Registration No :

Total Number of Pages : 02 **B.Tech**
PEE5I103

5^{th} Semester Regular / Back Examination 2018-19
DIGITAL SIGNAL PROCESSING
BRANCH : ELECTRICAL
Time : 3 Hours
Max Marks : 100
Q.CODE : E101

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 Short Answer Type Questions (Answer All-10) (2x10)

a) Determine the z-transform and ROC of the discrete time signal:
$$x(n) = \delta(n-k) + \delta(n+k), k > 0$$

b) Prove the initial value theorem of z-transform: if $x(n) = 0$ for n<0, then $x(0) = \lim_{z\to\infty} X(z)$

c) Comment on the ROC of an causal linear time invariant system.

d) What is the significance of Discrete Fourier Transform over Fourier Transform ?

e) State the condition when $x_p(n) = \sum_{l=-\infty}^{\infty} x(n-lN)$ obtained by the periodic repetition $x(n)$ every N samples can be used to recover back the signal $x(n)$.

f) Write the expressions for finding out DFT & IDFT respectively.

g) Write the general expressions to characterize a linear time invariant discrete-time system in time domain. Also write the corresponding system transfer function expression.

h) Direct form structure of filter realization follows from_____difference equation.(recursive/non-recursive). Give the expression.

i) Ideal filters are ________ filters so they are physically unrealizable.

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

Part- II

Q2 Focused-Short Answer Type Questions- (Answer Any EIGHT out of TWELVE) (6x8)

a) Determine the convolution of the following signals by means of the z-transform:
$$x_1(n) = \left(\frac{1}{4}\right)^n u(n-1) x_2(n) = \left[1 + \left(\frac{1}{2}\right)^n\right] u(n)$$

b) Find the z-transform of the signal : $x(n) = a^n(\cos\omega_0 n)u(n)$

c) Determine the inverse z-transform of $X(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}$ when ROC:$|z| < 0.5$.

d) Find the circular convolution of the following two sequences using time domain formula:
$$x_1(n) = \{1,2,3,1\} \& x_2(n) = \{4,3,2,2\}$$

e) Use the 4-point DFT and IDFT to determine the circular convolution of the two sequences:
$$x_1(n) = \{1,2,3,1\} \& x_2(n) = \{4,3,2,2\}$$

f) Prove that multiplication of two DFTs is equivalent to circular convolution of their respective time domain sequences of length N.

g) Determine the zero-input response of the system described by the homogeneous second-order difference equation:

$$y(n) - 3y(n-1) - 4y(n-2) = 0$$

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

i) Explain the method of designing a linear-phase FIR filter using windows with supporting mathematical expressions.

j) Explain FIR & IIR filters. Compare FIR & IIR filters on the aspects of memory requirement, complexity, linear phase characteristics and sidelobes.

k) Derive the Wiener Hopf equation based on minimum mean square error.

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

Part-III

Long Answer Type Questions (Answer Any TWO out of FOUR)

Q3 Show that $x_1(n) = \alpha^n u(n)$ and $x_2(n) = -\alpha^n u(-n-1)$ have identical z-transform closed form expressions, identified uniquely only when z-transform is accompanied with corresponding ROC. **(16)**

Q4 What is 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. **(16)**

Q5 Obtain the direct form-I, direct form II, cascade and parallel structures for the system represented by the difference equation: **(16)**

$$y(n) = \frac{1}{2}y(n-1) + \frac{1}{4}y(n-2) + x(n) + x(n-1)$$

Q6 Compute the eight point DFT of the sequence $x(n) = \{0.5,0.5,0.5,0.5,0,0,0,0\}$ using the in-place radix-2 decimation in time algorithm. Show the signal flow graph. **(16)**