Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

I SEMESTER M.TECH. (INDUSTRIAL ROBOTICS AND AUTOMATION)

END SEMESTER EXAMINATIONS (PART-A), February 2022

SUBJECT: SIGNAL PROCESSING AND APPLICATIONS [MTE 5003]

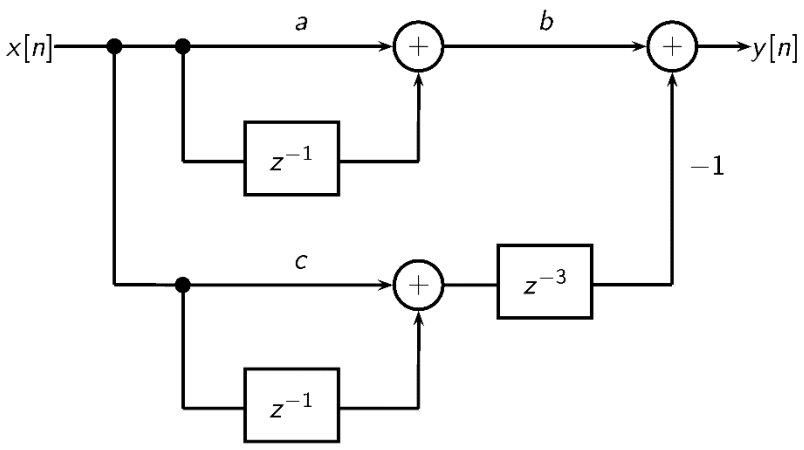
(Date: February 14, 2022)

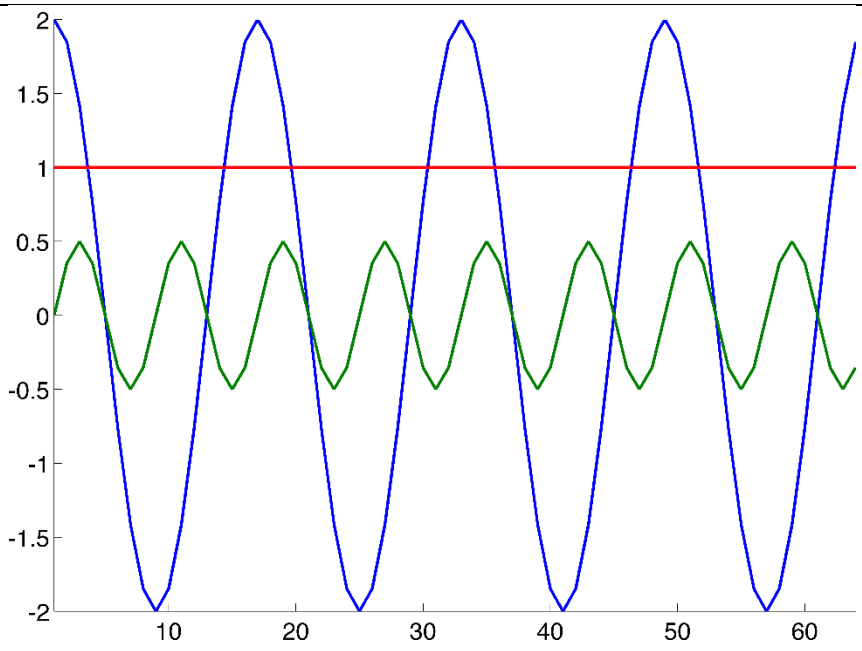
Time: 45+5 Minutes **MAX. MARKS: 30**

Instructions to Candidates:

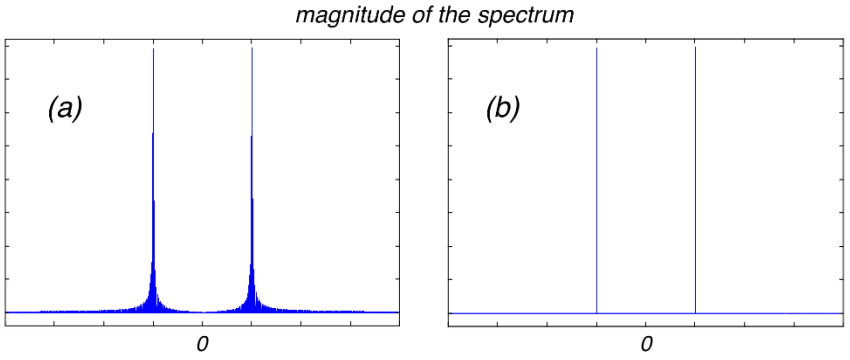
- Answer **ALL** the questions.
- Missing data, if any, can be suitably assumed.

