2016

ELECTRONICS

(Major)

Paper : 5.1

(Signals and Systems)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer *all* questions : 1×7=7

(a) Give an example of a random signal.

(b) Give an example of a time-variant signal.

(c) Why is sampling theorem used?

(d) What is convolution?

(e) What is an LTI system?

(f) What is the *z*-transform of 1?

(g) What is a DFT?

2. Answer *all* questions : 2×4=8

(a) Define and draw a ramp function.

(b) Give a mathematical expression of DFT of a signal.

(c) Suppose two signals each of sequence length N are taking part in convolution. What shall be the length of the output sequence?

(d) What shall be the Fourier transform of $e^{j(\omega-\omega_0)t}$?

3. Answer any *three* questions : 5×3=15

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

Check the causality of the above system.

(b) Give an example for each of the following :

(i) Linear system

(ii) System with memory

(iii) Stable system

(iv) Ramp function

(v) Singularity function

(c) Let $x(n) = [1, -1, 2, -2]$ be a signal be applied to a system $h(n) = [1, -1]$. The output is $y(n) = x(n) * h(n)$. Determine $y(n)$ using z-transform.

(d) What are the differences between an IIR and an FIR system?

(e) What is circular convolution? How is it different from linear convolution?

(f) What are the effects of oversampling, normal sampling and undersampling in a signal? Explain using diagrams.

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

(a) A signal is given as

$$x(n) = (1, -1, 2, -2)$$

Determine

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

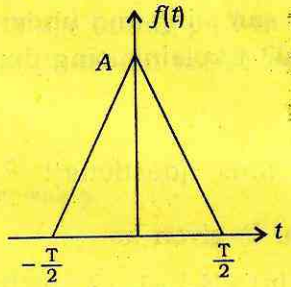
(b) Let $x(n) = x(n-1) + 2x(n-3) + x(2n)$ be a system. Find the initial and final values of the system.

(c) Prove that convolution in time domain is equivalent to multiplication in frequency domain.

(d) Show that the recovery of a system from its samples is equivalent to passing the sampled signal through a low-pass filter.

(e) Why is FFT required? Derive the steps of decimation in time algorithm. Show how decimation is achieved in the process.

(f) For the waveform shown in figure below, find the Fourier transform.



★★★