Online Midterm Examination – EE092IU

DSP-Paper No.1; Date: April 25th, 2020

Duration: 90 minutes (9am-10:30am)

SUBJECT: DIGITAL SIGNAL PROCESSING – EE092IU	
Dean of School of Electrical Electronics Engineering Signature: Full name:	Lecturer: Prof. Dr. Thuong Le-Tien (Cell : 0903 787 989) Signature:  Full name: THUONG LE-TIEN

INSTRUCTION:

- **Any of notes is allowed in the exam**
- **Student should correctly pick up the instructed exam paper**
- **Student's scanned exam-papers should be submitted no later than 10:40am (the system will be locked after this deadline!)**
- **Answer 4 of 5 questions**

Question 1: (25marks)

A continuous time filter has a impulse response function $h_a(t)=e^{-t}u(t)$. If $h_a(t)$ is sampled to form a discrete time system with a unit sample response $h(n)=h_a(nT_s)$. Find the value for T_s so that $H(e^{j\omega})$ at $\omega=\pi/2$ is down 6dB from its maximum value at $\omega=0$, that is,

$$20log\left(\frac{|H(\pi/2)|}{|H(0)|}\right) = 6$$

Given the Discrete Time Fourier Transform (DTFT) of h(n) as follows

$$H(\omega) = \sum_{-\infty}^{+\infty} h_a(nT_s)e^{-j\omega n}$$

Question 2: (25marks)

Consider the LTI system initially at rest and described by the difference equation: $y(n) + 2y(n-1) = x(n) + 2x(n-2)$

a. Find the impulse response of the system
b. Find the response y(n) of this system to the input x(n)={1,2,3,2,2,1} with n=[-2, 3]
c. Realize this LTI system by using the basic block elements.

Question 3: (25marks)

Assuming a DSP system with a sampling time interval of 125msec,

a. Convert the following analog signals x(t) to the digital signal x(n)
   $x(t) = 10 \sin(2000\pi t)\, u(t)$
b. Determine and plot the sample values from the obtained digital function

Question 4: (25marks)

A causal discrete time LTI system is described by

$$y(n) - \frac{3}{4} y(n-1) + \frac{1}{8} y(n-2) = x(n)$$

Where x(n) and y(n) are the input and output of the system, respectively

a. Determine the frequency response H(ω) of the system,
b. Find the impulse response h(n) of the system
c. Realize the block diagram of the system.

Hint: Use the delay property of the Fourier Transform and H(ω)=Y(ω)/X(ω)

Question 5: (25 Marks)

Consider a 4-bit successive approximation AD converter with full scale range of 5volts. Using the rounding technique, determine the 4-bit codes of the voltage values x = 2.3; -1.4; 0.76; -0.4; 2.19; -0.91 volts, for the following types of converters:

a. Write the code table for converting the samples of full scale range of 5 volts with the natural binary, the offset and the two's complement codes.
b. Write a table for converting the values of x into the Natural binary codes, the offset and the two's complement codes.

Good lucks!