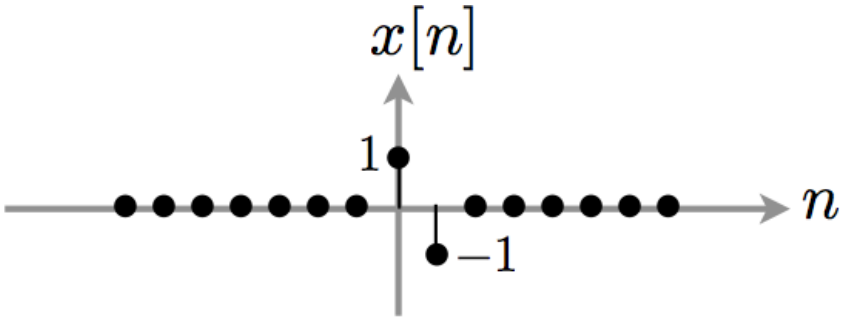
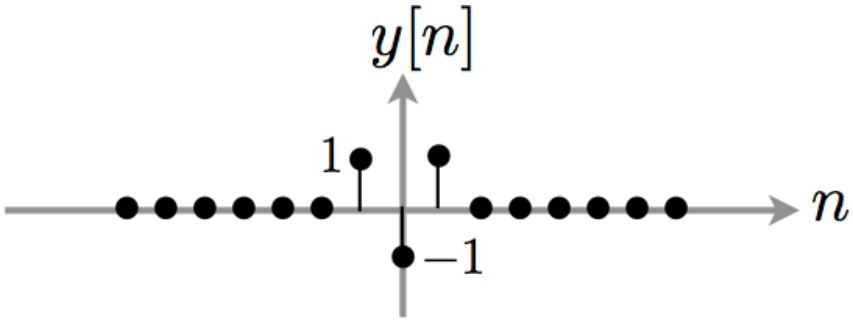
Q No	Question	M	CO	PO	LO	BL
	MCQ Type Questions (1 × 30 = 30)					
1	What are the advantages of using digital signals over analog ones? Choose the correct answer(s). **a. Processing of digital signals can be easily implemented in modern computers.** **b. Digital signals can be easily stored.** c. Digital signals contain more information than analog ones. d. **Digital signals are more robust to noise.**	1	1	1	1	2
2	Consider the following finite support signal: $x[n] = \begin{cases} (-1)^n n & \text{for n = 1,2,3} \\ 0 & \text{otherwise} \end{cases}$ Energy of the signal is _____ a. 14 b. 1 c. 6 d. 4	1	1	1	1	3
3	Consider the signal $x[n] = \delta[n] + 2\delta[n-1] + 3\delta[n-2]$	1	1	2	2	4

