Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKEUP EXAMINATIONS, DEC 2016 - JAN 2017

SUBJECT: DIGITAL SIGNAL PROCESSING [ELE 3102]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 29 December 2016** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- DSP Quick reference table may be supplied.

1A. Find 6point DFT of sequence $x[n]=\delta[n+1]+\delta[n]-2\delta[n-2]$ using twiddle factor ***(03)***

1B. Consider an analog signal

$x_a(t)=2\sin(200\pi t)+3\sin(300\pi t)+5\sin(700\pi t)$.

(i) If the signal is sampled at the rate of 400 Hz, what is the discrete time signal obtained after sampling?

(ii) Illustrate aliasing if any.

(iii) What is the analog signal $y_a(t)$ that we can reconstruct from the samples if we use ideal interpolation? ***(03)***

1C. A linear shift invariant discrete-time system has a unit sample response of

$h[n]=\delta[n]-\delta[n-1]$

and the input signal to the system is $x[n]=\begin{cases}1 & ;0\le n\le 9 \ for n: even\\ -1 & ;0\le n\le 9 \ for n: odd\\ 0 & ;otherwise\end{cases}$

Determine the output response of system using Overlap and Add method. Take sub-frame length of 4. ***(04)***

2A. Find 8-point DFT using DIF radix-2 FFT algorithm for a continuous-time signal

$x[n]=\delta[n+3]+\delta[n+2]+2\delta[n+1]+\delta[n]+\delta[n-1]+2\delta[n-2]+\delta[n-3]+0\delta[n-4]$

Show all intermittent values on the butterfly diagram. ***(06)***

2B. Find the IDFT of $Y[k]=|X[k]|^2$ where $X[k]$ is 8-point DFT of the sequence $x[n]=u[n]-u[n-5]$ ***(04)***

3A. Consider a causal linear time-invariant system whose system function is

$$H(z)=\frac{1-\frac{1}{5}z^{-1}}{\left(1-\frac{1}{2}z^{-1}+\frac{1}{3}z^{-2}\right)\left(1+\frac{1}{4}z^{-1}\right)}$$

Draw the Lattice-ladder structure. Also comment on the stability of the system based on the value of reflection coefficients ***(04)***

3B. Certain FIR filter has zeroes at $z=e^{j\pi}$, $z=\frac{3}{4}e^{\pm j\frac{\pi}{3}}$ and $z=\frac{4}{3}e^{\pm j\frac{\pi}{3}}$.

Find system function. Is it linear phase filter? ***(03)***

3C. Determine the coefficients of a filter with difference equation $y(n)=b_0x(n)+b_1x(n-1)+b_2x(n-2)$ such that it rejects completely a frequency component 100 Hz. The filter works at a sampling frequency of Fs=300 samples/sec. ***(03)***

4A. Find the constants a, b, and c for a given frequency response $H[\omega]$ of a linear phase FIR system.

Given: $H[0]=\frac{5}{4}$, $H\left[\frac{\pi}{2}\right]=0$, $H[\pi]=-\frac{1}{4}$, and

$$y[n]=a\,x[n]+b\,x[n-1]+c\,x[n-2]+b\,x[n-3]+a\,x[n-4]$$ ***(04)***

4B. Design a linear phase FIR high-pass filter using Hamming window, with a cutoff frequency, $\omega_c=0.8\pi$ rad/sample and length of the filter = 7. Also plot the frequency response. ***(06)***

5A. Establish a relation between analog and digital frequency with reference to bilinear transformation and also show that for every point in z-plane there is exact corresponding point in s-plane and vice versa. ***(04)***

5B. A digital Butterworth low-pass filter is required to meet the following specifications:

Pass band ripple: $\leq 1\ dB$
Pass band edge frequency: 0.33π rad
Stop band attenuation: $\geq 40\ dB$
Pass band edge frequency: 0.5π rad

The digital filter is to be designed by applying bilinear transformation on an analog system function. Take T=1 sec. ***(06)***