

M.TECH/ECE/1ST SEM/ECEN 5102/2016
ADVANCED DIGITAL SIGNAL PROCESSING
(ECEN 5102)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group - A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

- (i) Convolution is used to find
 - (a) impulse response of LTI system
 - (b) frequency response of LTI system
 - (c) time response of LTI system
 - (d) phase response of LTI.
- (ii) Linear Phase system have a constant
 - (a) phase
 - (b) magnitude
 - (c) group delay
 - (d) phase and magnitude.
- (iii) A system characterized by the system function $H(z) = \frac{1}{2}(1 + z^{-1})$ is a
 - (a) Low pass filter
 - (b) Band pass filter
 - (c) High pass filter
 - (d) Band stop filter.
- (iv) The algorithm used to compute any set of equally spaced of fourier transform on the unit circle is
 - (a) DFT algorithm
 - (b) FFT algorithm
 - (c) Goertzel algorithm
 - (d) Chirp transform algorithm.
- (v) In DIT-FFT, which domain sequence is decimated?
 - (a) Time
 - (b) Frequency
 - (c) Time and Frequency
 - (d) None.
- (vi) As the length of window increases in designing a FIR filter, the width of main lobe
 - (a) does not change
 - (b) increases
 - (c) becomes zero
 - (d) decreases.

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- (vii) FIR filter is always stable because all of its pole are
 - (a) at the origin
 - (b) at infinity
 - (c) at the Roc
 - (d) none of these.
- (viii) Down sampler is usually preceded by a LPF. This combination is called
 - (a) decimator
 - (b) interpolator
 - (c) rational sampling rate converter
 - (d) none of these.
- (ix) A signal $x(n)$ is down sampled by a factor M . The output $y(n)$ of the down sampler is given as
 - (a) $M x(n)$
 - (b) $1/M x(n)$
 - (c) $x(n/M)$
 - (d) $x(nM)$.
- (x) The discrete time system described by $y(n)=x(n^2)$ is
 - (a) causal, linear and time-variant
 - (b) causal, non-linear and time-variant
 - (c) non-causal, linear and time-invariant
 - (d) non-causal, linear and time-variant.

Group - B

- 2. (a) Determine the range of value of **a** and **b** for which the linear time invariant system with impulse response $h(n) = a^n n \geq 0$
 $= b^n n < 0$ is stable.
- (b) State and explain Parseval theorem for Fourier transform.
- (c) A linear time invariant system is describe by following difference equation $y(n) = ay(n-1) + bx(n)$; . Determine the magnitude and phase of frequency response $H(w)$ of system. **4 + 4 + 4 = 12**
- 3. (a) Write down the properties of Cross correlation and auto correlation.
- (b) Compute the auto correlation of the signal $x(n) = a^n u(n)$ $0 < a < 1$.
- (c) A linear time invariant system is characterized by the system function $H(z) = (3 - 4z^{-1}) / (1 - 3.5z^{-1} + 1.5z^{-2})$ Specify the ROC of $H(z)$ and determine $h(n)$ for the following condition:
 - (i) The system is stable.
 - (ii) The system is causal.
 - (iii) The system is anticausal.**3 + 3 + 6 = 12**

Group - C

4. (a) What do you mean by Minimum phase , Maximum phase , mixed phase of the system.
- (b) Determine the zeros for the following system and indicate whether the system is minimum phase, maximum phase or mixed phase.
 $H_1(z) = (6 + z^{-1} - z^{-2})$
 $H_2(z) = (1 - z^{-1} - 6z^{-2})$
- (c) Determine the relation between DFT and Z-transform.
- (d) Determine the output response $y(n)$ of linear convolution with the help of circular convolution with zero padding where $h(n) = \{1, 1, 1\}$ and $x(n) = \{1, 2, 3, 1\}$

$$3 + 2 + 3 + 4 = 12$$

5. (a) Determine the values of power and energy of the following signals:
 (i) $x(n) = e^{j(\pi n/6 + \pi/4)}$
 (ii) $x(n) = (1/4)^n u(n)$.
- (b) Determine if the following systems are linear or not:
 (i) $y(n) = 3x(n) + 2$
 (ii) $y(n) = nx(n) + x(n-2)$
- (c) Give some applications of Multirate signal processing.

$$4 + 4 + 4 = 12$$

Group - D

6. (a) What do you mean by Gibbs phenomena and explain it.
- (b) Design a linear phase FIR filter using Hamming window for the following desired frequency response for $N=7$
 $H_d(w) = e^{-3jw} \quad \pi/4 \leq w \leq \pi$
 $= 0 \quad \text{otherwise}$
7. (a) What is FFT? How do you get the Radix 2 FFT algorithm?
- (b) Derive the expression of DIT algorithm.
- (c) Determine 8 point DFT of $x(n) = \{0, 1, 2, 3\}$ using DIF butterfly structure.

$$2 + 3 + 7 = 12$$

Group - E

8. (a) Explain in detail LMS algorithm for FIR adaptive filtering
- (b) Compare the LMS algorithm with RLS algorithm.
- (c) What is need for spectral estimation?

$$5 + 5 + 2 = 12$$

9. Write short notes on any two of following.
- (i) Power estimation using DFT.
- (ii) Multirate Signal Processing.
- (iii) Wavelet Transform.
- (iv) Kalman filter.

$$6 + 6 = 12$$