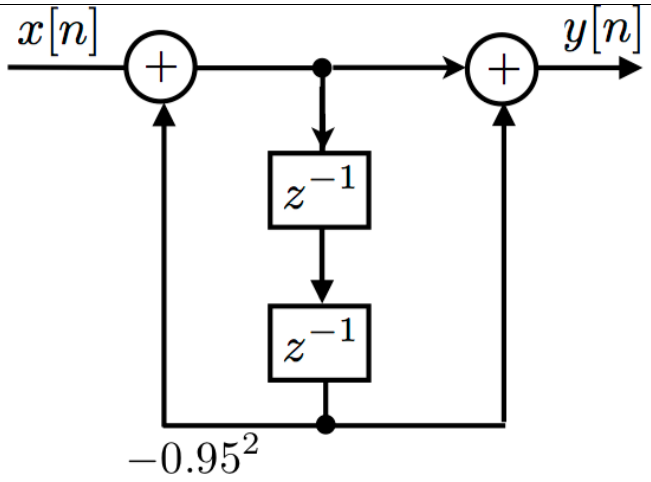
	And moving average filter with impulse response $h[n]=\frac{1}{2}(x[n]+x[n-1])$. Select the output of the system. a. $y[n]=0.5\delta[n]+1.5\delta[n-1]+2.5\delta[n-2]+1.5\delta[n-3]$ b. $y[n]=\delta[n]+2\delta[n-1]+5\delta[n-2]+5\delta[n-3]$ c. $y[n]=\delta[n]+\delta[n-1]+\delta[n-2]+\delta[n-3]$ d. None of the above					
4	A music song recorded in a studio is stored as a digital sequence on a CD. The analog signal representing the music is 2 minutes long and is sampled at a frequency f_s=44100Hz. Assume that the audio file is mono, or in other words, single-channel. Select the number of samples stored on the CD. a. 31,75,20,000 bytes b. 88,200 bytes c. 15,87,600 bytes **d. 52,92,000**	1	4	2	2	3
5	 a. $y[n]=abx[n]+bx[n-1]+cx[n-3]-x[n-4]$ b. $y[n]=abx[n]+bx[n-1]-cx[n-3]-x[n-4]$ c. $y[n]=b(bx[n]+ax[n-1])+cx[n-3]-x[n-4]$ d. $y[n]=abx[n]+bx[n-1]-(cx[n-3]+x[n-4])$	1	3	3	3	4

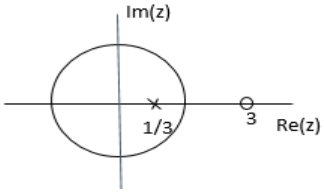
6	Let $W_N^k = e^{-j\frac{2\pi}{N}k}$ and $N > 1$, then $W_N^{N/2}$ is **a. -1** b. 1 c. -j d. j	1	2	3	3	3
7	Choose the non periodic signal from the sets below. $x[n] = \sin(2\pi fn)$ $x[n] = (-1)^n$ $x(t) = \cos(2\pi f_o t + \phi)$ $x[n] = n^2$	1	1	3	3	4
8	 Consider the three sinusoids of length N=64 as illustrated in the above figure; note that the signal values are shown from n=0 to n=63. If $y_1[n]$ the blue signal, $y_2[n]$ the green and $y_3[n]$ the red. The sum x[n]=$y_1[n]$+$y_2[n]$+$y_3[n]$. Note that the capital letters indicate the DFT vectors. Then the contribution of $Y_3[k]$in X[k] is	1	2	2	2	4

