

[5253] - 523

T.E (E&TC) (End Semester)
DIGITAL SIGNAL PROCESSING
(2015 Pattern)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Neat diagrams must be drawn wherever necessary.
- 2) Figures to the right indicate full marks.
- 3) Your answers will be valued as a whole.
- 4) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
- 5) Assume suitable data, if necessary.

Q1) a) An analog signal given as $x(t) = 15 \cos(1250\pi t) + 17 \cos(2170\pi t) + 33 \cos(4750\pi t)$ is converted into discrete time signal. Determine Nyquist sampling rate, Folding frequency, resulting discrete time signal $x(n)$ if sampling frequency is 625 Hz. Also write discrete time frequencies in radians. [5]

b) An LTI system is defined by difference equation $y(n) = y(n-1) + y(n-2) + x(n-1)$. Find system function $H(z)$. Draw pole zero diagram. Find out $h(n)$ for causal, non-causal systems, if not why? [5]

OR

Q2) a) Find the DFT of the sequence $x(n) = 1$ for $0 \leq n \leq 2$
 $= 0$ otherwise
 for $N = 4$. Find $|X(K)|$ and $\angle X(K)$ [5]

b) Explain the sampling theorem and advantages of Digital over Analog Signal Processing. [5]

Q3) a) State any four properties of Z transform. [4]

b) Compare circular convolution with linear convolution find the circular convolution of two finite duration sequences. [6]

$$x_1(n) = \{1, -1, -2, 3, -1\} \text{ \& }$$

$$x_2(n) = \{1, 2, 3\}$$

OR

- Q4) a)** What is FFT? Explain Bit-reversal and In place computation concepts in FFT algorithm. Show the 3-bit bit reversed sequence. [5]
- b)** Explain the concept of orthogonality. Check whether the functions given are orthogonal or not over an time interval $[0,1]$, $f(t) = 1$, $x(t) = \sqrt{3}(1-2t)$. [5]
- Q5) a)** Design the second order low pass Digital Butterworth filter with cut off frequency of 1 KHz and sampling frequency 10,000 samples/sec by Bilinear transformation. [9]
- b)** Write the equation, Draw & compare the characteristics of Butterworth filter, Chebyshev filters and elliptic filter. [9]

OR

- Q6) a)** What is Bilinear transformation? Explain the properties of BLT. What is warping effect? How do you take care of it in design. [9]
- b)** State the advantage of direct form II realization over direct form I. Hence implement the following difference equation in direct form I and II. [9]
- $$y(n) + 0.1 y(n-1) + 0.72 y(n-2) = 0.7 x(n) - 0.95 x(n-2)$$

- Q7) a)** Design an FIR filter having desired frequency response as given below using rectangular window

$$H_d(w) = \begin{cases} 1 & |w| \leq \pi/4 \\ 0 & \pi/2 \leq |w| \leq \pi \end{cases} \quad \& \quad w(n) = \begin{cases} 1 & |n| < 2 \\ 0 & \text{otherwise} \end{cases}$$

Find $H(w)$. Does the filter is realizable. Justify your answer. What modification is required in $H_d(w)$ to make it realizable. [10]

- b)** Explain frequency sampling technique of FIR filter designing in detail.[6]

OR

- Q8) a)** Explain windowing technique of FIR filter design in detail. Also explain Gibb's phenomena and how it can be reduced. State different types of windows used with their window function. [10]
- b)** What is the meaning of linear phase. Prove that FIR filters are inherently stable. [6]

- Q9) a)** Speech signal is corrupted by low and high frequency noise. Explain in detail how DSP is used to remove noise with illustration. [8]
- b)** Explain the application of DSP in vibration signature analysis for defective gear teeth. [8]

OR

- Q10)a)** Explain speech coding and compression technique. How signal processing techniques are used in this. [8]
- b)** Explain how DSP is useful in Interference cancellation in ECG. [8]

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