BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE **SEMESTER : IV/ADD**
BRANCH: EEE **SESSION : SP/19**

SUBJECT EE4207-DIGITAL SIGNAL PROCESSING

TIME: 3 Hours **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Find the relationship between Discrete-Fourier Transform to Discrete-Time Fourier Series [2]

Q.1(b) Distinguish between linear convolution and circular convolution. [4]

Q.1(c) Given x(n) = {0,1,2,3,4,5,6,7}, find 8-point DFT X(k) using the DIT-FFT algorithm. Show all the intermediate results. [6]

Q.2(a) The following specifications are given for an LPF: $\Omega_P = 1$, $\Omega_S = 2.33$, $A_P = 0.5$ dB, $A_S = 22$ dB. Compute the filter order for a Chebyshev and a Butterworth analog filter. [2]

Q.2(b) Write the comparison characteristics between IIR and FIR filter. [4]

Q.2(c) Design an IIR low-pass Butterworth filter using the impulse invariant method for the following specifications Pass band: $0.8 \leq |H(e^{jw})| \leq 1 \quad |w| \leq 0.2\pi$
Stop band: $|H(e^{jw})| \leq 0.2 \quad 0.6\pi \leq |w| \leq \pi$. Assume T= 1 sec. [6]

Q.3(a) Explain the scaling and differentiation property of Z-transform? [2]

Q.3(b) What is the Gibbs phenomena? [4]

Q.3(c) Explain the given system $\sum_{k=-\infty}^{n} x(k)$ with respect to following properties (i) Dynamicity (ii) Time invariance (iii) Linearity (iv) Causality (v) Stability [6]

Q.4(a) Write the comparisons for the window, frequency sampling and optimal methods for linear- phase finite impulse response filters. [2]

Q.4(b) Determine the frequency response (DTFT) of causal rectangular window of length N? [4]

Q.4(c) Design an FIR filter to meet the following specifications: (i) pass band edge : $F_P = 2$ KHz, (ii) stop band edge: $F_S = 5$KHz (iii) pass band attenuation: $A_P = 2$ dB (iv) stop band attenuation: $A_S = 42$ dB (v) sampling frequency : $F_T = 20$ KHz [Don't evaluvate frequency response] [6]

Q.5(a) List the three properties of DFT. [2]

Q.5(b) Determine the impulse response for the cascaded of two linear time-invariant systems having impulse responses $h_1(n) = (1/2)^n u(n)$ and $h_2(n) = (1/4)^n u(n)$. [4]

Q.5(c) Determine the inverse Z-transform of the $X(z) = (z+2) / (2z^2-7z+3)$ if the ROCs are (i) $|z| > 3$ (ii) $|z| < (1/2)$ (iii) $(1/2) < |z| < 3$. [6]

Q.6(a) Distinguish between the following: (i) Energy and Power signal (ii) Multichannel and Multidimensional. [2]

Q.6(b) Consider the analog signal $X_a(t) = 3\cos(2000\pi t) + 5\sin(6000\pi t) + 10\cos(12000\pi t)$ [4]
(i) what is the Nyquist rate for this signal? (ii) if we sampled this signal with the sampling rate 5000 samples/s. What is the discrete time signal after sampling?

Q.6(c) The accumulator described by $\sum_{k=-\infty}^{n} x(k) = y(n)$ is excited by the sequence x(n) = nu(n). Determine its output under the condition (i) It is initially relaxed (ii) Initially, y (-1) =1 [6]

Q.7(a) Estimate the filter order of a linear-phase low-pass FIR filter using Kaiser formula with the following specifications: Pass band edge frequency = 1.8 KHz, Stop-band edge frequency = 3 KHz, Maximum pass-band attenuation = 6.1 dB, Minimum stop-band attenuation = 35 dB, and sampling frequency= 12 KHz. [2]

Q.7(b) Describe the relationship between analog and digital, filter poles and frequencies in Impulse- Invariant Transformation. [4]

Q.7(c) Obtain the direct-form II structure of the system described by difference equation. [6]
$y(n) = 2r\cos(w_0)\, y(n-1) - r^2 y(n-2) + x(n) - r\cos(w_0)\, x(n-1)$

:::::24/04/2019 E:::::