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

CLASS: BE **SEMESTER : V**
BRANCH: ECE **SESSION : MO/18**

SUBJECT: EE4207-DIGITAL SIGNAL PROCESSING

TIME: 03:00 HRS. **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) Define causality and time invariance of a discrete time system. State whether the system $y(n) = x(n)\sin(w_0 n)$ is time variant or invariant. [2]

(b) Find the impulse response of the system whose frequency response is defined as [4]

$$\boldsymbol{H(w) = e^{-jw}(3 - 2cosw)}$$

(c) Compute the convolution y(n) of the signals $x(n) = \begin{cases} \frac{1}{3}n, & 0 \le n \le 6 \\ 0, & elsewhere \end{cases}$ and $h(n) = \begin{cases} 1, & -2 \le n \le 2 \\ 0, & elsewhere \end{cases}$. [6]

Q.2(a) Define stability of a discrete time system. Check whether the system with impulse response $h(n) = 3^{-n}u(n)$ is stable or unstable. [2]

(b) Sketch the magnitude spectrum of the signal x(n)=u(n)-u(n-4). [4]

(c) Using partial fraction expansion, find the inverse Z-transform of the signal [6]

$X(z) = \frac{1-1/2z^{-1}}{1-1/4z^{-2}}$ ROC: $|z| > 1/2$

Q.3(a) Define the condition of causal and stable system in Z-domain. [2]

(b) Find the 10-point inverse DFT of the sequence $X(k) = \begin{cases} 3, & k = 0 \\ 2, & k = 2,7 \\ 1, & elsewhere \end{cases}$. [4]

(c) Determine the discrete Fourier transform of the sequence $x(n) = \{1,2,3,4,4,3,2,1\}$ using decimation in time FFT method. [6]

Q.4(a) Explain why ideal filters are not realizable. [2]

(b) Given a discrete time system y(n)=0.5y(n-1)+0.8y(n-2)+x(n)+3x(n-2), draw it in direct form-II structure. [4]

(c) Given a system function $H(z) = \frac{5Z^3+3Z^2+4Z+2}{z[2Z^2+3Z+1]}$, Realize it using ladder structure. [6]

Q.5(a) Find the lowest order of low pass Butterworth filter having maximally flat characteristics with 1 dB cutoff frequency at 1kHz and minimum attenuation of 40dB at 5 kHz. [2]

(b) Explain the frequency transformation in Analog domain. [4]

(c) The transfer function of the analog filter is given as $H(s) = \frac{s+0.1}{(s+0.1)^2+16}$. Find the system function of the digital filter using bilinear transformation which resonates at $w = \pi/2$. [6]

Q.6(a) Explain symmetric and antisymmetric properties of linear phase filters and its effect in FIR filter design. [2]

(b) Evaluate the system function of the digital filter using impulse invariance method at 5 Hz sampling frequency from the analog filter given as $H_a(s) = \frac{2}{(s+1)(s+2)}$. [4]

(c) Explain the bilinear transformation method of IIR filter design. Establish the relation between analog frequency and digital frequency. [6]

Q.7(a) Compare between the FIR and IIR filter. [2]

(b) Design a linear phase FIR filter of order 15 having ideal frequency response $H_d(w) = \begin{cases} 1, 0 \le |w| \le \frac{\pi}{6} \\ 0, \quad \frac{\pi}{6} < |w| \le \pi \end{cases}$. Use the windowing method with a rectangular window. [4]

(c) Explain the equiripple method of FIR filter design. Define the alternation theorem. [6]

********28.11.18******E**