Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 90207

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Fifth Semester
Electrical and Electronics Engineering
EE 8591 – DIGITAL SIGNAL PROCESSING
(Common to : Electronics and Instrumentation Engineering)
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. Show that $\delta(n) = u(n) - u(n-1)$ graphically.
2. Show that the product of two even signals or of two odd signals is an even signal while the product of an even signal and an odd signal is an odd signal.
3. State and prove that convolution in the time domain is the same as multiplication in the Z-domain.
4. Determine the magnitude and phase representation for the following system : $y(n) + \frac{1}{4} y(n-1) = x(n) - x(n-1)$.
5. Draw the basic butterfly structure of radix-4 algorithm in the DIT algorithm.
6. Compute the x(n) for the following sequence using DIF FFT algorithm : $\{1, 1 - j\sqrt{2}, 1, 1 + j - j\sqrt{2}\}$.
7. Justify the usage of Hamming or Hanning window for FIR filter design as against Rectangular window.
8. Differentiate IIR and FIR filters.
9. Justify the usage of Branch, Call and Return instruction in Digital signal processor.
10. Name any 4 assembler directives and their usage in any Digital signal processor.

PART – B (5×13=65 Marks)

11. a) Check whether the following systems are static, linear, time invariant, causal or stable :

i) $y(n) = x(n) \cos w\, n$ (4)

ii) $y(n) = x(n) + n\, x(n+1)$ (5)

iii) $y(n) = \text{Truncation } [x(n)]$ (4)

(OR)

b) Two discrete time systems T1 and T2 are connected in cascade to form a new system T. Prove or disprove the following statements :

i) If T1 and T2 are causal, then T is causal. (3)

ii) If T1 and T2 are linear and time invariant, then interchanging the order doesn't change the system T. (4)

iii) If T1 and T2 are stable, then T is stable. (3)

iv) If T1 and T2 are non-causal, then T is non-causal. (3)

12. a) i) Determine the Z-transform and compute the Region of convergence : $x(n) = e^{-3n}u(n-1)$ (7)

ii) Use convolution to find x(n), if X(z), is given by (6)

$$X(z) = \frac{1}{\left(1-\frac{1}{2}z^{-1}\right)\left(1+\frac{1}{4}z^{-1}\right)} .$$

(OR)

b) Compute and sketch the convolution and correlation of the two signals (7+6)

$x(n) = \{\underset{\uparrow}{1}, 2, 3, 4\}$ and $h(n) = \{1, 2, 3, \underset{\uparrow}{4}\}$.

13. a) Compute the FFT using DIT algorithm for the following sequence : (13)

$x(n) = \{1, -1, -1, -1, 1, 1, 1, -1\}$

(OR)

b) i) Compute the circular convolution of the following sequences : (7)

$x_1(n) = \{\delta(n) + \delta(n-1) - \delta(n-2) - \delta(n-3)$

$x_2(n) = \{\delta(n) - \delta(n-2) + \delta(n-4)$

ii) Establish the relationship between Fourier transform and Z-transform. (6)

14. a) Determine H(z) for a Butterworth filter satisfying the following constraints using impulse invariant transformation and T = 1 sec. **(13)**

Pass band edge magnitude = $\sqrt{0.5}$

Pass band frequency = $\frac{\pi}{2}$

Stop band magnitude = 0.2

Stop band frequency = $\frac{3\pi}{4}$.

(OR)

b) The desired frequency response of a Low pass filter is **(13)**

$$H_d\left(e^{j\omega}\right) = \begin{cases} e^{-j3\omega}, & \frac{-3\pi}{4} \le \omega \le \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} \le \omega \le \pi \end{cases}$$

Determine $H(e^{j\omega})$ for a rectangular window of width 7.

15. a) Discuss the architecture of any one commercial DSP and explain with necessary diagram. **(13)**

(OR)

b) Discuss in brief the addressing formats and functional modes of any one commercial DSP. **(13)**

PART – C **(1×15=15 Marks)**

16. a) i) Determine the response of the system defined by the equation

$$y(n) = \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n)$$

to the input signal $x(n) = \delta(n) - \frac{1}{3}\delta(n-1)$ assuming zero initial conditions. **(10)**

ii) Justify and explain the necessity for quantization and the Nyquist criterions influence on the quantization function. **(5)**

(OR)

b) Obtain the parallel and cascade realization of the following filter structure using Transpose form II. **(7+8)**

$$H(z) = \frac{\left(3+5z^{-1}\right)\left(0.6+3z^{-1}\right)}{\left(1-5z^{-1}+2z^{-2}\right)\left(1-z^{-1}\right)}.$$