CBCS SCHEME

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18EI/BM52

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Fundamentals of Signals and DSP

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. With necessary diagram, briefly describe the difference between Analog and Digital Signal Processing system. Mention any two advantages of digital system over analog system. **(08 Marks)**

b. State and explain the Sampling theorem, with necessary waveforms. **(08 Marks)**

c. Consider the analog signal $x_a(t) = 3\cos 50\pi t + 10\sin 3000\pi t - \cos 100\pi t$. Find the Nyquist rate for the signal. **(04 Marks)**

OR

2 a. Consider the Discreet time signal $x_1(n)$ and $x_2(n)$ as shown in Fig.Q2(a(i)) & Q2(a(ii)). Sketch and label the following signal.
i) $y_1(n) = 2x_2(n)$ ii) $y_2(n) = x_1(n) - x_2(n)$ iii) $y_3(n) = x_1(n)\, x_2(n)$. **(08 Marks)**

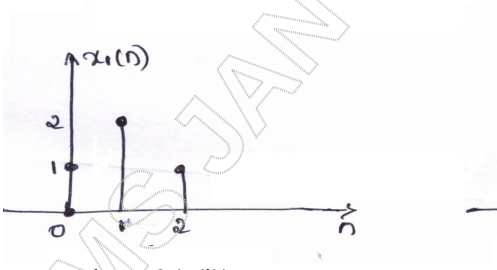

Fig. Q2(a(i))

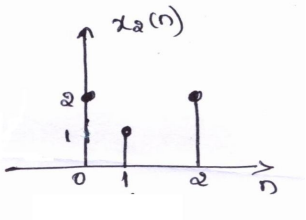

Fig. Q2(a(ii))

b. Determine whether the following systems are causal (or) non – causal.
i) $y(n) = x(n) - x(n-1)$ ii) $y(n) = 3\, y(n-1) - nx(n) + 5x(n-1) - 6x(n-1)$
iii) $y(n) = y(n)\, x(n)$ iv) $y(n) = e^{x(n)}$. **(08 Marks)**

c. Find the convolution of sequence using Tabular method
$x_1(n) = \{4, 1, 1\}$ $x_2(n) = \{2, 1, 1\}$. **(04 Marks)**

Module-2

3 a. Find the Z – transform of the following : i) $x(n) = u(-n)$ ii) $x(n) = -\beta^n u(-n-1)$
iii) $x(n) = 6\,\alpha^n u(n)$ iv) $x(n) = n\, u(n)$. **(08 Marks)**

b. Use Z – transform to perform the convolution of the following two sequences.
$h(n) = \delta(n) + 4\delta(n-1)$ and $x(n) = \delta(n) - 5\delta(n-1)$. **(08 Marks)**

c. Prove $Z[x(n+1)] = Z\,x(z) - Z\,x(0)$. **(04 Marks)**

OR

4 a. Find the Region of convergence and Z transform for the sequence.

$$x(n) = \begin{cases} 4^n & \text{for } n \geq 0 \\ 5^{-n} & \text{for } n < 0 \end{cases}.$$ **(08 Marks)**

b. Find the inverse Z – transform of the sequence

$X(z) = \dfrac{Z}{3z^2 - 4z + 1}$ for the following ROC's i) $|z| > 1$ ii) $\frac{1}{3} < |z| < 1$. **(08 Marks)**

c. Consider a difference equation $y(n) - \frac{3}{4} y(n-1) + \frac{1}{8} y(n-2) = x(n) + \frac{5}{3} x(n-1)$. Realize the system using direct form - I. **(04 Marks)**

Module-3

5 a. Define DFT and find 8 point DFT of the sequence $x(n) = \{1, 1, 1, 1, 1, 1, 0, 0\}$. **(10 Marks)**

b. Explain the following properties of DFT : i) Periodicity ii) Linearity iii) Parseval's theorem. **(10 Marks)**

OR

6 a. Find the N point DFT of the sequence :
i) $x(n) = e^{jwmn}$, $0 \le n \le N-1$ ii) $x(n) = 1$, $0 \le n \le N-1$. **(10 Marks)**

b. Compute X(k) for sequence $x(n) = 2^n$ using 8 point DIT FFT algorithm . **(10 Marks)**

Module-4

7 a. List any three advantages and disadvantages of IIR filters. **(06 Marks)**

b. Design Low pass Butterworth filter using Bilinear transformation method for satisfying the following constraints : i) Pass band wp : 0.162 rad ii) Stop band ws : 1.63 rad iii) Pass band ripple : 3 dB iv) Stop band attenuation : 30dB v) Sampling frequency : 8 KH_3. **(12 Marks)**

c. Briefly describe difference between the Butterworth and Chebyshev filter. **(02 Marks)**

OR

8 a. Write the magnitude response of Hamming, Hanning and Rectangular windows. **(06 Marks)**

b. Design low pass filter for the following desired frequency response using Hamming and Hanning window.

$$H_d(e^{jw}) = \begin{cases} e^{-jw3} & 0 \le |w| \le \pi/3 \\ 0 & \frac{\pi}{3} \le |w| \le \pi \end{cases}$$. **(12 Marks)**

c. Mention any two advantages of FIR filter. **(02 Marks)**

Module-5

9 a. With required diagram, explain the decimation process. **(08 Marks)**

b. With suitable diagram, explain Digital and Quadrature mirror filter bank. **(08 Marks)**

c. Consider a sample sequence $x(n) = \{\underset{\uparrow}{0}, 3, 6, 9, 12\}$, using linear interpolation method increases the sampling rate for L = 2. **(04 Marks)**

OR

10 a. With neat diagram and necessary equation, explain Adaptive filters. **(08 Marks)**

b. Explain the following applications of Adaptive filtering :
i) Noise Reduction for the hearing impaired ii) Fetal ECG from Abdominal ECG. **(08 Marks)**

c. Obtain the decimated signal w(n) by a factor 3 from the input signal.
$x(n) = \{\underset{\uparrow}{0}, 5, 4, 3, 1, 2, 5, 0, 5, 4, 3, 1, 2, 5, 0\}$. Obtain output y(n) by interpolating the signal by a factor 3 and what is linear interpolation. **(04 Marks)**

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