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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 = 0.2613π and stopband attenuation of at least 20dB for frequencies between w = 0.4018π 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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