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

CLASS: BE **SEMESTER: V**
BRANCH: ECE **SESSION : MO/2019**

SUBJECT : EE4207 DIGITAL SIGNAL PROCESSING

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) What is Shannon sampling theorem and show how it is derived for discrete signals? [2]

Q1 (b) The following input-output pairs have been observed during the operation of a linear system: [3]

$x_1(n)=\{-1, \underset{\uparrow}{2}, 1\} \xleftrightarrow{T} y_1(n)=\{1, 2, -1, 0, 1\}$

$x_2(n)=\{1, \underset{\uparrow}{-1}, -1\} \xleftrightarrow{T} y_2(n)=\{-1, 1, \underset{\uparrow}{0}, 2\}$

$x_3(n)=\{0, \underset{\uparrow}{1}, 1\} \xleftrightarrow{T} y_3(n)=\{1, \underset{\uparrow}{2}, 1\}$

Can you draw any conclusions about the time invariance of this system?

Q2 (a) Find the response of the system described by the difference equation: [2.5]
$y(n)+4y(n-1)+ y(n-2)=x(n)+x(n-1)$
when input, $x(n)=(0.5)^n.u(n)$ & $y(-1)=y(-2)=1$;

Q2 (b) Find the inverse z-transform of the following system: [2.5]
$\boldsymbol{X(z)=\frac{z+2}{(z+0.4)(z-1)}}$, $\boldsymbol{ROC: |z|>1}$

Q3 (a) Prove the multiplication of two DFTs leads to circular convolution, as given [2]
$\boldsymbol{X_3(k)=X_1(k)X_2(k) \overset{DFT,N}{\longleftrightarrow} x_3(m)=\sum_{n=0}^{N-1} x_1(n)x_2((m-n))_N}$

Q3 (b) Compute the DTFT of $\boldsymbol{x(n)=a^{|n|}}$, $\boldsymbol{|a|<1}$ and plot the spectrum. [3]

Q4 (a) Compare the order of computations of DFT with FFT. [1]

Q4 (b) Find the DFT of x(n) = {1,2,3,4,4,3,2,1} using DIT algorithm. [4]

Q5 (a) Realize the IIR filter described by the following transfer function in Cascade form: [2]

$$\boldsymbol{H(z)=\frac{1+\frac{1}{3}z^{-1}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}}$$

Q5 (b) Obtain the Routh array and design the IIR filter in ladder form for: [3]

$$\boldsymbol{H(z)=\frac{2+8z^{-1}+6z^{-2}}{1+8z^{-1}+12z^{-2}}}$$

Q6 (a) Realize the IIR filter described by the following input-output relationship in Direct form-II: $y(n)=2r\cos(\omega o)y(n-1)-r^2y(n-2)+x(n)- r\cos(\omega o)x(n-1)$ [2.5]

Q6 (b) Obtain the cascade realization for the following FIR system: [2.5]
$\boldsymbol{H(z)=1+\frac{5}{2}z^{-1}+2z^{-2}+2z^{-3}}$

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