Total No. of printed pages = 6

EC 131404

Roll No. of candidate

2017

B. Tech 4th Semester End-Term Examination

SIGNALS AND SYSTEMS

Full Marks-100 Pass Marks-35 Time-Three hours

The figures in the margin indicate full marks for the questions.

1. Answer any *ten* questions : 10×3=30

(i) Define and classify signal.

(ii) What is BIBO stability ? Mention the stability condition for an LTI system.

(iii) Define time variant and time invariant system.

(iv) Determine whether the following systems are static or dynamic :

(a) $y(n) = n^2x(n)$

(b) $y(t) = 5x(t-2) - 4x(t)$

(c) $y(n) = 4x(n+5) + 3n + nx(n)$.

[Turn over

(v) Show that :

$u(t) * u(t) = tu(t)$.

(vi) Show that :

$$\delta(at)=\frac{1}{|a|}\delta(t).$$

(vii) Determine whether the given signal is periodic or aperiodic :

$$x(t) = 2\cos\frac{2\pi t}{3}+3\cos\frac{2\pi t}{7}.$$

(viii) State whether the given system is linear or non-linear :

$y(t) = e^{x(t)}$.

(ix) Write the condition for existence of Fourier series.

(x) Define energy and power signal.

(xi) Define autocorrelation and cross correlation.

(xii) Define sampling. What is the minimum sampling rate required to avoid aliasing of a signal ?

(xiii) Find the minimum sampling rate required to avoid aliasing of the signal $x(t) = 3\cos(100\pi t)$.

2. Answer any *eight* questions : 8×5=40

(i) r(t) is neither an energy nor a power signal. Justify the statement.

(ii) Determine the natural response of the system described by the differential equation :

$$\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+5y(t)=\frac{dx(t)}{dt}+4x(t); y(0)=1;$$

$$\frac{dy(t)}{dt}=-2\Big|_{t=0}$$

(iii) Find the Fourier transform of signum function.

(iv) Find the DTFT of the following sequence :

$x(n) = 2$ for $0 \le n \le 5$

$= 0$ otherwise

(v) Find the Laplace transform and ROC of the signal $x(t) = e^{-4t}u(t)$.

(vi) Determine the linear convolution of the following sequence using matrix method :

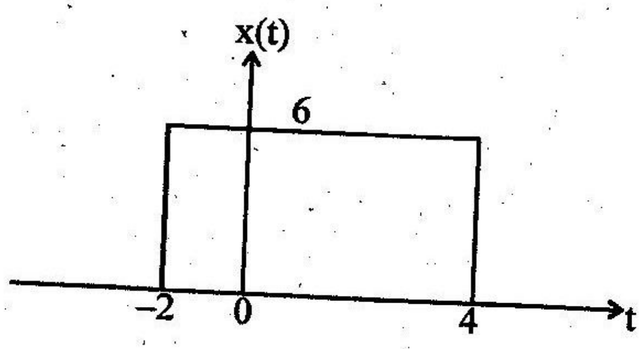
$x(n) = \{1, -1, 2, 3\}$
$\uparrow$
$h(n) = \{1, -2, 3, -1\}$.

(vii) Prove that if X(Z) is the z-transform of x(n), then $nx(n) = -Z\frac{dx(z)}{dz}$.

(viii) Determine the z-transform and ROC of the following sequence :

$x(n) = \{3, 2, 5, 7\}$.

(ix) Determine the even and odd part of the given signal diagrammatically :



(x) Show that a signal x(t) that satisfies half-wave symmetry contains Fourier coefficients with odd harmonics only.

3. Answer any *three* questions : 3×10=30

(i) Perform convolution of the given signal using graphical method :

$x(t) = 2$ for $0 \le t \le 2$
$= 0$ otherwise
$h(t) = 3$ for $0 \le t \le 4$
$= 0$ otherwise.

(ii) State sampling theorem. What is aliasing effect encountered in sampling of an analog signal ? How would you combat this effect ? Explain with the help of diagrams.

(iii) Find the inverse z-transform of :

$$\frac{3+2Z^{-1}+Z^{-2}}{1-3Z^{-1}+2Z^{-2}}.$$

(iv) State and prove the convolution property and Parseval's relation of DTFT.

(v) Write short notes on :

(a) Application of signals and systems

(b) Properties of ROC of z-transform

(c) Unit impulse signal and its properties

(d) Initial value theorem and final value theorem of Laplace transform

(e) Response of LTI discrete time system using discrete convolution.