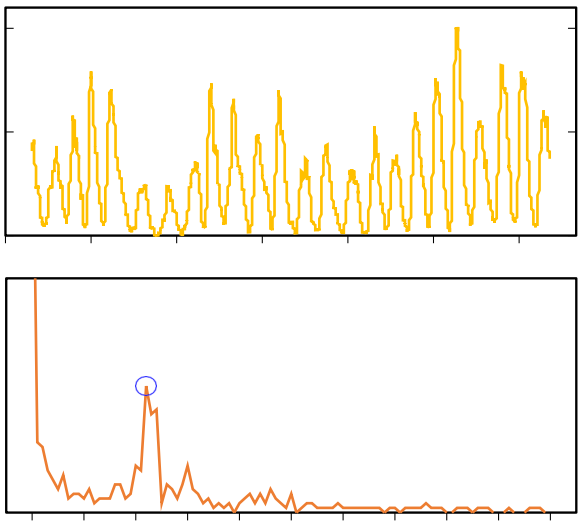
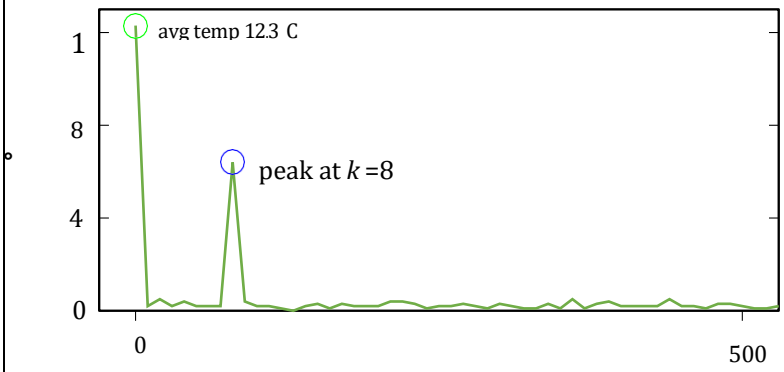
	a. $Y_3[k]=\frac{1}{64}\delta[k]$ b. $Y_3[k]=\frac{1}{32}\delta[k]$ c. $Y_3[k]=\frac{1}{32}\delta[k]+\frac{1}{32}\delta[N-k]$ d. None of the above					
9	A ring back tone is the sound you hear in your landline telephone when the remote phone you are trying to call is ringing. In most European countries, the ring back tone is a single sinusoid turned on and off periodically while in the USA, the ring back tone is the sum of 2 sinusoids with relatively close frequencies turned on and off periodically. Which analysis helps to identify two audio clips a. Frequency domain b. Short time Fourier Transform c. Time-domain Signal d. Any of the above	1	4	2	2	4
10	Listen carefully to these two samples (with earphones, if possible); each audio clip is the recording of two notes played together: • Audio clip A • Audio Clip B Select the correct options below. a. The notes are in tune in both audio clips b. The notes are in tune in audio clip B and out of tune in audio clip A **c. The notes are in tune in audio clip A and out of tune in audio clip B** d. The notes are out of tune in both audio clips	1	4	3	3	4

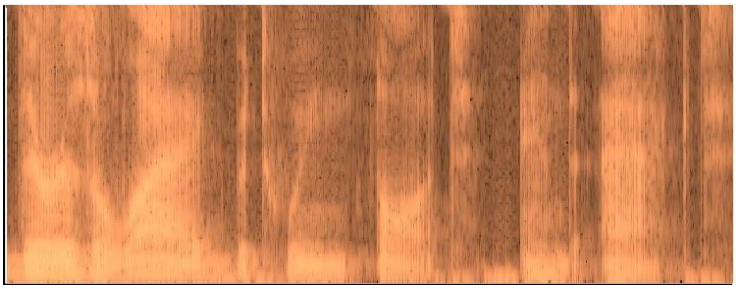
11	European and US ringback tones are composed of one or two sinusoids respectively, multiplied by a square wave switching between 00 and 11. This multiplication by a square wave periodically mutes the sinusoid(s). Look at the following magnitude DTFT plots (each plot shows the interval $[-\pi\ \pi]$)  Select the correct statement amongst the choices below. a. Spectrum (a) corresponds to the European ringback tone. b. Spectrum (a) corresponds to the US ringback tone. c. Spectrum (b) corresponds to the European ringback tone. **d. Spectrum (b) corresponds to the US ring back tone.**	1	4	3	3	4
12	Let $h[n]=\delta[n]-\delta[n-1]$ $x[n]=\begin{cases}1 & n\geq 0\\ 0 & \text{else}\end{cases}$ $y[n]=x[n]*h[n]$ Then $y[-1], y[0],]y[1], y[2]$ …..are [1 0 0 0 0 ….] This process is an example for _____ a. Low pass filter b. High pass filter c. Band pass filter d. Band stop filter	1	3	3	3	4
13	Which of the following filters are BIBO-stable? a. The following smoothing filter: $h[n]=\sum_{k=0}^{\infty}\frac{1}{k+1}\delta[n-k]$ b. The moving average: $h[n]=\frac{\delta[n]+\delta[n-1]}{2}$ c. The step function: $h[n]=u[n]$ d. Any filter h[n] with finite support and bounded coefficients.	1	1	2	2	4

