f_0)]$ where $w_0 = 2\pi f_0$. **(04 Marks)**

7 a. What is region of convergence of X(z), where X(z) is the z-transform of x(n). State all the properties of R.O.C. **(05 Marks)**

b. Determine the Z-transform of the following sequences including R.O.C.
i) $\delta(n+5)$ ii) $\left(\frac{1}{2}\right)^{n+1} u(n+3)$ iii) $\left(-\frac{1}{3}\right)^{n} u(-n-2)$
iv) $2^n u(-n) + \left(\frac{1}{4}\right)^n u(n-1)$ v) $\alpha^{|n|}$ for $o < \alpha < 1$. **(15 Marks)**

8 a. State and prove time reversal property. Find value theorem of Z-transform. Using suitable properties, find the Z-transform of the sequences
i) $(n-2)\left(\frac{1}{3}\right)^{n-2} u(n-2)$ ii) $(n+1)\left(\frac{1}{2}\right)^{n+1} \cos w_0(n+1)u(n+1)$ **(10 Marks)**

b. Consider a system whose difference equation is $y(n-1) + 2y(n) = x(n)$
i) Determine the zero-input response of this system, if y(-1) = 2.
ii) Determine the zero state response of the system to the input $x(n)=(1/4)^n u(n)$.
iii) What is the frequency response of this system?
iv) Find the unit impulse response of this system. **(10 Marks)**

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