Registration No :

Total Number of Pages : 02 **B.Tech.**
PCS6J002

6th Semester Regular Examination 2017-18
DIGITAL SIGNAL PROCESSING
BRANCH : CSE
Time : 3 Hours
Max Marks : 100
Q.CODE : C344
Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

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

a) Give an example for even and odd signal each.

b) Determine the response of a system to the input $x(n) = \begin{Bmatrix} |n|, -3 \le n \le 3 \\ 0, otherwise \end{Bmatrix}$, if $y(n) = x(n-1)$.

c) What do you mean by zero-state response of a system?

d) What is meant by stability of a system?

e) State the *periodicity property* in DFT.

f) In an N-point DFT, what is the relationship between the radix 'r' of the FFT algorithm and 'N'?

g) What is the shape ROC of a finite duration both-sided discrete time sequence?

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

i) Cite two properties of circular convolution and write the expression to compute it.

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

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

a) A filter can easily be designed by strategic location of zeros and poles. In particular, if we want to block a frequency, we ____________ , and if we want to pass or amplify a frequency, we ______________.

b) Ideal filters are ________ filters so they are physically unrealisable.

c) Z-plane is ________ plane.

d) Direct form structure of filter realisation follows from__________difference equation.(recursive/non-recursive)

e) LMS is a ________ descent algorithm.

f) A signal with a pole near the origin decays _______ than one associated with a pole near the unit circle.

g) If $x_p(n)$ is the N-point periodic extension of L-length $x(n)$, then $x(n)$ can be recovered from $x_p(n)$ if __________________.

h) A causal system has ____________-sided impulse response.

i) The region of z-plane, where $X(z)$ exists is called as ___________.

j) An FIR filter is stable because ___________________.

Part – B (Answer any four questions)

Q3. **a)** Determine the zero-input response of the system described by the homogeneous second-order difference equation: **(10)**

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

b) The impulse response of a linear time-invariant system is $h(n) = \{1,2,1,-1\}$ and is excited by an input $x(n) = \{1, 2, 3, 1\}$. Determine the output of the **(5)**

system graphically.

Q4. 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) 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. **(5)**

Q5. a) Determine the inverse z-transform of $X(z) = \frac{1}{1-z^{-1}+0.5z^{-2}}$, when **(10)**

I. ROC: $|z| > 1$
II. ROC: $|z| < 0.5$

b) An LTI system is characterised by the system function **(5)**
$H(z) = \frac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$. Specify the ROC of $H(z)$, when the system is:

I. Stable
II. Causal
III. Anticausal

Q6. 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)**

Q7. a) Explain the method of designing a linear-phase FIR filter using windows with supporting mathematical expressions. **(10)**

b) What are the characteristics of an ideal frequency selective filter? What compromises can be made while designing a practical filter? **(5)**

Q8. a) Explain the decimation in frequency FFT algorithm with its mathematical background. **(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)**

Q9. a) **(10)**

i. Determine the Fourier transform $X(\omega)$ of the signal:
$x(n) = \{1,2,3,2,1,0\}$
↑

ii. Compute the 6-point DFT $V(k)$ of the signal:
$v(n) = \{3,2,1,,0,1,2\}$

iii. Is there any relationship between $X(\omega)$ & (k) ? Explain.

b) Prove that the discrete sequence recovered from the N-point DFT of a sequence $x(n)$ is a periodic one. **(5)**