Registration No: -

Total Number of Pages:02 **B.Tech**

PEE5I103

5th Semester Regular / Back Examination 2019-20

DIGITAL SIGNAL PROCESSING

BRANCH:ELECTRICAL

Max Marks: 100

Time: 3 Hours

Q.Code: HRB226

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part- I

Q1 Only Short Answer Type Questions (Answer All-10) **(02x10)**

Suggested Words: How, Why, Determine, Derive, State, Write, Create, etc

a) How is an LTI system characterized in discrete time domain.

b) Differentiate between zero input and zero-state response of a discrete system.

c) State the modulation property in DTFT.

d) Enumerate those properties of DFT which are exploited to design efficient methods for calculating DFT ?

e) State the common characteristic of any gradient descent algorithm?

f) Give the weight updation rule for LMS algorithm, explaining each parameter in the expression.

g) Express and explain the relationship between Discrete Fourier Transform and Fourier Transform ?

h) Give the difference equation and system function expression for an FIR filter.

i) What is the z-transform of the finite duration signal:

$x(n) = \{1,3,\underset{\uparrow}{4},7,0,1\}$

j) Comment on the shape of ROC for an infinite duration, right-sided signal?

Part- II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) **(06x08)**

Analyze, Justify, Design, Formulate, Calculate, Develop, Illustrate, Explain, Distinguish, Differences & Similarities

a) Determine the particular solution of the difference equation:

$$y(n) = \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n)$$

When the forcing function is $x(n) = 2^n u(n)$

b) The impulse response of a *Linear Time Invariant* system is $h(n) = \{1,3,-1,2\}$ and is excited by an input $x(n) = \{1,4,3,-11\}$. Determine the output of the system graphically.

c) Define what are poles and zeros of a z-transform X(z). Explain with an example that there are exactly same number of poles and zeros, if we count the poles and zeros at zero and infinity.

d) Compute the convolution of the following signals by means of z-transform:

$$x_1(n) = \begin{cases} \left(\frac{1}{3}\right)^n, n \geq 0 \\ \left(\frac{1}{2}\right)^n, n < 0 \end{cases}$$

$$x_2(n) = \left(\frac{1}{2}\right)^n u(n)$$

e) What is the significance of circular convolution. Determine the circular convolution of the sequences using time domain formula :

$$x_1(n) = \{1,2,3,1\}$$
$$x_2(n) = \{4,3,2,2\}$$

f) Formulate the frequency domain equivalence of circular convolution. Determine the circular convolution of the sequences using DFT and IDFT :

$$x_1(n) = \{1,2,3,1\}$$
$$x_2(n) = \{4,3,2,2\}$$

g) Compute the energy of the N-point sequence:

$x(n) = cos\frac{2\pi k_0 n}{N}$; $0 \leq \mathrm{n} \leq \mathrm{N}-1$

h) What do you understand by linear phase response? Exemplify to show its significance.

i) Write the expression for direct form structure, and give its computational complexity. Determine a direct-form realization for the following linear phase filter: $h(n) = \{2,1,3,4,3,2,1\}$.

j) State the orthogonality principle in mean-sqaure estimation? Give the mathematical expression and emphasise its significance.

k) With supporting block diagram and mathematical expressions, explain what is noise cancellation and how it can be realised with adaptive filters.

l) Compute the 6-point DFT $\mathrm{V(k)}$ of the signal:

$$\mathrm{v(n)} = \{3,2,1,,0,1,2\}$$

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four) **(02X16)**

Discuss, Describe, Examine, Classify, Prove, Evaluate, Compare, Contrast, etc

Q3 What is meant by an anticausal signal. Formulate and prove an initial value theorem for anticausal signals.

Q4 Contrast on the significance of linear filtering by the methods of overlap-add and overlap-save methods? Explain the method of linear filtering by overlap-save method with an example.

Q5 Explain the method of designing a linear-phase FIR filter using windows with supporting mathematical expressions. What are the characteristic features of FIR filters?

Q6 Give the expressions for directly calculating the DFT and IDFT. What are the symmetry property and periodicity property of phase factor W_N in context to finding DFT. Discuss the need and feasibility of efficient algorithms for finding DFT.