Reg. No.											

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

V SEM B.Tech (BME) DEGREE END-SEMESTER EXAMINATIONS, DEC/JAN 2020-21.

SUBJECT: DIGITAL SIGNAL PROCESSING (BME 3153)
(REVISED CREDIT SYSTEM)
Monday, 4th January 2021, 2 to 5 PM

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to Candidates:

1. **Answer ALL questions.**
2. **Draw labeled diagram wherever necessary**

1. a) Explain each operation performed on the sequences $x(n) = \begin{cases} n & -3 \leq n \leq 3 \\ 0 & otherwise \end{cases}$ to represent the resultant sequence $y(n) = x(-2n+1)$ (5)

b) Let $x_{ev}(n)$ and $x_{od}(n)$ be even and odd real sequences, respectively. Examine the symmetry of $g(n) = x_{ev}(n)x_{od}^2(n)$ (3)

c) Consider the Discrete-time sequence $x(n) = |\alpha|^n$. Justify whether the given sequence is bounded or unbounded. (2)

2. a) Adapt the circular convolution of two 4-point finite length sequence $x(n) = \{1, 0, 0, 0\}$ and $y(n) = \{2, 1, 1, 2\}$ to determine linear convolution of the given sequences. (5)

b) Consider the continuous time sinusoidal signal $x(t) = \cos(90\pi t) - 0.2\cos(290\pi t)$. If $x(t)$ is discretized with a sampling rate of 300 samples/sec to yield discrete-time sequence $x(n)$, then examine whether $x(t)$ is reconstructed from $x(n)$. (3)

c) Justify whether the fundamental period of the following discrete-time sequences $x(n) = e^{j\sqrt{8}\pi n}$is determined. (2)

3. a) Evaluate the inverse z-transform for all possible ROCs for the given z-transforms $X(z) = \frac{3z}{z^2+0.3z-0.18}$ and examine the existence of the Discrete-time Fourier transform on the resultant sequence(s). (5)

b) Consider the IIR High pass filter defined by the system function $H(z) = \frac{1+\alpha}{2}\frac{1-z^{-1}}{1-\alpha z^{-1}}$. Design the filter for the $\frac{3\pi}{4}$ $radians/sample$ cut off frequency. (3)

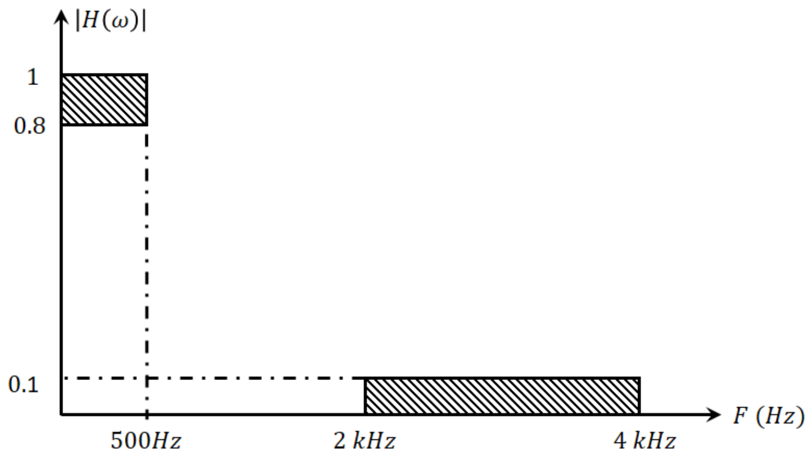
c) Design the Doubly complementary filter for the given filter with the system function $H(z) = \frac{1}{2}(1-z^{-1})$. (2)

4. a) Consider the M-point Moving Average System characterized by its difference equation $y(n) = \frac{1}{M}\sum_{k=0}^{M-1} x(n-k)$. Determine the Frequency Response $H(e^{j\omega})$ of this system. Plot the Magnitude and phase spectrum of the Frequency Response $H(e^{j\omega})$ for M=5-point Moving Average System. (5)

b) Design the Type-2 linear-phase FIR filter with the following zeros: $z_1 = 3.1,\ z_2 = -2 + j4$. (3)

c) Consider the FIR Low pass filter defined by the system function $H(z) = \frac{1}{2}(1 + z^{-1})$. Determine the characteristics of the system from its magnitude and phase spectrum. (2)

5. a) The IIR digital Low Pass filter specifications are as shown in the Figure below. (5)



Design the Analog Butterworth Low Pass Filter.

b) Design the Digital IIR Low Pass Filter from Q5(a) using Bilinear Transformation method. (3)

c) Plot the Magnitude spectrum of the Digital IIR Low Pass Filter designed in Q5(b). (2)