(Please write your Exam Roll No.) Exam Roll No. .....

END TERM EXAMINATION

FIFTH SEMESTER [B.TECH./M.TECH.] DECEMBER 2013

Paper Code: IT307 **Subject: Digital Signal Processing**

Time : 3 Hours **Maximum Marks :60**

Note: Attempt any five questions. Usage of calculators is allowed.

Q1. Attempt any four parts. (3x4)

(i) Explain one-dimensional signal with suitable examples.

(ii) Distinguish between continuous time and discrete time signals.

(iii) Explain periodic signals.

(iv) Define the term "stability" for a linear time invariant system.

(v) Determine the *z*-transform as well as the Region of Convergence for $x[n]=(\frac{1}{2})^n u[n]$.

(vi) State and establish the circular – shift property for the Discrete Fourier Transform (DFT).

Q2. Attempt any three parts. (4x3)

(i) Consider the discrete time Linear Time Invariant (Linear Shift Invariant) system with input *x*[n] and output is *y*[n] for which *y*[n-1] – (10/9)*y*[n]+*y*[n+1] = *x*[n]. Determine the unit-response in *z*-domain.

(ii) Find the *z*-transform of the following:

(a) $x[n] = -n\, a^n\, u[-n-1]$

(b) $x[n] = a^n \sin(w\, n)\, u[n]$

(iii) Find the inverse *z*-transform of , $X(z)=\frac{1+z^{-1}+2z^{-2}}{(1-\frac{1}{2}z^{-1})(1-\frac{1}{3}z^{-1})(1-\frac{1}{4}z^{-1})}; |z|>\frac{1}{2}$

(iv) Given that the *z*-transform of x[n] is X(z), find the *z*-transform of x[n] – x[n-1]. Establish your result.

Q3. Attempt any three parts. (4x3)

(a) Determine the output of the linear filter whose impulse response is h[n] = {1,-2,3} and the input signal is x[n] = {-1,2,-3,4,-5,6,-8} using either overlap-save or overlap-add method. State the method used.

(b) State and establish the Parseval's property/theorem for DFT.

(c) If the DFT of two N point sequences x[n] and y[n] is X[k] and Y[k], respectively. What is the DFT of x[n]y[n].

(d) Find the circular convolution of the given sequences: x[n] = {1,3,5,7} and y[n] = {2,4,6,8}.

Q4. Attempt all parts: (9+3)

(a) Determine the DFT of the given data sequence: x[n] = {2,1,4,6,5,8,3,9} using decimation in time FFT.

(b) What is the computational complexity of the FFT algorithm. Write a brief note.

Q5. For the system described by the difference equation: (6+6)

$y[n] - (13/12)\, y[n-1] - (1/24)\, y[n-3] = x[n]+2x[n-1]$

obtain the following realizations:

i. Direct Form I

ii. Parallel

Q6. Obtain the direct form structure and the cascade structure form for: (6+6)

$H(z) = 1 + 8z^{-1} + 21z^{-2} + 35z^{-3} + 28z^{-4} + 15z^{-5}$.

Q7. Attempt any 3 parts. (4x3)

i. Determine the impulse invariant digital filter transfer function corresponding to the transfer function for an anlaog filter given by

$$H(s)=\frac{s+2}{(s+2)^2+4}$$

ii. Compare and contrast IIR and FIR filters.

iii. Write short note on the sampling theorem. Determine the Nyquist rate / sampling rate for the given signal:
$x(t) = 2\cos(50\pi t) + 3\sin(150\pi t) - 4\cos(300\pi t)$

iv. Write short note on linear phase filter.

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