Reg. No. :

Question Paper Code : X10402

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
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 $\delta(n) = u(n) - u(n-1)$.

2. Given that $x(n) = \begin{cases} 1+\frac{n}{3} & , \quad -3 \le n \le -1 \\ 1 & , \quad 0 \le n \le 3 \\ 0 & , \quad \text{elsewhere} \end{cases}$, sketch the signal $x(-n+4)$.

3. State and prove the time shifting property of Z-transform.

4. State and prove Parseval's theorem in the context of DTFT.

5. Discuss the circular convolution property.

6. Draw the basic butterfly structure of a radix-4 DIT algorithm.

7. Differentiate IIR and FIR filters.

8. Give the basic structure of Direct form II structure for realizing an IIR filter.

9. Give the data formats of any one DSP processor.

10. How is pipelining effected in a DSP processor ?

PART – B **(5×13=65 Marks)**

11. a) Determine whether the following systems are static, linear, time invariant, causal and stable with proper justifications. **(4+4+5)**

 i) $y(n) = x(n) + nx(n + 1)$

 ii) $y(n) = x(-n)$

 iii) $y(n) = \text{sign}(x(n))$

(OR)

b) i) Determine the zero-input response of the difference equation given by the following :

$x(n) - 3y(n - 1) - 4y(n - 2) = 0$ **(6)**

 ii) Determine the impulse response of the following causal system. **(7)**

$y(n) - 3y(n - 1) - 4y(n - 2) = x(n) + 2x(n - 1)$

12. a) i) Determine the Z-transform and sketch the ROC of the following signal by applying the appropriate property of the Z-transform wherever necessary. **(7)**

$x(n) = n^2u(n)$

 ii) Determine the inverse Z-transform of **(6)**

$$X(z) = \frac{1 + 2z^{-1}}{1 - 2z^{-1} + z^{-2}}$$

If x(n) is causal, x(n) is anti-causal.

(OR)

b) i) Determine the magnitude and phase spectra for the following signal by computing its Fourier transform. **(7)**

$x(n) = u(n) - u(n - 6)$

 ii) Consider the following signal, determine its power density spectrum and evaluate the power of the signal. **(6)**

$$x(n) = 2 + 2\cos\frac{n\pi}{4} + \cos\frac{n\pi}{2} + \frac{1}{2}\cos\frac{3n\pi}{4}$$

13. a) i) Discuss the savings in time for a radix-2 DIT algorithm to compute FFT. **(4)**

 ii) Determine the eight point FFT using DIT algorithm. **(9)**

$x(n) = \{1, 1, 1, 1, 1, 1, 0, 0\}$

(OR)

b) Derive the butterfly structure for a radix-2 DIF algorithm that is used to compute FFT. Explain with an example. **(13)**

14. a) A digital low-pass filter is required to meet the following specifications : **(13)**

Pass band ripple : ≤ 1 dB

Pass band edge : 4 kHz

Stop band attenuation : ≥ 40 dB

Stop band edge : 6 kHz

Sample rate : 24 kHz

The filter is to be designed using bilinear transformation on an analog system function. Use Butterworth approximation.

(OR)

b) Determine the coefficients h(n) of a linear-phase FIR filter of length M = 15, which has a symmetric unit sample response and a frequency response that satisfies the following condition : **(13)**

$$H(k) = \frac{2\pi k}{15}\begin{cases} 1, & k = 0, 1, 2, 3 \\ 0.4, & k = 4 \\ 0, & k = 5, 6, 7 \end{cases}$$

15. a) Discuss the architecture of any one DSP processor and explain its features. **(13)**

(OR)

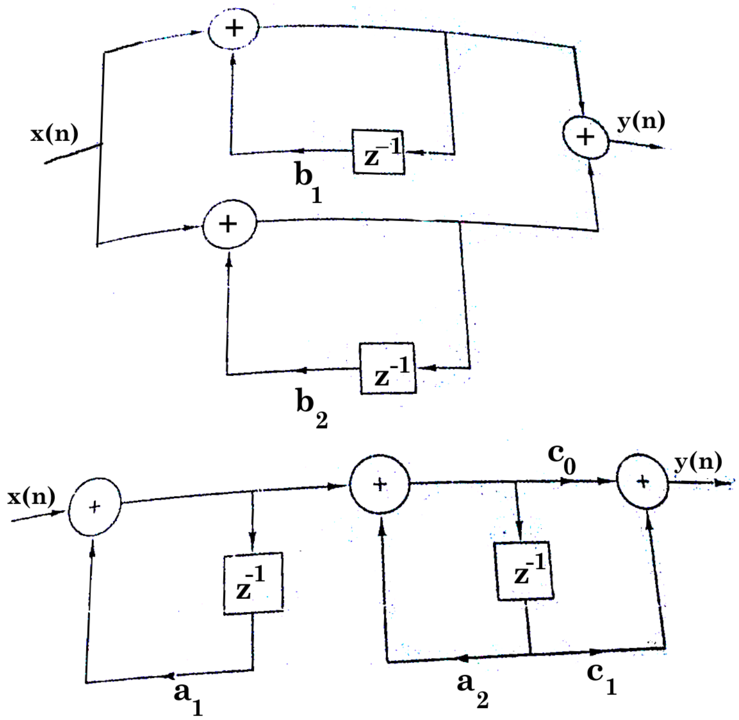
b) Discuss the addressing modes supported by a DSP processor and explain how each is used for various DSP operations. **(13)**

PART – C **(1×15=15 Marks)**

16. a) i) Obtain the cascade and parallel structures for the following system and realize it using Direct form II. **(8)**

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

ii) Determine the coefficients a_1, a_2, c_1, c_0 in terms of b_1 and b_2 so that the two systems in the given figure below are equivalent. **(7)**



(OR)

b) Discuss about implementation of FFT with any suitable digital signal processor. Also write a 'C' program to implement the FFT with the same processor.
