No. of Printed Pages : 4 **MINI-030/MINE-056/MINI-005**

M.Tech. – ADVANCED INFORMATION TECHNOLOGY (MTECHSD/MTECHVD/MTECHCS)

Term-End Examination

00273

June, 2015

MINI-030/MINE-056/MINI-005 : DIGITAL SIGNAL PROCESSING

Time : 3 hours *Maximum Marks : 100*

Note :

(i) *Section I is **compulsory**.*

(ii) *Answer any **five** questions from Section II.*

(iii) *Assume suitable data wherever required.*

(iv) *Draw suitable sketches wherever required.*

(v) *Italicized figures to the right indicate maximum marks.*

(vi) *Use of calculator is allowed.*

SECTION I

1. Answer the following short answer questions : *10×3=30*

(i) In a random signal $x(t) = A(t)\cos(\omega_0(t)t + \phi(t))$, is the exact value of x(t) predictable ?

(ii) What are the specific characteristics of FFT algorithm ?

(iii) Is the magnitude response of the DFT continuous or discontinuous ? Justify.

(iv) How can an LTI system be characterised in time-domain ?

(v) When does the FFT of a signal not exist ?

(vi) If the input x(n) and the impulse response h(n) are both finite length, is the output y(n) always of finite length ?

(vii) What results in phase delays ? How can the phase delays be corrected ?

(viii) What are the advantages of representing the system function into different structures ?

(ix) What is the effect of adding a pole zero to an LTI system function ?

(x) Which is linear phase system, FIR or IIR ? What is/are the advantage(s) of linear phase response systems ?

SECTION II

2. The signal s(t) is band limited to 4 kHz. We want to sample it, but it has been subjected to various signal processing manipulations. 7+7

(a) What sampling frequency (if any works) can be used to sample the derivative of s(t) ?

(b) What sampling frequency can be used to sample a signal $y(t) = s^2(t)$?

3. A digital filter has a unit sample response $h(0) = 1$; $h(1) = 2$; $h(2) = 1$; 7+7

(a) What is the difference equation that defines this filter's input-output relationship ?

(b) What is the filter's transfer function ?

4. A digital filter is characterised by the difference equation $y(n) = x(n) + e^{\alpha}y(n - 1)$. Check the filter for BIBO stability. Find the conditions on α for stability. *14*

5. Answer the following questions : 7+7

(a) Explain the relation between the circular and linear convolution.

(b) Explain the relation between convolution and correlation.

6. Answer ***all*** questions given below. *5+5+4*

(a) Find if the Fourier transform exists for the following z-transform and explain.

$$X(z) = \frac{1}{1 - 0{\cdot}5z^{-1}}, \text{ ROC}: |z| > 0{\cdot}5$$

(b) Determine the 4-point convolution of the two length-4 sequences g[n] and h[n] given by

$g[n] = \{\underset{\uparrow}{1}\ 2\ 0\ 1\}$, $h[n] = \{\underset{\uparrow}{2}\ 2\ 1\ 1\}$;

(c) The z-transform of a sequence x(n) is given by

$$X(z) = \frac{1 - 4z^{-1} + 2z^{-2}}{1 - 3z^{-1} + 0{\cdot}5z^{-2}}.$$ If the region of convergence includes the unit circle, find the DTFT of x(n) at $\omega = \pi/2$.

7. (a) What is decimation in time and decimation in frequency ? How do these techniques help in FFT computations ? *7*

(b) Describe and differentiate between the phase delay and group delay. Derive the relation between the linear phase and group delay of the system. *7*

8. What is the difference between the analog filtering and digital filtering ? Find the order of the filter and transfer function of Butterworth highpass filter with the specification given as passband edge at 4 kHz, stopband edge 1 kHz, maximum passband attenuation of 1 dB and minimum stopband attenuation of 40 dB. *7+7*
