Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, DEC 2017

SUBJECT: DIGITAL SIGNAL PROCESSING [MTE 3105]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed
- Use of Transform Tables is permitted.

1A. In the linear time-invariant system shown in **Fig.Q1(A)** blocks labeled D represent unit delay elements. Find the expression for y[n] and also determine the transform function Y(z)/X(z) in the z domain for system shown in **Fig**. **Q1(A)** **6**

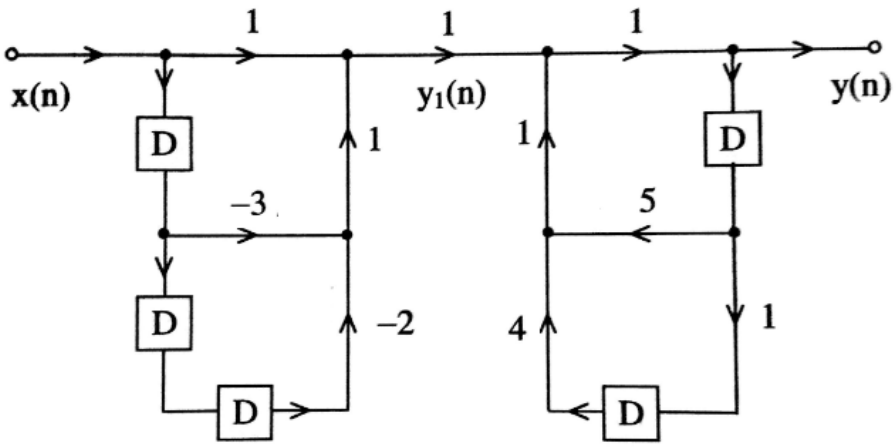

Fig.Q1(A

1B. Classify the signal as periodic or aperiodic. If periodic find its periodicity. **2**

i. $x(t) = sin^2 t$

ii. $x[n] = cos\frac{\pi}{3}n + sin\frac{\pi}{3}n$

1C. Consider an LTI system whose response to input signal $x_1(t)$ is $y_1(t)$ as shown in **Fig**. **1C(a).** Find the response of system due to input $x_2(t)$ shown in **Fig. 1C (b).** **2**

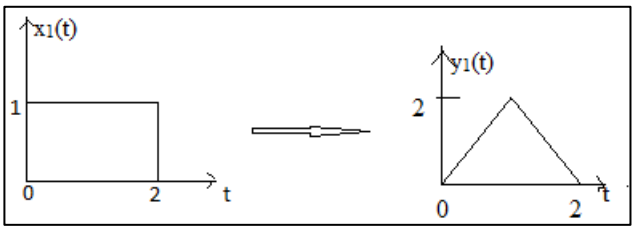

Fig. **1C(a)**

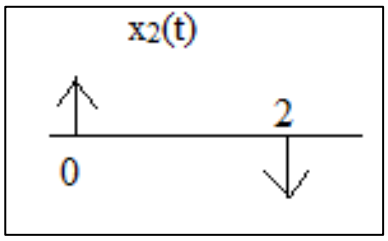

Fig. 1C(b)

2A. When the input to an LTI system is **5**

$$x[n] = \left(\frac{1}{2}\right)^n u[n] + 2^n\, u[-n-1]$$

the output is

$$y[n] = 6\left(\frac{1}{2}\right)^n u[n] - 6\left(\frac{3}{4}\right)^n u[n]$$

i) Determine the system function H(z) of the system. Plot the poles and zeros of H(z), and indicate the region of convergence.
ii) Obtain the impulse response h[n] of the system.
iii) Comment on stability and causality of the system.

2B. Find the 8 point DFT of the given sequence x(n)=[1,2,1,3,1,2,3,2] using DIT FFT algorithm. **5**

3A. Design a band pass FIR filter using a rectangular window to meet the following specifications **5**
f_{c1}= 100Hz, f_{c2}= 200Hz , F_s= 1000Hz, filter length =9

3B. Apply the Z-Transform properties and find the Z-transform of signal **3**

$$x[n] = [n-1]\left(\frac{1}{2}\right)^n u[n-1] * \left(\frac{1}{3}\right)^n u[n+1]$$

3C. Describe Gibbs phenomenon. **2**

4A. Design a Butterworth high pass digital filter using bilinear to meet the following specifications: **6**

- Stopband attenuation ≥15dB
- Passband edge =250Hz
- $Passband\ attenuation > 1dB$
- Stopband edge = 100Hz, Sampling frequency =1kHz.

4B. Sketch the waveform of the following signal **4**

$$y(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$$

5A. A recorded discrete-time signal x[n] is distorted due to an echo. The echo has a lag of 1 samples and amplitude of 2/3. i.e **4**

y[n] = x[n] + (2/ 3)x[n -1]

Where x[n] is the original signal and y(n) is the distorted signal.
Realize the given system using direct form – I. Also design an LTI system that removes the echo from the recorded signal. That means, the system you design should recover the original signal x[n] from the signal y[n].

5B. Describe pipelining. Explain pipeline operation in a DSP processor. **4**

5C. Compute y[n] if $Y(k)= X(k-2)_4$ for the sequence x[n]=[1, 2, 3,4]. **2**