USN | | | | | | | | | | |

10EC44

Fourth Semester B.E. Degree Examination, June/July 2013
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Determine whether the discrete time signal $x(n) = \cos\left(\frac{\pi n}{5}\right)\sin\left(\frac{\pi n}{3}\right)$ is periodic. If periodic, find the fundamental period. **(04 Marks)**

b. Determine whether the signal shown in Fig. Q1 (b) is a power signal or energy signal. Justify your answer and further determine its energy/power. **(06 Marks)**

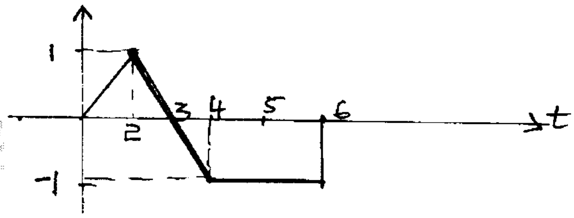

Fig. Q1 (b)

c. Given the signal $x(n) = (6 - n)\{u(n) - u(n-6)\}$ make a sketch of $x(n)$, $y_1(n) = x(4 - n)$ and $y_2(n) = x(2n - 3)$. **(04 Marks)**

d. Find and sketch the following signals and their derivatives:
i) $x(t) = u(t) - u(t-a); a > 0$ ii) $y(t) = t[u(t) - u(t-a)]$; $a > 0$. **(06 Marks)**

2 a. The impulse response of a discrete LTI system is give by, $h(n) = u(n+1) - u(n-4)$. The system is excited by the input signal $x(n) = u(n) - 2u(n-2) + u(n-4)$. Obtain the response of the system $y(n) = x(n)*h(n)$ and plot the same. **(07 Marks)**

b. Given $x(t) = t \quad 0 < t \leq 1$ and 0 elsewhere
and $h(t) = u(t) - u(t-2)$, evaluate and sketch $y(t) = x(t)*h(t)$, $x(t)$ and $h(t)$. **(07 Marks)**

c. Show that : i) $x(t)*h(t) = h(t)*x(t)$
ii) $\{x(n)*h_1(n)\}*h_2(n) = x(n)*\{h_1(n)*h_2(n)\}$. **(06 Marks)**

3 a. Solve the difference equation, $y(n) - 3y(n-1) - 4y(n-2) = x(n)$ with $x(n) = 4^n u(n)$. Assume that the system is initially relaxed. **(06 Marks)**

b. Draw the direct form I and direct form II implementations for,

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

ii) $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt}$ **(10 Marks)**

c. Define causality. Derive the necessary and sufficient conditions for a discrete LTI system to be causal in terms of the impulse response. **(04 Marks)**

4 a. Determine the DTFS coefficients of,

$x(n) = 1 + \sin\left\{\frac{1}{12}\pi n + \frac{3\pi}{8}\right\}$ **(06 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

4 b. Find the exponential Fourier series of the waveform shown in Fig. Q4 (b). **(08 Marks)**

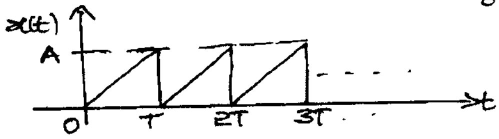

Fig. Q4 (b)

c. Explain the Direchlet conditions for the existence of Fourier series. **(06 Marks)**

PART – B

5 a. Find the DTFT of the signal x(n) given by $x(n) = u(n) - u(n-N)$; where N is any +ve integer. Determine the magnitude and phase components and draw the magnitude spectrum for N = 5. **(10 Marks)**

b. Determine the fourier transform of the following signals : i) $x(t) = e^{-3t}u(t-1)$ ii) $x(t) = e^{-a|t|}$. **(10 Marks)**

6 a. Determine the frequency response and the impulse response for the system described by the differential equation,

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = \frac{-d}{dt}x(t)$$ **(10 Marks)**

b. Determine the Nyquist sampling rate and Nyquist sampling interval for,

i) $x(t) = 1 + \cos 2000\pi t + \sin 4000\pi t$ ii) $x(t) = \left[\frac{\sin(4000\pi t)}{\pi t}\right]^2$ **(06 Marks)**

c. Explain briefly, the reconstruction of continuous time signals with zero order hold. **(04 Marks)**

7 a. Find the z-transform of the following and indicate the region of convergence:

i) $x(n) = a^n \cos\Omega_0(n-2)u(n-2)$

ii) $x(n) = n(n+1)a^n u(n)$ **(10 Marks)**

b. Find the inverse z-transform of the following:

i) $x(z) = \frac{z^4 + z^2}{z^2 - \frac{3}{4}z + \frac{1}{8}}$; $|z| > \frac{1}{2}$ by

Partial fraction expansion method.

ii) $x(z) = \frac{1 - az^{-1}}{z^{-1} - a}$; $z > \frac{1}{a}$ by long division method. **(10 Marks)**

8 a. A discrete LTI system is characterized by the difference equation,

$y(n) = y(n-1) + y(n-2) + x(n-1)$

Find the system function H(z) and indicate the ROC if the system, i) Stable ii) Causal. Also determine the unit sample response of the stable system. **(10 Marks)**

b. Solve the following difference equation using the unilateral z-transform.

$$y(n) - \frac{7}{12}y(n-1) + \frac{1}{12}y(n-2) = x(n) \text{ for } n \geq 0$$

With initial conditions y(-1) = 2, y(-2) = 4 and $x(n) = \left(\frac{1}{5}\right)^n u(n)$. **(10 Marks)**

* * * * *