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B.TECH.
(SEM V) THEORY EXAMINATION 2021-22
DIGITAL SIGNAL PROCESSING

Time: 3 Hours**Total Marks: 100****Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.**SECTION A****1. Attempt all questions in brief.****2 x 10 = 20**

- a. Define convolution.
- b. Compute convolution of following sequences $x(n) = h(n) = \{1, 2, -1\}$
- c. Define sampling theorem.
- d. What is aliasing effect?
- e. What is the sufficient condition for the existence of DTFT?
- f. List any two properties of DFT.
- g. What is the advantage of cascade realization?
- h. What is the reason that FIR filter is always stable?
- i. What is meant by radix-2 FFT?
- j. Why FFT is needed?

SECTION B**2. Attempt any three of the following:****10 x 3 = 30**

- a. Determine the direct Forms I and II realizations for a third order IIR transfer function

$$H(z) = \frac{0.28z^2 + 0.319z + 0.04}{0.5z^3 + 0.3z^2 + 0.17z + 0.2}$$
- b. Find an expression for sampling theorem on the basis of reconstruction of signal.
- c. Explain minimum phase, maximum phase and non-minimum phase systems with examples. Also explain group delay.
- d. Find an expression for bilinear transformation for IIR filter design.
- e. Explain Discrete Cosine Transform (DCT). Give a comparison of Wavelet transform with Fourier transforms.

SECTION C**3. Attempt any one part of the following:****10 x 1 = 10**

- (a) Determine the convolution of two signals $x(n) = u(n)$ and

$$h(n) = a^n u(n), ROC : |a| < 1; n \geq 0.$$

- (b) Determine the DTFT of the following finite duration sequence of length L

$$x(n) = \begin{cases} A, & \text{for } 0 \leq n \leq L-1 \\ 0, & \text{otherwise} \end{cases}$$



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4. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Explain the need of multirate signal processing. Find an expression for down sampling by a factor of M.
- (b) Explain digital processing of analog signals. Also explain oversampling and noise shaping in A/D and D/A conversion.
5. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Compute DFT using matrix approach for the 4-point sequence $x(n) = \{0, 1, 2, 3\}$
- (b) Perform linear convolution of finite duration sequences $h(n) = \{1, 1, 2, 1\}$ and $x(n) = \{1, -1, 1, 2, 1, 0, 1, -4, 3, 2, 1, 0, 1, 1\}$ by overlap add method.
6. Attempt any *one* part of the following: 10 x 1 = 10
- (a) How one can design digital filters from analog filters? Distinguish between Butterworth and Chebyshev (Type-I) filter.
- (b) What are the desirable characteristics of the window? Explain the procedure for designing FIR filters using windows.
7. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Given $x(n) = 2^n$ and $N=8$, find $X(k)$ using DIT FFT algorithm.
- (b) Given $X(k) = \{36, -4 + j9.656, -4 + j4, -4 + j1.656, -4, -4 - j1.656, -4 - j4, -4 - j9.656\}$, find $x(n)$.