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

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

Term-End Examination

00274

December, 2014

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*

(a) For a system defined by

$y[n] = x[n + 1] + 6x[n] - x[n - 1]$ where $x[n]$ is the input and $y[n]$ is the output, determine whether the system is *causal* and *shift invariant*.

(b) Highlight the significance of group delay in digital systems.

(c) List out the proprieties of direct-delta function.

(d) State Parseval's Theorem in frequency domain.

(e) What is impulse response of a system ?

(f) What are the conditions for a minimum phase system ? Give an example.

(g) What is zero-input limit cycles in fixed point realizations and how can we avoid it ?

(h) What is Region of Convergence of a stable and causal system ?

(i) What is the amplitude distortion of a signal ? How do we measure it ?

(j) What are the base elements/components required to realize the digital system ?

SECTION II

2. Consider the stable LTI system with input x[n] and output y[n]. The input and output satisfy the difference equation

$y[n-1] - 10/3\, y[n] + y[n+1] = x[n]$,

(a) Plot the poles and zeros in the z-plane.

(b) Find the impulse response h[n]. *14*

3. (a) Find the Z-transform and RoC of

$$x(n) = \left(\frac{1}{2}\right)^n \mu(n) + \left(-\frac{1}{3}\right)^n \mu(n)$$

(b) Analyse the above system for *stability* and *causality*. *7+7*

4. Draw the Direct form II and cascade form realization for

$$H(z) = \frac{0{\cdot}64z^{-1} + 0{\cdot}12z^{-3}}{1 + 0{\cdot}44z^{-1} + 0{\cdot}28z^{-2} - 0{\cdot}12z^{-3}}$$ *14*

5. What are the effects of arithmetic quantization in digital implementations and approaches for analysis ? *14*

6. A digital filter is characterized 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*

7. Define : Phase shift, Phase delay, Zero phase shift, Linear and Non-linear phase response. *14*

8. What is the difference between the analog filtering and digital filtering ? Find the order of the filter and transfer function of digital low pass filter using impulse invariance to an approximation of continuous time Butterworth low-pass filter, digital filter specification given as $0{\cdot}89125 \leq |H(e^{j\omega})| \leq 1$, $0 \leq |\omega| \leq 0{\cdot}2\pi$ and $|H(e^{j\omega})| \leq 0{\cdot}17783$, $0{\cdot}3\pi \leq |\omega| \leq \pi$. *14*
