Reg. No.											

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

III SEM B.Tech (BME) DEGREE END SEMESTER EXAMINATIONS, NOVEMBER 2019

SUBJECT: SIGNALS & SYSTEMS (BME 2155)

Thursday, 28th November, 2019, 8.30 AM to 11.30 AM

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

Instructions to Candidates:

Answer ALL questions.

1A. Find the Z-transform $X(z)$ and sketch the pole-zero plot with the ROC for each of the following sequences: 04

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

1B. Consider a LSI system described by the difference equation, $y(n) = x(n) - x(n-1)$. 03

(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.

1C. Consider a continuous-time signal $x(t) = cos(5\pi t) + 0.5\, cos(10\pi t)$. Determine the following: 03

(i) maximum allowable value of the sampling internal, T_s.

(ii) discrete-time sequence $x[n]$.

2A. Consider two LSI systems with impulse responses $h_1[n] = \delta[n-2]$ and $h_2[n] = \delta[n-3]$ respectively. Determine the overall impulse response $h[n]$, if the systems are connected in 04

(i) Cascade (ii) Parallel.

2B. A discrete-time signal is given by $x[n] = (6-n)(u[n] - u[n-6])$. Sketch each of the following versions of the signal. 03

(i) $x[4-n]$ (ii) $x[2n-3]$ (iii) $x[8-3n]$

2C. (i) State the condition (based on the ROC of the system function, $H(z)$), for stability and causality of LSI systems. 03

(ii) Check for causality and stability of the LSI system defined by the unit sample response $h[n] = \alpha^n u[n]$, using the above condition.

3A. Is the discrete-time system defined by $y[n] = x^2[n] + n\,x[n-1]$ a Linear and Shift-invariant system? Justify. 04

3B. Explain the relationship between DTFT and DFT. 03

3C. What is the condition for an LSI system to be (a) Causal (b) Stable? 03

Investigate the causality and stability of the following LSI systems. Justify your answer.

(i) $h[n] = 5\delta[n-2]$ (ii) $h[n] = u[n+2] + u[n-1] - 2u[n-3]$

4A. Consider a causal discrete-time FIR filter described by the impulse response, 04

$h(n) = \{2, 2, -2, -2\}$.

(i) Determine the frequency response $H(w)$ of the filter and sketch its magnitude over $-\pi \leq w \leq +\pi$.

(ii) Identify the filter.

4B. Prove the following: 03

(i) $x(n) * \delta(n) = x(n)$ (ii) $x(n) * \delta(n - n_0) = x(n - n_0)$

4C. (i) What is the relationship between Z-transform and DTFT? 03

(ii) Determine the Z-transform of the signal, $x(n) = 0.5\delta(n+1) + \delta(n) + 0.5\delta(n-1)$.

(iii) Using Z-transform, determine the DTFT of $x(n)$.

5A. A stable and causal system is described by the difference equation, 04

$y(n) + \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = -2x(n) + \frac{5}{4}x(n-1)$. Determine the impulse response of the system.

5B. A discrete-time system is both Linear & Shift-invariant. Suppose the output due to an input $x[n] = \delta[n]$ is given by $y[n] = \{1, -1, 1\}$. Determine the outputs due to the following inputs: 03

(i) $x[n] = \delta[n-1]$ (ii) $x[n] = 2\delta[n] - \delta[n-2]$

5C. Using DTFT, evaluate the convolution, $y(n) = x(n) * h(n)$ where 03

$x(n) = \{1, 1, 1, 1, -1, -1\}$ and $h(n) = \delta(n-2) - \delta(n-4)$.