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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH] NOVEMBER –DECEMBER 2019

Paper Code: IT 307 **Subject: Digital Signal Processing**

Time : 3 Hours **Maximum Marks :75**

Note: Attempt any five questions including Q. No. 1 which is compulsory. Assume missing data if any.

Q1. a) Compare between DFT and FFT. **(5)**

b) Define linearity and shift invariance properties of the discrete time systems verify there conditions for the following systems: **(5)**

i) $T[x(n)] = \sum_{k=n_0}^{n} x^{(k)}$ ii) T[x(n)]= $ex^{(n)}$

c) Describe methods for finding Inverse Z- bantam. **(5)**

d) Discuss the design for FIR differentiator. **(5)**

e) Compare FIR and IIR system. **(5)**

Q2. a) Discuss the Z-transform theorems and properties. **(6)**

b) Perform linear convolution for the input sequence:- X(n)= {1, 2,3,1,4} and h(n)={ 1,2,3,4). **(6.5)**

Q3. a) Explain DFT. Prove the following properties of DFT when x(k) is the N-point. **(6)**
i) If x(n) is real and odd.
ii) If x(n) is imaginary and odd.

b) Determine the Z-transform of the following sequences and give their region of convergence: **(6.5)**

i) $\left(\frac{1}{2}\right)^n u(n)$ ii) $\left(\frac{1}{2}\right)^n (u(n)-u(n-10))$

Q4. Explain decimation in-time FFT algorithm for computing DFT. Compute DFT for the sequence {1,4,8,6,3,5,6,2} using FFT algorithm. **(12.5)**

Q5. a) Give the symmetry properties of the DFT of a complex sequence and explain them. **(6)**

b) What are the sample-hold circuits? Explain with the help of an example. **(6.5)**

Q6. a) Discuss the frequency response of the discrete-time system. **(6)**

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b) A casual linear shift invariant filter system has the system function. **(6.5)**

$$H(z) = \frac{1+0.875Z^{-1}}{(1+0.2Z^{-1}+0.9Z^{-2})(1-0.7Z^{-1})}$$

Draw the signal flow graph using

i) Direct form –II
ii) Cascade of the first and second order systems in transposed direct form II.

Q7. Implement the all pass filter $H_a P(Z) = \frac{-0.5120Z^{-1} - 0.8Z^{-2} + Z^{-3}}{1 - 0.8Z^{-1} + 0.6402Z^{-2} - 0.512Z^{-3}}$ using a lattice filter structure. **(12.5)**

Q8. a) How digital filter specification are given? Explain with the help of magnitude response specifications. **(6)**

b) Explain the process of IIR filter design using a bilinear transformation. **(6.5)**

Q9. Discuss the cascade, parallel and transposed terms of the IIR filter structure. **(12.5)**

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH.] DECEMBER 2016

Paper Code: IT-307 **Subject: Digital Signal Processing**

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

Note: Attempt any five questions including Q no.1 which is compulsory. Assume suitable missing data, if any.

Q1 (a) Check the system $y(n)=a^n u(n)$ for stability. (3)

(b) Check $y(n)=\sin(n)x(2n-5)$ for Time-Invariance and $y(n)=\sin(n+3)x(n-4)+x(n+2)$ for Causality. (3)

(c) Find IR of system $y(n)+4y(n-1)+4y(n-2)=r(n-2)$ (3)

(d) Perform convolution of two periodic sequences $x_1(n)=\{1,2,3,4\}$ and $x_2(n)=\{5,6,7,8\}$ using Circular convolution. (3)

Q2 (a) The IR of a FIR filter, $h(n)=\delta(n)+\frac{1}{4}\delta(n-1)+\frac{1}{16}\delta(n-2)$. Find the response of this filter to $x(n)=\sin\left(\frac{n\pi}{2}\right)u(n)$ (6)

(b) Frequency response of a FIR filter is given as $H(e^{jw})=e^{-3Jw}[2+1.8\cos 3\omega t+1.2\cos 2\omega t+0.5\cos\omega t]$ Find IR of filter and identify filter type based on its passband. (6)

Q3 (a) Prove Initial Value Theorem of Z Transform. (6)

(b) Two systems having IR $h_1(n)=\left(\frac{1}{4}\right)^n u(n)$. And $h_2(n)=\left(\frac{1}{2}\right)^n u(n)$ are connected in cascade find the next IR. (6)

