Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: DIGITAL SIGNAL PROCESSING [ELE 303]

REVISED CREDIT SYSTEM

Time: 3 Hours 27 November 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. Let x[n] be a finite length sequence with X(k)={0, 1+j, 1, 1-j}. Using properties find $DFT\left\{\cos\left(\frac{\pi n}{2}\right)x[n]\right\}$. **(02)**

1B. Signal x[n]=10sin(20πt) +20cos(40πt) is sampled at 80Hz and 64 samples are collected. 64 point DFT, X(k) is then computed. At what k values, would you expect to see peaks in the DFT magnitude spectrum? **(02)**

1C. Explain the principles of radix-2 FFT algorithm. Develop N-point radix-2 DIT FFT algorithm. Illustrate with signal flow diagrams. (assume N=8) **(06)**

2A. Determine the output y(n) of a filter whose impulse response is $h(n)=\{\underset{\uparrow}{1}\ 0\ 1\}$ and input signal is $x(n)=\{\underset{\uparrow}{1}\ 1\ 0\ -2\ 3\ 4\ -3\ 8\ 0\ 6\ 7\}$ using Overlap- Save method. Take sub frame length of 4. **(05)**

2B. Obtain the lattice coefficients for the given FIR filter and draw the corresponding lattice structure. $H(z) = 8+16z^{-1}+24z^{-2}+16z^{-3}$. Is the system stable? **(05)**

3A. A digital notch filter is required to remove an undesirable 50Hz hum associated with a power supply in an ECG recording application. The sampling frequency used $F_s = 250\,samples/$. Design a second order FIR notch filter. Choose b_0 so that $|H(w)|=1$ for $w=0$. Draw the magnitude spectrum. **(03)**

3B. Show that M length FIR filter with impulse response satisfying the condition h(n) = h (M-1-n) has linear phase response. **(04)**

3C. The first five coefficients of 8 point DFT of real valued sequence x(n)=r(n)+jv(n) are $X(k)=\{15,\ -4+j9.66,\ -4+j5,\ -4+j1.66,\ -4\}$. Find the 8 point DFT of the real part and imaginary part of x(n). **(03)**

4A. Design a linear phase FIR bandpass filter to pass frequencies in the range 0.4π to 0.65π rad/sample by taking 7 samples using hanning window sequence. Also realize the linear phase structure. **(05)**

4B. A digital low pass Butterworth Filter is required to meet the following specifications.

$0.8 \le |H(\omega)| \le 1$ for $0 \le \omega \le 0.2\pi$

$|H(\omega)| \le 0.2$ for $0.6\pi \le \omega \le \pi$

Design the filter using BLT technique. **(05)**

5A. Design an analog Chebyshev type-I filter to meet the following specifications:

Pass band ripple ≤ 2 dB

Pass band edge frequency =1 rad/s

Stop band attenuation ≥ 20 dB

Stop band edge frequency = 1.3 rad/s **(03)**

5B. Explain bilinear transformation technique for digitizing analog filter. What is frequency warping? **(03)**

5C. An analog signal $x_a(t) = \sin(480\pi t) + 3\sin(720\pi t)$ is sampled 600 times per second.

(a) Determine the Nyquist sampling rate.

(b) Determine the folding frequency.

(c) What are the frequencies in the resulting discrete time signal x(n)?

(d) If x[n] is passed through an ideal D/A converter, what is the reconstructed signal $y_a(t)$? **(04)**

6A. Consider an FIR system having impulse response $h(n) = [\underset{\uparrow}{\mathbf{1}}, 0.5, 0.5, 1]$. Realize the system using frequency sampling structure. **(05)**

6B. Compare IIR and FIR filters. **(02)**

6C. Consider the filter y[n]= -0.9y[n-1]+0.1x[n].

Determine the frequency at which $|H(\omega)| = \frac{1}{\sqrt{2}}$. Is this filter low pass, high pass or bandpass? **(03)**