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

Question Paper Code : X20487

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Fourth Semester
Electrical and Electronics Engineering
EE 6403 – DISCRETE TIME SYSTEMS AND SIGNAL PROCESSING
(Common to Instrumentation and Control Engineering, Electronics and Instrumentation Engineering)
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Given a continuous signal $x(t) = 2\cos 300\pi t$. What is the Nyquist rate and fundamental frequency of the signal ?
2. Determine $x(n) = u(n)$ is a power signal or an energy signal.
3. Determine the Z-transform of $x(n) = a^n$.
4. Find the DFT of the sequence $x(n) = \{1, 1, 0, 0\}$.
5. Draw the flow graph of a 4 point radix-2 DIT-FFT butterfly structure for DFT.
6. What are the applications of FFT algorithm ?
7. Write the advantages and disadvantages of digital filters.
8. Define prewarping effect.
9. What is Gibbs Phenomena ?
10. State how spectrum meter application can be designed with DS Processor.

PART – B **(5×13=65 Marks)**

11. a) i) Find the impulse response of a discrete time invariant system whose difference equation is given by
$y(n) = y(n-1) + 0.5y(n-2) + x(n) + x(n-1)$. **(10)**

ii) Explain the properties of discrete time system. **(3)**

(OR)

b) i) A discrete time system is represented by the following difference equation in which x(n) is input and y(n) is output, $y(n) = 3y(n-1) - nx(n) + 4x(n-1) + 2x(n+1)$; and $n \geq 0$. Is this system linear ? Shift invariant ? Causal ? In each case, justify your answer. **(10)**

ii) What is meant by quantization and quantization error ? **(3)**

12. a) i) Find x(n) if $X(z) = \dfrac{1+\frac{1}{2}z^{-1}}{1-\frac{1}{2}z^{-1}}$. **(5)**

ii) Find the response of the causal system $y(n) - y(n-1) = x(n) + x(n-1)$ to the input $x(n) = u(n)$. Test its stability. **(8)**

(OR)

b) Find the impulse response, frequency response, magnitude response and phase response of the second order system.
$y(n) - y(n-1) + \frac{3}{16}\, y(n-2) = x(n) - \frac{1}{2}x(n-1)$.

13. a) i) The first five points of the eight point DFT of a real valued sequence are $(0.25, 0.125 - j0.3018, 0, 0.125 - j0.0518)$. Determine the remaining three points. **(3)**

ii) Compute the eight point DFT of the sequence $x = \{0, 1, 2, 3, 4, 5, 6, 7\}$ using DIF FFT algorithm. **(10)**

(OR)

b) i) Find the inverse DFT of
$X(K) = \left\{7, -\sqrt{2} - j\sqrt{2}, -j, \sqrt{2} - j\sqrt{2}, 1, \sqrt{2} + j\sqrt{2}, j, -\sqrt{2} + j\sqrt{2}\right\}$. **(7)**

ii) Using FFT algorithm compute the DFT of $x(n) = \{2, 2, 2, 2\}$. **(6)**

14. a) Design a 15 tap linear phase filter using frequency sampling method to the following discrete frequency response $H\left(\frac{2\Pi k}{15}\right)=\begin{cases}1 & 0\le k\le 3\\ 0.4 & k=4\\ 0 & k=5,6,7\end{cases}$. **(13)**

(OR)

b) Using bilinear transformation, design a high pass filter, monotonic in passband with cutoff frequency of 1000 Hz and down 10 dB at 330 Hz. The sampling frequency is 5000 Hz. **(13)**

15. a) Compute the following if : $x_1 = [-1, -1, -1, 2]$; $x_2 = [-2, -1, -1, -2]$

i) Linear and circular convolution of a sequence. **(6)**

ii) x_1 ; x_2 subject to addition and multiplication. **(7)**

(OR)

b) Write briefly an **any two** of the following :

i) Quantization and errors in DS processor.

ii) With neat figure explain the architecture of any one type of a DS processor.

iii) The addressing modes of one type of DS Processor.

PART – C **(1×15=15 Marks)**

16. a) The analog signal has a bandwidth of 4 KHz. If we use N point DFT with $N = 2^m$ (m is an integer) to compute the spectrum at the signal with resolution less than or equal to 25 Hz. Determine the minimum sampling rate, minimum number of required samples and minimum length of the analog signal. What is the step size required for quantize this signal ? **(15)**

(OR)

b) i) Name the different modes of a DSP processor. Explain them with an example. **(8)**

ii) Write a note on commerical DSP processors. **(7)**

———————