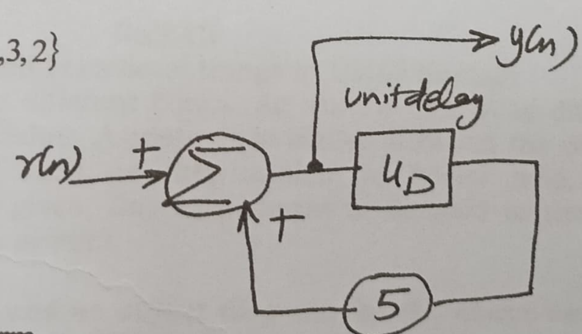
Q4 (a) Show that the magnitude response of an FIR filter at DC can be obtained as $|H(0)|=\left|\sum_{n=0}^{N-1}h(n)\right|$ and at frequency $w=\pi$ as $|H(\pi)|=\left|\sum_{n=0}^{N-1}\cos n\pi h(n)\right|$. (6)

(b) For the DTS shown, find (6)

(i) LDE

(ii) IR

(iii) Output if $r(n)=\{1,3,2\}$



Q5 Discuss-

(a) Properties of z-transform. (6)

(b) Linear convolution using DFT. (6)

Q6 The TF of a DT Causal system is $H(z)=\dfrac{1-\frac{1}{2}z^{-1}}{1-z^{-1}+\frac{3}{16}z^{-2}}$ obtain (12)

(a) Difference Equation.

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(b) Show DF-I, DF-II, Cascade and Parallel realization of this system.
(c) Find IR, step response and response to input

(i) $x(n)=\left(\frac{1}{2}\right)^n u(n)$ [an exponential excitation]

(ii) $x(n)=2\sin\left(\frac{\pi n}{3}-\frac{\pi}{5}\right)$ [a sinusoidal excitation]

Q7 Derive & explain the decimation in Time & Decimation in Frequency techniques for evaluating FFT.
(12)

Q8 (a) The signal $f(t)=(0.8)^t u(t)$ is discretized to $f(n)=(0.8)^n u(n)$ having infinite length. Find the DFT of this signal, may be evaluated through an 8-point rectangular window.
(6)

(b) Write short note on IIR filters.
(6)

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH./M.TECH.] DECEMBER 2015

Paper Code: IT307	**Subject: Digital Signal Processing**
Time : 3 Hours	**Maximum Marks :60**

Note: Attempt any five questions. Use of calculator is permitted.

Q1. Let x[n], y[n] and w[n] denote three arbitrary sequences. Show that: (6+6)

(a) Discrete convolution is commutative, i.e.,

x[n] * y[n] = y[n] * x[n]

(b) Discrete convolution is associative, i.e.,

x[n] * (y[n] * w[n]) = (x[n] * y[n]) * w[n]

Q2. For each of the following systems, determine whether or not the system is (1) stable), (2) casual, (3) linear, and (4) shift-invariant: (2x6)

(a) y[n] = g[n] x[n]

(b) $y[n]=\sum_{k=n_0}^{n} x[k]$

(c) $y[n]=\sum_{k=n-n_0}^{n+n_0} x[k]$

(d) $y[n] = x[n-n_0]$

(e) $y[n]=e^{x[n]}$

(f) y[n] = ax[n] +b where a,b >0

Q3 Find the z-transform of the following: (6+6)

(a) $x[n]=a^n \sin(\omega n) u[n]$ (b) $x[n]=a^n u[n]-b^n u[-n-1]$, (a and b) <1, b>a

Q4 Determine the impulse response of the FIR filter whose impulse response is h[n] = {1,-2,3} and the input signal is x[n] = {1,-2,3,-4,5,-6,7,-8,9}. Use any method for calculation of the concerned DFT and then use the following method for calculation of the linear convolution: (6+6)

(a) Overlap Save (b) Overlap Add

Q5 A system is described by the difference equation (4x3)

y[n] - (3/4) y[n-1] + (1/2) y[n-2] = x[n] + (1/2) x[n-1]

Draw a signal flow graph to implement this system in each of the following forms:

(a) Direct form I,

(b) Direct for II,

(c) Cascade and

(d) Parallel

Q6 Design a digital lowpass Butterworth filter worth a passband magnitude characteristic that is constant within 0.75 dB for a frequency below $w = 0.2613\pi$ and stopband attenuation of at least 20dB for frequencies between $w = 0.4018\pi$ and π. Use the Impulse Invariant Design Method. (12)

Q7a Determine the DFT of the signal x[n] = {2,1,4,6,5,8,3,9} by decimation in time FFT. (8)

Q7b What is the time complexity of the (naive) DFT algorithm, and the time complexity of the radix-2 Decimation in time FFT algorithm. (4)

Q8 Write short notes on any two of the following: (6+6)

(a) Sampling Theorem

(b) FIR filter design with windows

(c) Bi-linear transformation for Filter design

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END TERM EXAMINATION

SIXTH SEMESTER [B.TECH.] MAY-2008

Paper Code: ETIT308
Paper Id: 31308
Time : 3 Hours

Subject: Digital Signal Processing
(Batch: 2004-2005)
Maximum Marks :75

Note: Q.1 is compulsory. Attempt one question from each unit.

