Reg. No.										

प्रज्ञानं ब्रह्म

Manipal

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Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

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MANIPAL INSTITUTE OF TECHNOLOGY

V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKE UP EXAMINATIONS, DEC 2015 / JAN 2016

SUBJECT: DIGITAL SIGNAL PROCESSING [ELE 303]

REVISED CREDIT SYSTEM

Time: 3 Hours | 31 December 2015 | MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.
- DSP Quick reference table may be used.

1A. Using overlap-add method perform the convolution of x(n) with h(n). Take sub frame length of 6.

x(n)=[1, 2, 0, -3, 4, 2, -1, 1, -2, 3, 2, 1] and h(n)= [1, 1, 1] **(05)**

1B. Design an FIR-Linear phase digital filter approximating the ideal frequency response

$$H_d(\omega)=\begin{cases}1, & for\ 0\le|\omega|\le\frac{3\pi}{4}\\ 0, & for\ \frac{3\pi}{4}\langle|\omega|\le\pi\end{cases}.$$

Determine the filter co-efficient of a 7-tap filter based on window method with a Hamming window. **(05)**

2A. Consider a causal IIR system with system function

$$H(z)=\frac{1+2z^{-1}+3z^{-2}+2z^{-3}}{1+0.9z^{-1}-0.8z^{-2}+0.5z^{-3}}$$

a) Determine the equivalent lattice-ladder structure.

b) Check if the system is stable. **(08)**

2B. An analog electrocardiogram (ECG) signal contains useful frequencies up to 100Hz.

a) What is the Nyquist rate of the signal?

b) Suppose that we sample this signal at a rate of 250 samples/s what is the highest frequency can be represented uniquely at this sampling rate? **(02)**

3A. Consider the sequence $x(n)=4\delta(n)+3\delta(n-1)+2\delta(n-2)+\delta(n-3)$. If X(k) be the 6 point DFT of x(n), find the finite length sequence y(n) that has a 6 point DFT $Y(k)=W_6^{4k}X(k)$. **(03)**

3B. Determine the coefficients h(n) of a linear-phase FIR filter of length M=15 which has a symmetric unit sample response and a frequency response that satisfies the condition

$$H_r\left(\frac{2\pi k}{15}\right) = \begin{cases} 1, & k = 0,1,2,3 \\ 0, & k = 4,5,6,7 \end{cases}$$ **(07)**

4A. An IIR filter digital low pass filter is required to meet the following specifications

Passband ripple ≤ 0.8dB	Passband edge: 1KHz
Stopband edge: 5KHz	Stopband attenuation: ≥ 40dB

The filter is to be designed using impulse invariant transformation on an analog system function. Use Chebyshev approximation. **(05)**

4B. Find the 4 point circular convolution of $x_1(n)$ and $x_2(n)$ using DFT –IDFT method.

$x_1(n)$=[1, 2, 3, 1] and $x_2(n)$=[4, 3, 2, 2] **(05)**

5A. Compute the 8 point DFT of the sequence x(n) using radix-2 DIT-FFT algorithm.

x(n)= [2, 1, -1, -3, 0, 1, 2, 1] **(06)**

5B. Consider the causal linear shift invariant filter with system function H(z). Draw the cascade structure for the system.

$$H(z) = \frac{1 + 0.875z^{-1}}{(1 + 0.2z^{-1} + 0.9z^{-2})(1 - 0.7z^{-1})}$$ **(04)**

6A. A digital notch filter is required to remove an undesirable 60Hz hum associated with a power supply in an ECG recording application. The sampling frequency used is F_s= 260 samples/s.

a) Design a second order FIR notch filter. b) Design a second order pole-zero notch filter. For both the cases choose b_0 so that $H|\omega| = 1$ for ω=0. **(05)**

6B. An IIR Butterworth digital low pass filter is required to meet the following specifications

Passband ripple ≤ 0.5dB	Passband edge: 1KHz
Stopband edge: 2KHz	Stopband attenuation: ≥ 40dB
Sample rate: 8KHz	

Use Bilinear transformation. **(05)**