Seventh Semester B.Tech. Degree Examination, December 2016
(2013 Scheme)
13.702 : DIGITAL SIGNAL PROCESSING (E)

Time : 3 Hours
Max. Marks : 100

PART – A

Answer all questions. (10x2=20 Marks)

1. What is meant by aliasing in a band limited signal? How can it be avoided?


3. What are causal systems? Give one example.

4. What do you understand by odd and even functions?

5. Find the Fourier transform of a gate pulse of unit height, unit width and centered at \( t = 0 \).

6. Show that \( \delta[n] = u[n] - u[n - 1] \).

7. Explain the significance of ROC.

8. What are FIR and IIR systems?

9. What are linear phase filters?

10. What is warping?
PART - B

Answer any one full question from each Module.

Module - I

11. a) Explain the various steps in converting a continuous time signal to a digital signal.
   b) Determine the response of $y[n]$, $n \geq 0$, of the system, described by second order difference equation $y[n] = 3y[n - 1] - 4y[n - 2] = x[n] + 2x[n - 1]$, to the input $x[n] = 4^n u[n]$.

12. a) State and explain sampling theorem.
    b) Test the time invariance, linearity and causality of the following:
       i) $y[n] = x[n^2]$  
       ii) $y[n] = x[-n] + x[n]$  
       iii) $y[n] = n^2 u[n]$.

Module - II

13. a) Find the 4-point DFT of $x[n] = \{1, -1, 2, -2,\}$ directly.
    b) Find the linear convolution of the sequences $x[n] = \{1, 0, 2\}$ and $h[n] = \{1, 1\}$ using DFT.

14. a) Perform circular convolution of the following sequences using DFT and IDFT.
    
   $x[n] = \{1, 2, 1, 2\}$ and $h[n] = \{4, 3, 2, 1\}$.
    b) Find the 4-point DFT of the sequence $x[n] = \{2, 1, 4, 3\}$ by
       i) DIT FFT
       ii) DIF FFT.

Module - III

15. a) An LTI system is described by the equation $y[n] = x[n] + 0.81x[n - 1] - 0.81x[n - 2] - 0.45y[n - 2]$. Determine the transfer function of the system. Also sketch the poles and zeros on the z plane and assess the stability.
    b) Determine the inverse z transform of $X(z) = \frac{2z + 1}{z^2 + z - 0.3125}$.
    c) Find the Z transform and ROC of the sequence $x[n] = \{2, 1, 3, -4, 1, 2\}$.  

16. a) Obtain FIR linear phase and cascade realisations of the system function
   \[ H(z) = (1 + 0.5z^{-1} + z^{-2}) (1 + 0.25z^{-1} + z^{-2}). \]

   b) Determine the direct form I and II for the second order filter given by
   \[ y[n] = 2bcos\omega_0 y[n - 1] - b2y[n - 2] + x[n] - bcos\omega_0 x[n - 1]. \]

   **Module – IV**

17. a) For the analog transfer function \( H(s) = \frac{1}{(s + 1)(s + 2)} \) determine \( H(z) \) using
   impulse invariant technique. Assume \( T = 1s \).

   b) Convert the analog filter with system function \( H(s) = \frac{s + 0.1}{(s + 0.1)^2 + 9} \) into a
digital IIR filter using bilinear transformation. The digital filter should have a
resonant frequency \( \omega_r = \frac{\pi}{4} \).

18. a) Explain the properties of any two types of window functions used in the design
of FIR filters.

   b) Explain the frequency sampling method of digital filter design.