Q1 (a) Determine the stability criteria for discrete-time systems. Is the system with impulse response $h(n)=2^n u(n)$ stable or unstable? Justify.
(b) Derive the condition for Linear Phase in FIR filters. Why is linear phase important?
(c) Show that the impulse response of an ideal low pass filter is non-causal. How it can be made causal?
(d) Derive the condition on number of samples N required to represent the discrete-time Fourier Transform of a sequence x(n) of length L.
(e) Derive the Bilinear transformation relation between s and z^{-1}. Discuss the mapping properties. **(5x5=25)**

UNIT-I

Q2 (a) Using convolution, determine the response of a relaxed system characterized by the impulse response $h(n)=\left(\frac{1}{2}\right)^n u(n)$ to the input signal $x(n)=2^n u(n)$. **(6)**
(b) Find the homogeneous solution of the system described by the 2nd order differential equation: $y(n)=0.6y(n-1)-0.08y(n-2)+x(n)$ **(6.5)**

Q3 (a) Find the Z-transform and ROC for the signals:- **(6)**
(i) $x(n)=\left(\frac{-1}{5}\right)^n u(n)+5\left(\frac{1}{2}\right)^{-n} u(-n-1)$ (ii) $x(n)=\left(\frac{1}{2}\right)^n [u(n)-u(n-10)]$
(b) Determine the causal signal x(n) having the 2-tranform given by $X(z)=\frac{1}{(1-2z^{-1})(1-z^{-1})^2}$. **(6.5)**

UNIT-II

Q4 (a) Explain the Decimation in-time FFT algorithm for computing DFT. Discuss the savings in complex multiplications and additions. **(6)**
(b) Using the signal flow method, determine the eight point DFT of the sequence $x(n)=\{1,1,1,1,1,0,0,0\}$. Show the intermittent values on the graph. **(6.5)**

Q5 Given the sequence - $x_1(n)=\{1,2,3,1\}$ $x_2(n)=\{4,3,2,1\}$. Determine
(i) $x_1(n) \textcircled{4} x_2(n)$ [circular convolution] (ii) $x_1(n) * x_2(n)$ [Linear convolution].
Explain the difference in the result obtained. **(6+6.5)**

UNIT-III

Q6 (a) The unit sample response of an FIR system is given as $h(n)=\begin{cases}1 & 0\le n\le 5\\ 0 & elsewhere\end{cases}$.
Plot the magnitude and phase spectra of the frequency response. **(6.5)**

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(b) Explain the difference in minimum-phase and maximum-phase FIR systems. Test the following systems for phase: $H_1(z) = 6 + z^{-1} - z^{-2}$, $H_2(z) = 1 - z^{-1} - 6z^{-2}$ (6)

Q7 (a) Draw the block schematic of a Digital Signal Processing system and explain the function each block. List the important advantages of DSP. (4)

(b) Explain the sampling theorem in time domain. Discuss the design of reconstruction filter. (8.5)

UNIT-IV

Q8 (a) Draw the direct form-II, cascade and parallel structures for the system described by the difference equation:

$$y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) + \frac{1}{3}x(n-1)$$ (6)

(b) Explain the design method for a low pass Butterworth filter using bilinear transformation. Given $\begin{cases} \delta_1 \le \left|H\left(e^{jw}\right)\right| \le 1 & 0 < |\omega| \le \omega_p \\ \left|H\left(e^{jw}\right)\right| \le \delta_2 & \omega_s \le |\omega| \le \pi \end{cases}$. (6.5)

Q9 (a) Design an FIR low pass filter with following desired frequency response:-

$$Hd(e^{jw}) = \begin{cases} e^{-j2\omega} & 0 \le |\omega| \le \frac{\pi}{4} \\ 0 & \frac{\pi}{4} < |\omega| \le \pi \end{cases}$$

. Use a Hamming window function. (8.5)

(b) Write a short note on 'Digital Sinusoidal Generator'. (4)

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