B.Sc. Engg. CSE 6th Semester

13 August 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION **SUMMER SEMESTER, 2017-2018**

DURATION: 1 Hour 30 Minutes **FULL MARKS: 75**

CSE 4631: Digital Signal Processing

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

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1. a) Why is DSP important? Evaluate the necessity of DSP in *Echo Location.* 7

   b) Classify the following signals according to whether they are (1) one- or multi-dimensional, (2) single or multichannel, and (3) analog or digital. 6

      i. Position of the steering wheel of a car in motion relative to the car's reference frame.

      ii. Goals scored by the strikers of Real Madrid and Manchester City in FIFA world cup 2018.

   c) A digital communication link carries binary-coded words representing samples of an input signal 12

$$x_a(t) = \sin 2\pi t + 3\cos 200\pi t + 15\sin 5000\pi t + 11\cos 10000\pi t$$

   This link is operated at 500 bits/s and each input sample is quantized into 1024 different voltage level.

      i. What are the sampling frequency and folding frequency?

      ii. What is the Nyquist rate for the signal $x_a(t)$?

      iii. What is the discrete-time signal $x_d[n]$ obtained after sampling?

      iv. What is the analog signal $y_a(t)$ that we can reconstruct from the samples if we use ideal interpolation?

      v. What is the resolution Δ?

2. a) Why is *Shift invariance* important for DSP though it is not a necessity for linear system? 5

   b) Why is decomposition important? Determine and sketch the even and odd parts of the signal depicted below: 3+4

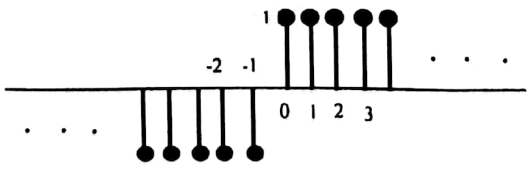

Figure 1: Signal

   c) Find the output of the following operations: 6

      i. $x[n] * \delta[n+6]$

      ii. $x[n] * 5\delta[n]$

      iii. $x[n-3] * 7\delta[n+5]$

   d) From calculus, you know that the derivative and integral are inverse operations; one undoes the effect of the other. Prove that the first difference and the running sum are also inverse operations. That is, show that the cascade of these two systems is identical to the delta function. 7

3. a) There are many annoying nuisances associated with using polar notation. What are those? What possible solution can be used? 15

b) Two signals, x(n) and h(n), are defined as follows: 7+3

x(n): 2, 1, 2, 3, 2, 1,-1,-2,-1, 0, 2, 3, 3, 2, 4, 1 (samples -2 to 13)

h(n): 3, 2, 1,-3,-2,1 (samples -3 to 2)

If y(n) = x(n)*h(n),

i. Use the input side convolution algorithm to determine the value of y(12)

ii. Use the output side convolution algorithm to determine the value of y(8)

4. a) Define basis function. Why is it easier to understand the frequency domain in polar notation? 2+6

b) Suppose, samples from 0 to 32 of the signal $x_d[n]$ of Question 1(c) produces **X[n]** as output of DFT. The horizontal axis of **X[n]** can be referred to in four different ways. 12

i. Draw the horizontal axis of **X[n]** showing four notations.

ii. Explain which notation is the most important one.

c) What are the strategies of making the nonlinear system resemble a linear system? 5