Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

I SEMESTER M.TECH (INDUSTRIAL AUTOMATION AND ROBOTICS)

END SEMESTER EXAMINATIONS, NOV 2017

SUBJECT: SIGNAL PROCESSING AND APPLICATIONS [MTE 5140]

REVISED CREDIT SYSTEM
(23/11/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **any five** questions.
- Data not provided may be suitably assumed
- Use of transform table is permitted

1A. Draw $x[n] = u[n] - u[n-5]$.Sketch the even and odd part of the signal x[n]. **3**

1B. Two finite duration sequences $h_1[n]$and $h_2[n]$ of length 8 are sketeched in **fig.Q1B(a) and fig.Q1B(b)** respectively. $h_2[n]$is the time shifted version of $h_1[n]$ by 4. $H_1[K]$={ 20, -5.8284 - 2.4142i , 0, -0.1716 - 0.4142i, 0, -0.1716 + 0.4142i, 0, -5.8284 + 2.4142i}. Find $H_2[K]$. **3**

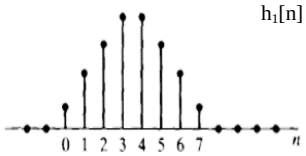

fig.Q1B(a)

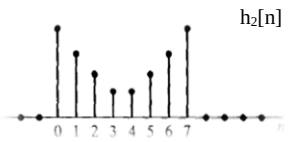

fig.Q1B(b)

1C. Find the inverse z transform of $X(z) = \frac{3-\frac{5}{6}z^{-1}}{(1-\frac{1}{4}z^{-1})(1-\frac{1}{3}z^{-1})}$ for all possible combination of ROC **4**

2A. Find the 8 point DFT of the given sequence x[n]={1,1, 0,0,-1,-1,0,0} using DIT FFT algorithm. **5**

2B. Determine response of FIR filter with impulse response h[n]=[1 2 3 4] to the input sequence x[n]=[1 2 3]. **3**

2C. Classify the signals as energy or, power, or neither energy nor power signals. Determine the values of power (P_∞) and energy (E_∞) **2**

a) $x[n] = nu[n]$ b) $x(t) = e^{-t}u(t)$

3A. In automobiles, Knock sensors are used to sense vibrations caused by engine knock or detonation. This sensor data has been corrupted by some high **5**

frequency signals. Design a FIR filter with 7 coefficients which allows only low frequency signals up to 250Hz so that we can improve the response of knock sensor. Take sampling frequency=1000Hz

3B. Verify whether the following systems are (i) Memory less (static)/Dynamic (memory) (ii) causal/Non causal (iii) Linear/Nonlinear (iv) Time variant/Time invariant (v) stable/unstable. **5**

a) $y[n] = \cos(x[n])$ b) $y(t) = (t+2)\,x(t)$

4A. In the linear time-invariant filter structure shown in **fig.Q4A**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. **Q4(A)** **5**

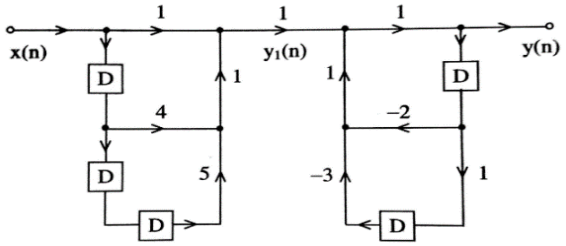

fig.Q4A

4B. Smoothing is performed for removing the unwanted noise. It produces slow changes in value so that it's easier to see trends in our data. Smoothening can be obtained by moving average filter where the system response **5**

$y[n] = \frac{1}{m}\sum_{k=0}^{m-1} x[n-k]$. Consider window length m=3

- Obtain h[n].
- Determine the moving average filter is FIR filter/ IIR filter. Justify your answer
- For given x[n]= [3 3 3 3 27 3 3], obtain the output of moving average filter using convolution and explain smoothening operation

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

- Stop band attenuation ≥15dB
- Pass band edge =150Hz
- Passband attenuation $>$ 1dB
- Stop band edge = 100Hz, Sampling frequency =1 kHz.

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

6A. Realize the system described by difference equation given below using direct form I. Also find Y(z)/X(z). **5**

y[n]= 3y[n-1]+4y[n-2]+x[n]+2x[n-1]-3x[n-2].

6B Consider signal $x[n] = \begin{cases} 1\,; 0 \le n \le 5 \\ 0; elsewhwere \end{cases}$. **5**

The signal is given to a system whose impulse response is given by y[n]=x[n]-x[n-1]. Find impulse response H(z) and determine its ROC. Also identify one application of the given system