Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

V SEMESTER B.TECH. (MECHATRONICS ENGINEERING)
END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: DIGITAL SIGNAL PROCESSING [MTE 3105]

REVISED CREDIT SYSTEM
(1/12/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:
- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. A causal LTI system is described by the difference equation y[n]=y[n-1]+y[n-2]+x[n-1] **5**
- (i) Compute the system function H(z) = Y(z)/X(z) for this system. Plot the zeros and poles of H(z) and indicate the region of convergence.
- (ii) Find the impulse response of the system
- (iii) Determine the stability of the system. Compute a stable (non causal) impulse response that satisfies the difference equation.

1B. Obtain the direct form –I and direct form –II realization for the system described by difference equation y[n]= 0.5y[n-1]-0.25y[n-2]+x[n]+0.4x[n-1]. **4**

1C. Determine Y(z)/X(z) for Question 1B. **1**

2A. Let x[n] be a discrete time signal and let $y_1[n]=x[2n]$ and **4**

$$y_2[n] = \begin{cases} x\left[\frac{n}{2}\right], & for\ n\ even \\ 0, & for\ n\ odd \end{cases}$$

The signals $y_1[n]$ and $y_2[n]$ respectively represent the speed up and slowed down versions of x[n].Consider the following statements:
- (i) If x[n] is periodic , then $y_1[n]$ is periodic
- (ii) If $y_1[n]$ is periodic , then x[n] is periodic
- (iii) If x[n] is periodic, then $y_2[n]$ is periodic
- (iv) If $y_2[n]$ is periodic, then x[n] is periodic.

For each of these statements, determine whether it is true, and if so compute the relationship between the fundamental periods of the signals considered in the statement.

2B. Describe pipelining. Explain pipeline operation in a DSP processor. **4**

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

3A. Band pass filters are widely used in wireless transmitters and receivers. The main function of such a filter in a transmitter is to limit the bandwidth of the output signal to the band allocated for the transmission. This prevents the transmitter from interfering with other stations. Design a band pass filter using Hamming window with following specifications: fc_1=200Hz, fc_2=400 Hz, fs=2000Hz, filter length =9 **5**

3B. Consider three systems with the following input-output relationships: **3**

System 1:

$$y[n] = \begin{cases} x\left[\frac{n}{2}\right], & for\ n\ even \\ 0, & for\ n\ odd \end{cases}$$

System 2: y[n] =x[n]+1/2 x[n-1] +1/4 x[n-2]

System 3: y[n]=x[2n]

Suppose that these systems are connected in series as depicted in **fig.Q3 (B),** Determine the input-output relationship for the overall interconnected system. Comment on the linearity and time invariance property of system.

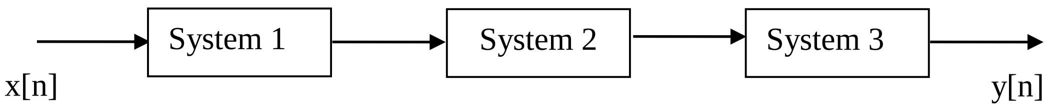

Fig. Q3(B)

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

4A. Determine the 8 point DFT of the given sequence x(n)=[2, 4, 4, 2, 1,2,1,1] using DIT FFT algorithm **5**

4B. In **fig.Q4(B)** a linear time invariance discrete system is shown. Blocks labelled D represent unit delay elements.For n<0,you may assume that x(n),y_1(n), y_2(n) are all zero. **5**

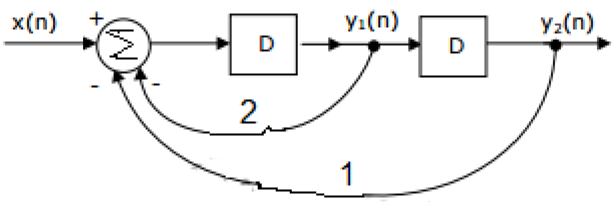

fig.Q4(B)

- Compute the expression for y_1(n) and y_2(n) in terms of x(n).
- Find the transfer function $Y_2(z)/X(z)$ in z domain
- If x(n)=1 at n=0
  =0 otherwise
  Determine y_2(n)

5A. Design a Butterworth high pass digital filter using bilinear to meet the following specifications: **6**

- Stopband attenuation ≥15dB
- Passband edge =150Hz
- $Passband\ attenuation > 1dB$
- Stopband edge = 100Hz, Sampling frequency =1kHz.

5B. Consider an LTI system whose response to the signal x_1(t) in **fig.Q5(B)(a)**is the signal y_1(t) illustrated in **fig.Q5(B)(b).** Determine and sketch the response of the system to the **4**

(i) input $x_2(t)$ depicted in **fig.Q5(B)(c)**
(ii) input $x_3(t)$ depicted in **fig.Q5(B)(d)**

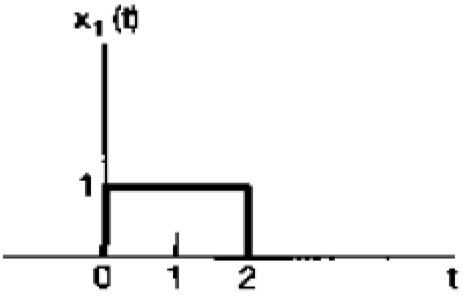

fig.Q5(B)(a)

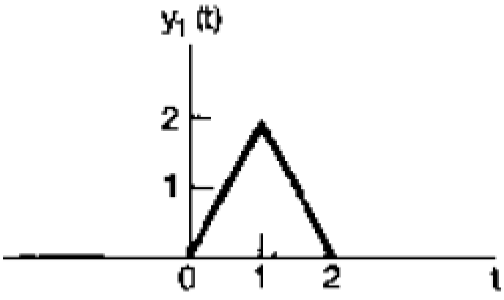

fig.Q5(B)(b)

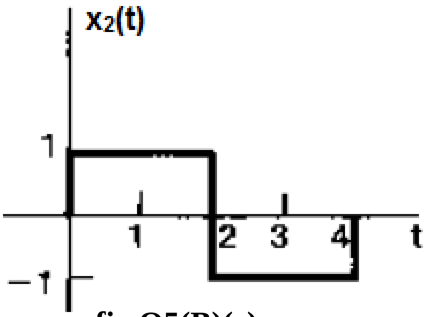

fig.Q5(B)(c)

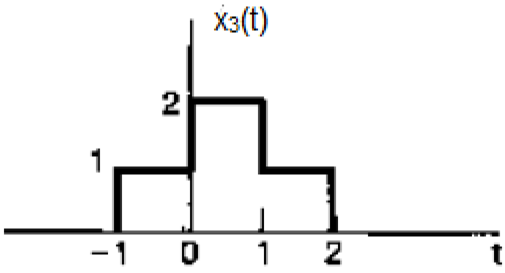

fig.Q5(B)(d)