USN | | | | | | | | | | 10EC44

# Fourth Semester B.E. Degree Examination, December 2012
## 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 following systems are:
i) Memoryless, ii) Stable iii) Causal iv) Linear and v) Time-invariant.
- $y(n) = nx(n)$
- $y(t) = e^{x(t)}$ **(10 Marks)**

b. Distinguish between: i) Deterministic and random signals and
ii) Energy and periodic signals. **(06 Marks)**

c. For any arbitrary signal x(t) which is an even signal, show that $\int_{-\infty}^{\infty} x(t)dt = 2\int_{0}^{+\infty} x(t)dt$. **(04 Marks)**

2 a. Find the convolution integral of x(t) and h(t), and sketch the convolved signal, $x(t) = (t-1)\{u(t-1) - u(t-3)\}$ and $h(t) = [u(t+1) - 2u(t-2)]$. **(12 Marks)**

b. Determine the discrete-time convolution sum of the given sequences.
$x(n) = \{1, \underset{\uparrow}{2}, 3, 4\}$ and $h(n) = \{1, \underset{\uparrow}{5}, 1\}$ **(08 Marks)**

3 a. Determine the condition of the impulse response of the system if system is,
i) Memory less ii) Stable. **(06 Marks)**

b. Find the total response of the system given by,
$$\frac{d^2y(t)}{dt^2} + 3\frac{d}{dt}y(t) + 2y(t) = 2x(t) \text{ with } y(0) = -1;\ \left.\frac{d}{dt}y(t)\right/_{t=0} = 1 \text{ and } x(t) = \cos(t)u(t).$$ **(14 Marks)**

4 a. One period of the DTFS coefficients of a signal is given by, $x(k) = (1/2)^K$, on $0 \le K \le 9$. Find the time-domain signal x(n) assuming N = 10. **(06 Marks)**

b. Prove the following properties of DTFs: i) Convolution ii) Parseval relationship iii) Duality iv) Symmetry. **(14 Marks)**

### PART – B

5 a. Find the DTFT of the sequence $x(n) = \alpha^n u(n)$ and determine magnitude and phase spectrum. **(04 Marks)**

b. Plot the magnitude and phase spectrum of $x(t) = e^{-at}u(t)$. **(08 Marks)**

c. Find the inverse Fourier transform of the spectra, $x(j\omega) = \begin{cases} 2\cos(\omega), & |\omega| < \pi \\ 0, & |\omega| > 0 \end{cases}$ **(08 Marks)**

6 a. Find the frequency response and impulse response of the system described by the differential equation.

$$\frac{d^2}{dt^2}y(t)+5\frac{d}{dt}y(t)+6y(t)=-\frac{d}{dt}x(t)$$ **(08 Marks)**

b. State sampling theorem. Explain sampling of continuous time signals with relevant expressions and figures. **(06 Marks)**

c. Find the Nyquist rate for each of the following signals:

i) $x_1(t)=\sin c(200t)$ ii) $x_2(t)=\sin c^2(500t)$ **(06 Marks)**

7 a. Prove the complex conjugation and time-advance properties. **(06 Marks)**

b. Find the z-transform of the signal along with ROC.

$x(n)=n\sin\left(\frac{\pi}{2}n\right)u(n)$ **(06 Marks)**

c. Determine the inverse z-transform of the following x(z) by partial fraction expansion method,

$$x(z)=\frac{z+2}{2z^2-7z+3}$$

if the ROCs are i) $|z|>3$ ii) $|z|<\frac{1}{2}$ and iii) $\frac{1}{2}<|z|<3$. **(08 Marks)**

8 a. A system has impulse response $h(n)=\left(\frac{1}{2}\right)^n u(n)$, determine the input to the system if the output is given by,

$$y(n)=\frac{1}{3}u(n)+\frac{2}{3}\left(-\frac{1}{2}\right)^n u(n).$$ **(08 Marks)**

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

$y(n)-\frac{3}{2}y(n-1)+\frac{1}{2}y(n-2)=x(n)$, for $n\geq 0$, with initial conditions $y(-1)=4$, $y(-2)=10$, and $x(n)=\left(\frac{1}{4}\right)^n u(n)$. **(12 Marks)**

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