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Total Number of Pages: 02

B.Tech.
PEL51103

5th Semester Regular Examination 2017-18
Digital Signal Processing

BRANCH: EEE

Time: 3 Hours

Max Marks: 100

Q.CODE: B404

Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: *multiple type or dash fill up type* (2 x 10)

- (ROC) Region of convergence of $x(n) = \delta(n)$ is _____.
- If $Z[x(n)] = X(z)$, then $Z[a^n x(n)] =$ _____.
- The number of arithmetic operations (multiplications and additions) required to compute the output of a system is called _____ of that system.
- _____ filters are preferred in filtering problems where there is a requirement of linear phase characteristics in the passband of filter.
- IIR filter has lower _____ in the stopband than FIR filter having same number of parameters.
- To compute N point DFT, it requires _____ complex multiplications and _____ complex additions.
- FFT is an efficient way of finding _____.
- Adaptive filter is an example of _____ system. (open loop/ closed loop)
- _____ band lies in between passband & stopband of the filter characteristics.
- In an adaptive filter, _____ of the filter are made to adapt to signal statistics.

Q2 Answer the following questions : *Short answer type* (2 x 10)

- What is the condition on the ROC of the system function for stability of an LTI system?
- What do you understand by a causal LTI system?
- The first five points of the eight-point DFT of a real valued sequence are $\{0.25, 0.125-j0.3018, 0, 0.125-j0.0518, 0\}$. Determine the remaining three points.
- Give the difference equation and system function expression for an FIR system.
- Draw a direct form realisation for the filter with impulse response:
$$h(n) = \{1, 2, 3, 4, 3, 2, 1\}$$
- State the *Time Reversal Property* in DFT.
- What is N in N-point DFT ?
- What do you understand by radix of an FFT algorithm ?
- What is meant by linear phase characteristic of a filter?
- What is BIBO in reference to stability of a system ?

Q3 a) Determine the inverse z-transform of $X(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}$, when (10)

ROC: $|z| > 1$
ROC: $|z| < 0.5$

b) An LTI system is characterised by the system function $(z) = \frac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$. (5)

Specify the ROC of $H(z)$, when the system is:

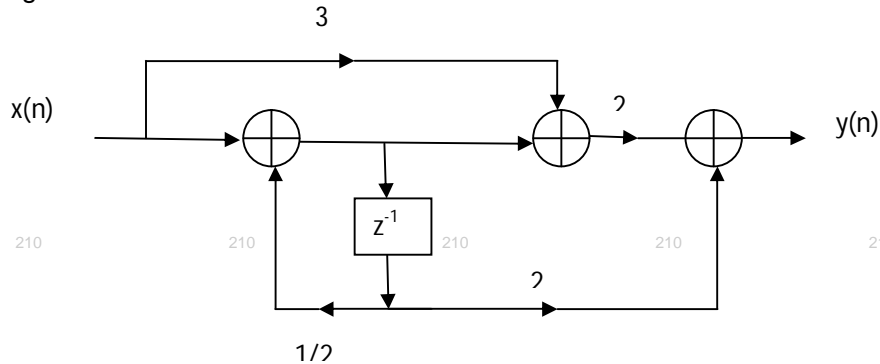
Stable
Causal
Anticausal

- Q4 a)** Prove that the multiplication of two DFTs is equivalent to circular convolution of their respective time domain sequences. **(10)**
- b)** Perform the circular convolution of the following two sequences: **(5)**
 $x_1(n) = \{2, 1, 2, 1\}$ & $x_2(n) = \{1, 2, 3, 4\}$ using the time domain formula.

- Q5 a)** Obtain the direct form-I, direct form II, cascade and parallel structures for the system represented by the difference equation: **(10)**

$$y(n] = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) + \frac{1}{3}x(n-1)$$

- b)** Determine the system function and impulse response of the system shown in the figure: **(5)**



- Q6 a)** 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. **(10)**
- b)** 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. **(5)**
- Q7 a)** With supporting block diagram and mathematical expressions, explain what is channel equalisation and how it can be realised with adaptive filters. **(10)**
- b)** Explain LMS algorithm in terms of gradient descent and recursion with supporting mathematical expressions. **(5)**
- Q8 a)** Derive the *Wiener Hopf* equation based on minimum mean square error. **(10)**
- b)** State the orthogonality principle in mean-square estimation? Give the mathematical expression and emphasise its significance. **(5)**
- Q9 a)** Compute the convolution of the following signals by means of z-transform: **(10)**

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

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

- b)** Use the convolution property to express the z-transform of: **(5)**

$$y(n) = \sum_{k=-\infty}^n x(k)$$