BANGLADESH UNIVERSITY OF BUSINESS AND TECHNOLOGY (BUBT)
Faculty of Engineering and Applied Sciences
Department of Electrical and Electronic Engineering
Program: B.Sc. in EEE
EEE 313: Digital Signal Processing I
(Section: 1 & 2; Shift: Day; Intake: 25, 26)

Final Exam **Fall 2021-22** **Total Marks: 40** **Time: 2 hrs.**

Course Instructor: Sk. Hasibul Alam

Instructions:
- Answer all questions. Q1 includes five short questions in total with 2 marks each.
- The marks on the right-hand side in square brackets indicate marks for that question only.

CO2: Perform z-Transform and Fourier transform to analyze signals and systems. [PO2]

Q1. **(a)** Determine the z-transform of $x[n] = 6\delta[n-9]$. **[2]**

(b) A 3rd-order anti-causal LTI system has all its poles outside unit circle on z-plane. Find its stability. **[2]**

(c) Determine the DTFT of $x[n] = 2\delta[n-3]$. **[2]**

(d) Determine the z-transform of $x[n] = (-11)^n u[n]$. **[2]**

(e) A causal LTI system is described by the following LCCDE. Determine its system function. **[2]**

$$y[n] - 0.5y[n-1] = x[n]$$

Q2. **(a)** Determine the 4-point DFT of $x[n] = [\underline{5} \quad -6 \quad 7 \quad -8]$. **[5]**

(b) Determine whether the z-transform exists for $x[n] = -(-8)^n u[-n-1] - (-4)^n u[n]$. If it exists, find it and draw its ROC on z-plane. If it doesn't exist, justify your reason. **[5]**

Q3. Determine the inverse z-transform for the following. Assume, $x[n]$ is anti-causal. **[10]**

$$X(z) = \frac{1}{(1+3z^{-1})(1+4z^{-1})^2}$$

CO3: Design Finite Impulse Response and Infinite Impulse Response filters to meet expected system specifications. [PO2]

Q4. **(a)** A causal LTI system is characterized by the following system function. Determine the system's impulse response and stability. **[5]**

$$H(z) = \frac{1}{1 - 1.3z^{-1} + 0.4z^{-2}}$$

(b) Draw the block diagram of a single pole IIR HPF. Assume, the -3 dB cutoff frequency is 0.05, expressed as fraction of the sampling rate. **[5]**

BANGLADESH UNIVERSITY OF BUSINESS AND TECHNOLOGY (BUBT)
Faculty of Engineering and Applied Sciences
Department of Electrical and Electronic Engineering
Program: B.Sc. in EEE
EEE 313: Digital Signal Processing I
(Section: 1; Shift: Evening; Intake: 24)

Final Exam **Summer 2021** **Total Marks: 40** **Time: 3 hrs.**

Course Instructor: Sk. Hasibul Alam

Instructions:
- Answer all questions. Q1 includes 5 (five) short questions in total with two marks each.
- The marks on the right-hand side in square brackets indicate marks for that question only.
- Attach your answer script in PDF format in Google Classroom.
- Do not forget to rename your PDF file as: **ID**.pdf
  (Example: 16173208999.pdf)
- Upload the answer script in portrait orientation.

CO2: Perform z-transform and Fourier transform to analyze signals and systems. [PO2]

Q1. **(a)** A causal LTI system has only a single real pole on z-plane at $(a+1) \times 0.18$, where 'a' is the last digit of your student ID. Find its BIBO stability. **[2]**

(b) Find the z-transform of $x[n] = [9 \quad a \quad b \quad 7 \quad \underline{-7}]$, where '$a$' to '$b$' are the last two digits of your student ID. **[2]**

(c) Find the ROC of $x[n] = -n(a+4)^n u[-n-1]$, where 'a' is the last digit of your student ID. **[2]**

(d) Find the z-transform of $x[n] = 5\delta[n-a-5]$, where 'a' is the last digit of your student ID. **[2]**

(e) The z-transform of $x[n]$ has ROC: $7 < |z| < 12$. Find the ROC for z-transform of $(a+1)^n x[n]$, where 'a' is the last digit of your student ID. **[2]**

Q2. **(a)** A causal LTI system is described by the following LCCDE. Find the input signal that will cancel the closest pole to the origin. Also find the system response for that input. Here, 'a' is the last digit of your student ID. **[5]**

$$y[n] = -10y[n-1] - (a+14)y[n-2] + x[n]$$

(b) An LTI system is characterized by the following system function, where 'a' is the last digit of your student ID. If the system is known to be stable, find its impulse response. **[5]**

$$H(z) = \frac{2}{1 - 10z^{-1} + (a+10)z^{-2}}$$

(c) A military relay station is transmitting $x[n]$, but the receiver in an intended aircraft-carrier is receiving $x[n] - 7x[n-1] + (a+3)x[n-2]$ due to radar jamming by an enemy aircraft. Here, 'a' is the last digit of your student ID. Design a subsystem just before the receiver that can recover actual signal from the distorted version. **[5]**

(d) Find the 5-point DFT of $x[n] = [\underline{7} \quad a \quad b \quad 5]$, where '$a$' to '$b$' are the last two digits of your student ID, respectively. **[5]**

CO3: Design Finite Impulse Response and Infinite Impulse Response filters to meet expected system specifications. [PO2]

Q3. **(a)** Design an FIR LPF using Kaiser window according to the following specifications. Here, 'a' to 'b' are the last two digits of your student ID. **[5]**

$$(0.97 - a \times 0.01) \leq \left|H\left(e^{j\omega}\right)\right| \leq (1.03 + a \times 0.01) \quad \text{for} \quad 0 \leq |\omega| \leq \left((b+1) \times 0.05\right)\pi$$

$$\left|H\left(e^{j\omega}\right)\right| \leq 0.04 \quad \text{for} \quad 0.6\pi \leq |\omega| \leq \pi$$

(b) Draw the block diagram of a single-pole IIR LPF if the −3 dB cutoff frequency is $\left((a+5) \times 0.02\right)$. Here, '$a$' is the last digit of your student ID. **[5]**