14	Consider an LTI system H. When the input to H is the following signal.  and  The h[n] of LTI system is _____ **a. [1 1]** b. [1 -1] c. [-1 1] d. [1 0]	1	2	2	2	4
15	Suppose that the ROC of the sequence x[n] is $r_L < \|z\| < r_U$. Then the ROC of $x^*[-n]$ is a. $r_U < \|z\| < r_L$ b. $\frac{1}{r_U} < \|z\| < \frac{1}{r_L}$ c. $\frac{1}{r_L} < \|z\| < \frac{1}{r_U}$ d. $r_L < \|z\| < r_U$	1	2	2	2	4

16	 a. The system is a resonator b. The system is a hum removal filter c. The system is a DC notch. d. None of the above	1	4	3	4	4
17	The N-point DFT of the sequence $x[n] = \delta(n - n_0)$ where $0 < n_0 < N$ is a. 1 b. $W_N^{n_0 k}$ c. $W_N^{-n_0 k}$ d. 0	1	2	2	2	3
18	What is the one sided z-transform of x(n)=δ(n+k)? a. z^{-k} b. 0 c. z^{k} d. 1	1	2	2	2	3
19	Consider 2 real sequences $x_1[n]$ = { 1 2 3 0}, $x_2[n]$={ 1 3 2 1}. Let $X_1(K)$ and $X_2(K)$ be 4-point DFTs of $x_1[n]$ and $x_2[n]$ respectively. Another sequence $x_3[n]$ is derived by taking 4-point inverse DFT of $X_3(K)= X_1(K)\, X_2(K)$. The value of $x_3[2]$ is ---------- a. 5 b. 14 c. 11 d. 12	1	2	2	2	3
20	Number of multiplications in DIF FFT algorithms is a. $\frac{N}{2}\log_2 N$ b. $\frac{N}{2}\log_2 \frac{N}{2}$ c. N^2 d. None of the above	1	2	2	2	3
21	Identify the number of adders required to realize a 256 point radix 2 FFT using DIT algorithm. a. 2048	1	2	2	2	3

	b. 1024 c. 616 d. 65536					
22	Consider a real sequence x[n] = {2 4 6 2}. The value of y[1] if $Y(k)=X(k-2)_4$ is _____ a. -4 b. 4 c. -6 d. 6	1	2	2	2	3
23	Pole –zero plot of a filter H(z) is given in fig1. Identify the filter.  a. FIR filter **b. IIR filter** c. All pass filter d. None of the above	1	3	2	2	4
24	Identify the filtering operation in edge detection in an image a. High pass filter b. Lowpass filter c. All pass filter d. None of the above	1	4	3	3	4
25	circular convolution of sequences y(n)= {1, 1, 1, 1} and x(n) = {1, 1, 1, 1} is _____ a. {4,4,4,4} b. {1,1,1,1} c. {10,10,10,10} d. {0,0,0,0}	1	2	2	2	3

26	sunspot number: $s = 10 \times$ # of clusters + # of spots The solar spot data is collected and plotted in the first figure: (data set from 1749 to 2003, **2904** months). Second figure shows the peak at k=22. Choose the period of solar spot as per given data. a. 11 b. 12 c. 13 d. 14 	1	4	2	2	4
27	The daily temperature of a city is noted down for 2920 days and DFT is computed. The peak value occurs at 0 degrees C and 6.4°C (k=8) Choose the temperature excursion as per provided data.  a. 12.3°C ± 12.8°C b. 12.3°C ± 6.4°C c. 12.3°C ± 3.2°C d. None of the above	1	4	3	3	4

28	The diagram shown below is an example for _____.  a. Frequency domain signal b. Time domain signal c. Short time Fourier transform d. None of the above	1	4	2	2	4
29	The equation represents _____ $$\sum_{n=-N/2}^{N/2-1} \lvert x[n]\rvert^2 = \frac{1}{N} \sum_{k=-N/2}^{N/2-1} \lvert X[k]\rvert^2$$ a. DFT b. Convolution c. Energy conservation d. None of the above	1	2	2	2	3
30	Choose the correct answer when the averaging filter is applied on the image. a. Blur b. Sharpen c. Remove constant areas d. Retains as it is	1	2	2	2	3