Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent institution of MAHE, Manipal)

V SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, JAN 2018

SUBJECT: DIGITAL SIGNAL PROCESSING [MTE 3105]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:
- Answer **ALL** the questions.
- Data not provided may be suitably assumed
- Use of Transform Table is permitted.

1A. Explain the following central processing unit of digital signal processor: (i) Parallel logic unit (PLU), (ii) Auxiliary register arithmetic unit (ARAU), and (iii) Memory-mapped registers. **(3)**

1B. Describe fixed-point and 32-bit floating point digital signal processor. Further, differentiate the fixed-point and 32-bit floating point digital signal processor in terms of (i) accuracy, and (ii) cost vs ease of use. **(4)**

1C. Compute the inverse z-transform for the following function: **(3)**
$X(z) = \frac{z+4}{z^2-4z+3}$, where Region of convergence: $|z| < 1$.

2A. In **Fig. Q2A** 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. **(3)**

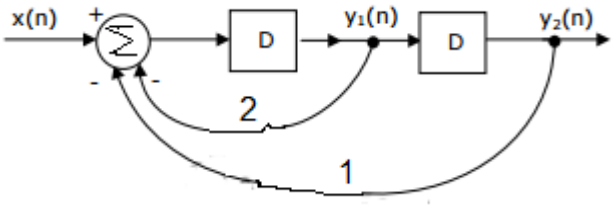

Fig. Q2A

- 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 the output signal $y_2(n)$.

2B. A causal LTI system is described by the difference equation $y[n] = y[n-1] + y[n-2] +$ **(4)**

$x[n-1]$

(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.

(iv) Compute a stable (non causal) impulse response that satisfies the difference equation.

2C. Let $x[n]$ be a discrete time signal, $y_1[n] = x[2n]$, and **(3)**

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

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

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.

3A. Discuss the drawback of rectangular window? Suggest the remedy for the same. **(2)**

3B. Determine the z-transform of the following signal: **(4)**

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

3C. Compute the 4- point DFT of the sequence $x(n) = \{1,2,3,0\}$ using DIF-FFT algorithm. **(4)**

4A. Design an IIR digital notch filter using bilinear transformation and butterworth approximation for the following specifications: **(7)**

Lower passband edge 25 Hz

Lower Stopband edge 100 Hz

Upper stopband edge 150 Hz

Upper passband edge 225 Hz

Passband ripple 3 dB, Stopband attenuation 18 dB, and sampling frequency 500 Hz.

4B. Discuss the advantages and disadvantages of IIR filter over the FIR filter. Explain, why there are ripples in the passband of type-1 Cheveshev approximation of IIR filter. **(3)**

5A. Design a FIR low pass filter using Hanning window with 11 coefficients for the following specifications: **(7)**

Passband frequency edge=0.25 kHz and Sampling frequency = 1 kHz.

5B. Construct the parallel form realization of the following filter: **(3)**

$$H(z) = \frac{0.44z^2 + 0.362z + 0.02}{(z^2 + 0.8z + 0.5)(z - 0.4)}$$