Reg. No.											

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

III SEM B.Tech (BME) DEGREE END-SEMESTER EXAMINATIONS, MARCH 2021

SUBJECT: SIGNALS & SYSTEMS (BME 2155)

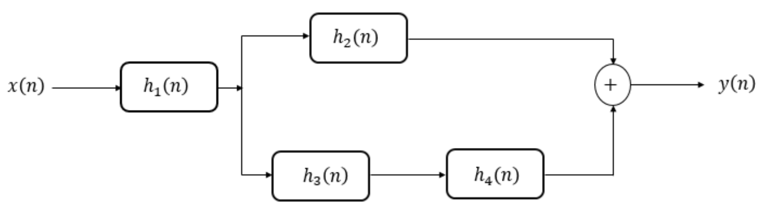
Friday, 12th March, 2021, 9 to 12 Noon

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

Instructions to Candidates:

Answer ALL questions.

1A.	(i) State the condition (based on the ROC of the system function, $H(z)$), for stability and causality of LSI systems. (ii) Find the inverse Z-transform of $X(z) = \frac{1}{1-\frac{1}{2}z^{-1}} + \frac{2}{1-2z^{-1}}$ if (a) System is causal (b) System is stable	04
1B.	Find the DTFT of the following sequences and sketch the magnitude spectrums over $-\pi \le w \le +\pi$. (a) $x(n) = \delta(6-3n)$ (b) $x(n) = u(n+1) - u(n-2)$	03
1C.	Consider a continuous-time signal, $x(t) = 12\ \cos(800\,\pi t)\ \cos^2(1800\,\pi t)$. Determine the minimum allowable sampling frequency.	03
2A.	Two LSI systems are connected in cascade. The impulse responses associated with the two systems are given as follows: $h_1(n) = \left(\frac{1}{5}\right)^n u(n)$ $h_2(n) = 2\delta(n-1) + 5\delta(n-2)$ Find the overall impulse response of the system.	04
2B.	A discrete-time signal is given by $x(n) = 2^n[u(n+1) - u(n-4)]$. Sketch each of the following versions of the signal. (a) $y_1(n) = x(-n+4)$ (b) $y_2(n) = x(-n-2)$	03

2C.	Find the Z-transform $X(z)$ and sketch the pole-zero plot with the ROC for each of the following sequences: (a) $x(n) = \left(\frac{1}{3}\right)^n u(n) + \left(\frac{1}{2}\right)^n u(-n-1)$ (b) $x(n) = \left(\frac{1}{2}\right)^n u(n) + \left(\frac{1}{3}\right)^n u(-n-1)$	03
3A.	For each, determine whether the system is linear or nonlinear, shift-invariant or shift-varying, stable or unstable and, causal or non-causal. Justify your answer. (a) $y(n) = x(n) + x(-n)$ (b) $y(n) = x^2(n)$	04
3B.	Using DTFT, evaluate the convolution, $y(n) = x(n) * h(n)$ where $x(n) = \{1, 1, 1, 1, -1, -1\}$ and $h(n) = \delta(n-2) - \delta(n-4)$.	03
3C.	(i) What is the condition for an LSI system to be (a) Causal (b) Stable? (ii) A LSI system is characterized by its unit sample response $h(n)$ given by $h(n) = \propto^n u(n)$. (a) Does this represent a causal system? (b) Is the system BIBO stable? Justify your answer.	03
4A.	Consider the interconnection of LSI systems:  Where, $h_1(n) = \delta(n) + 2\,\delta(n-2) + \delta(n-4)$ $h_2(n) = h_3(n) = (0.2)^n u(n)$ $h_4(n) = \delta(n-2)$ Calculate the overall frequency response of the system in terms of its individual frequency responses.	04
4B.	If the input to the LSI system is represented by weighted sum of time-shifted impulses, prove that the output is represented by the weighted sum of time-shifted impulse responses.	03

4C.	(i) What is the relationship between Z-transform and DTFT? (ii) What is the Z-transform of the series that has the Fourier transform $X(e^{jw}) = 1 + \cos w$? Also find $x(n)$.	03
5A.	If the input to a LSI system is $x(n) = \left(\frac{1}{2}\right)^n u(n) + 2^n\, u(-n-1)$ and the output is $y(n) = 6\left(\frac{1}{2}\right)^n u(n) - 6\left(\frac{3}{4}\right)^n u(n)$. Find the system function, $H(z)$, and determine whether or not the system is stable and/or causal.	04
5B.	Given the continuous-time signal specified by $x(t) = \begin{cases} 1 - \|t\|, & -1 \leq t \leq 1 \\ 0, & otherwise \end{cases}$ Determine the resultant discrete-time sequence obtained by uniform sampling of $x(t)$ with a sampling interval of (a) 0.25sec (b) 0.5sec (c) 1.0sec.	03
5C.	Consider a LSI system described by the difference equation, $y(n) = x(n) + x(n-1)$. (i) Determine the frequency response $H(w)$ of the system and sketch its magnitude over $-\pi \leq w \leq +\pi$. (ii) What is the impulse response $h(n)$ of the system? (iii) Identify the system.	03