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**BTECH**  
**(SEM V) THEORY EXAMINATION 2024-25**  
**DIGITAL SIGNAL PROCESSING**

TIME: 3 HRS

M.MARKS: 70

**Note:** Attempt all Sections. In case of any missing data; choose suitably.

**SECTION A**

**1. Attempt all questions in brief. 2 x 07 = 14**

Q no.	Question	CO	Level
a.	Draw the sequence $x(n) = u(n) - u(n-4)$	1	K2
b.	Calculate the DTFT for $x(n) = a^n u(n)$	1	K2
c.	Enlist the advantages of multirate signal processing.	2	K3
d.	State Nyquist theorem.	2	K3
e.	State circular convolution property of DFT	3	K5
f.	In what way Kaiser window is superior to other window functions?	4	K6
g.	What is the need of FFT algorithm? Why is FFT called so?	5	K5

**SECTION B**

**2. Attempt any three of the following: 07 x 3 = 21**

Q no.	Question	CO	Level
a.	Draw the structures of cascade and parallel realization of $H(z) = \frac{(1-Z^{-1})^3}{(1-\frac{1}{2}Z^{-1})(1-\frac{1}{8}Z^{-1})}$	1	K2
b.	Explain the interpolation and decimation process with an example.	2	K3
c.	Compute the circular convolution of two sequences $x(n) = \{1, 1, 2, 2\}$ and $y(n) = \{1, 2, 3, 4\}$ using graphical method.	3	K5
d.	Design a high pass filter using Hamming window with a cut-off frequency of 1.2 rad/sec and order of filter is 9.	4	K6
e.	Given $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ , find $X(k)$ using DIT FFT algorithm.	5	K5

**SECTION C**

**3. Attempt any one part of the following: 07 x 1 = 07**

Q no.	Question	CO	Level
a.	Give the system function $H(z) = \frac{1+8Z^{-1}+6Z^{-2}}{1+8Z^{-1}+12Z^{-2}}$ Realize using ladder structure.	1	K2
b.	Obtain the FIR linear phase and cascade realization of the system function $H(z) = (1+\frac{1}{2}Z^{-1} + Z^{-2})(1+\frac{1}{4}Z^{-1} + Z^{-2})$	1	K2



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**4. Attempt any one part of the following: 07 x 1 = 07**

Q no.	Question	CO	Level
a.	What is meant by sampling? State and prove the sampling theorem.	2	K3
b.	Explain the process of reconstruction of the signal from its samples.	2	K3

**5. Attempt any one part of the following: 07 x 1 = 07**

Q no.	Question	CO	Level
a.	Explain the properties of twiddle factor. Find the 4 point DFT of the sequence $x(n) = \cos\frac{n\pi}{4}$ using matrix method.	3	K5
b.	Find the output $y(n)$ of a filter whose impulse response is $h(n) = \{2,2,1\}$ and input signal $x(n) = \{3,0,-2,0,2,1,0,-2,-1,0\}$ using overlap add method.	3	K5

**6. Attempt any one part of the following: 07 x 1 = 07**

Q no.	Question	CO	Level
a.	A digital filter with a 3 dB bandwidth of $0.25\pi$ is to be designed from the analog filter whose system response is $H(s) = \frac{\Omega_c}{s+\Omega_c}$ Use bilinear transformation and obtain $H(z)$ .	4	K6
b.	For the analog transfer function $H(s) = \frac{1}{(s+1)(s+2)}$ Determine $H(z)$ using impulse invariant technique.	4	K6

**7. Attempt any one part of the following: 07 x 1 = 07**

Q no.	Question	CO	Level
a.	Given $x(n) = 2^n$ and $N=8$ , find DFT of $x(n)$ using DIF FFT algorithm.	5	K5
b.	Explain the applications of Wavelet cosine transform.	5	K5