JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST - 3 EXAMINATION MAY-2023

COURSE CODE (CREDITS): 18B1WEC636 (2) MAX. MARKS: 35

COURSE NAME: Fundamentals of Digital Signal Processing & Applications

COURSE INSTRUCTORS: Dr. Vikas Baghel MAX. TIME: 2 Hours

Note: *All questions are compulsory. Marks are indicated against each question in square brackets.*

Q1. a) State sampling theorem? [2] [CO1]

b) A discrete-time signal $x[n]$ is downsampled by a factor of 2. If the original signal has a sampling rate of 1000 *samples per second*, what is the resulting sampling rate after downsampling? [2]

c) What is the concept of aliasing, and how is it avoided in digital signal processing? [3]

Q2. a) What is the significance of the Fast Fourier Transform (FFT) in digital signal processing? Draw the basic butterfly diagram of radix -2 FFT. [2] [CO2]

b) Given a discrete-time signal $x[n] = \{1, 2, 3, 4, 5\}$, find its discrete Fourier transform (DFT) using the fast Fourier transform (FFT) algorithm. [2]

c) If $H(K)$ is the $N - point$ DFT of a sequence $h(n)$, Prove that $H(K)$ and $H(N - K)$ are complex conjugates. [3]

Q3. a) Distinguish between linear & circular convolution. [2] [CO2]

b) For List any two properties of DFT. [2]

c) Given the impulse response $h[n] = \{1, -1, 2, -2\}$, and an input signal $x[n] = \{3, 4, 5, 6\}$, calculate the output signal $y[n]$ using convolution. [3]

Q4. a) What are differences between overlap-save and overlap-add methods. [2] [CO3]

b) How are finite impulse response (FIR) filters different from infinite impulse response (IIR) filters? [2]

c) Determine the order and coefficients of an FIR filter that meets the given specifications: a passband frequency range of 0 to 0.4π and a stopband frequency range of 0.6π to π. [3]

Q5. a) Find the Z-transform of the discrete-time signal $x[n] = \{1, 2, 3, 4, 5\}$. [2] [CO2]

b) Consider a digital filter with a transfer function $H(z) = \frac{1 - z^{-1}}{1 + 0.5z^{-1}}$. Determine the difference equation of the filter. [2]

c) A discrete-time system has the following difference equation: $y[n] = 0.5y[n - 1] + x[n] - 0.25x[n - 2]$. Find the impulse response $h[n]$ of the system. [3]