9th June 2020

# Signals and Systems for Computer Engineering

Important: Read the explanations at the end of questions before you start

1- A continuous time signal x(t) is given as $x(t)=10\cdot\sin(314t+\pi/3)$ . If we periodically sample this signal @$T_s$=5ms time intervals and denote the sampled sequence as x[n] where n=0,1,2,… then 402nd sample value will be,

x[402]=

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2- Find the 4-points DFT (Discrete Fourier Transform) of the sampled signal x[n] in question 1. If x[n]={x[0], x[1], x[2], x[3]} then its DFT X[k]=DFT{x[n]} can be given as,

X[k]={ }

where, $\mathbf{W}_N = \begin{bmatrix} 1 & 1 & 1 & \cdots & 1 \\ 1 & W_N & W_N^2 & \cdots & W_N^{N-1} \\ 1 & W_N^2 & W_N^4 & \cdots & W_N^{2(N-1)} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & W_N^{N-1} & W_N^{2(N-1)} & \cdots & W_N^{(N-1)(N-1)} \end{bmatrix}$ and $W_N = e^{-j(2\pi/N)}$

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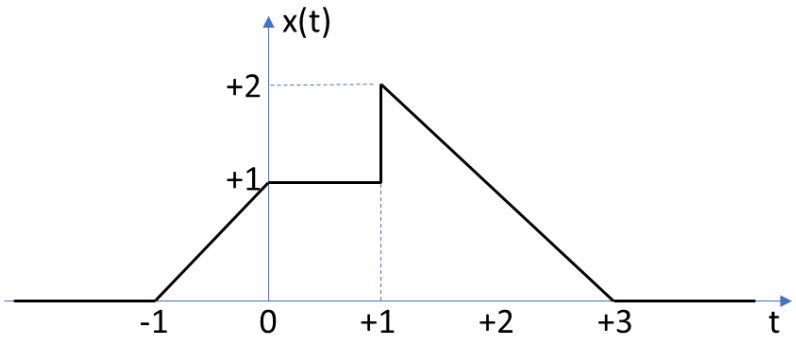
3- Continuous time signal x(t) is shown in the figure below.




x(t) can mathematically be expressed as,

x(t)=

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4- Two discrete time signals x[n] and h[n] are given as x[n] = {1, 3, 1} h[n] = {0, 2, 1} for n=0,1,2 respectively and they are zero for all other n values. If y[n] is the convolution of x[n] and h[n] ( y[n]=x[n]*h[n] ) then the sequence of y[n] is given as

y[n]={ }

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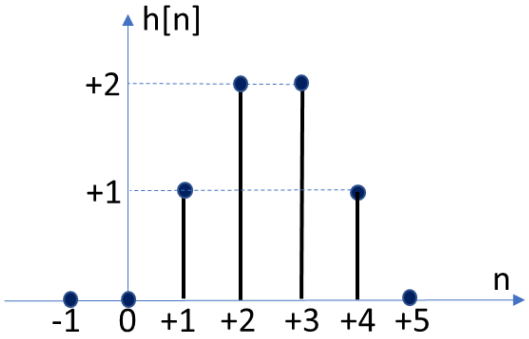
5- Impulse response h[n] of a system is given below. Find the output sequence y[n] of this system (for n≥0) if x[n]=2(u[n]-u[n-3]) is applied to its input.




y[n]={ }

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6- Transfer function of a discrete time system H(z) is given as $H(z) = \frac{Y(z)}{X(z)} = \frac{2z^{-1}}{(1-0.5z^{-1})^2}$

where $z^{-1}$ denotes the unit delay. If a unit step signal x[n]=u[n] is applied to this system then the first 4 values of the output signal sequence y[n]={y[0], y[1], y[2], y[3]) would be,

y[0]= , y[1]= , y[2]= , y[3]=

(initial condition can be considered as zero)

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7- Write the pseudo code that performs H(z) in question 6 if the input signal is periodically sampled at $T_s$

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Timer Interrupt @Ts:
X = Read (ADC)



Return
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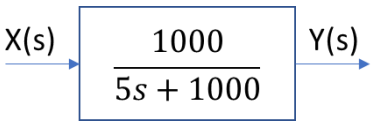
8- If a transfer function of a 1st order low pass filter H(s) is given as




then the cut off frequency $f_c$ of $H(j\omega)$ is,

$f_c$= [Hz]

(where s=jω)

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9- If the continuous time signal x(t)=10sin(400πt) is applied to the low pass filter system described in question 8 then the output signal y(t) can be expressed as,

y(t)=

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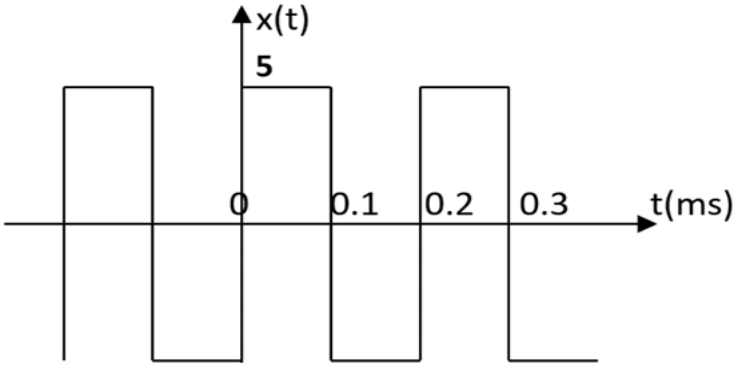
10- A continuous time periodic signal x(t) is given in the figure shown below




Write the first two non-zero component of Fourier transform of x(t)

x(t)=

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11- The input-output relationship of a discrete time system is given by the difference equation $y[n]=x[n-2]+2a\cdot y[n-1]-a^2\cdot y[n-2]$ . Find the value interval of "a" that makes this system BIBO stable.

(where x and y denotes input and the output respectively)

<a<

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12- Find the fundamental period of the signal $x(t) = \cos\left(\frac{14\pi}{3}t\right) + \sin\left(\frac{5\pi}{4}t\right)$

$T_0$=

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**a) Fill in the blanks on first 2 pages of your answers as shown in following sample answers pages.**
**b) Duration: 120minutes**
**c) points per question is 100/12.**
**d) Show the calculations for each question in a separate part after results.**
**e) Use page numbers as "page #1" at the top of answers pages.**
**f) Don't forget to sign each of the answers pages.**
**g) If you're not able to upload the question pages as pdf or image file then you may list the answers in separate box in the first page of your answers.**
**h) You may totally rewrite results part and fill in the blanks. Given answers pages are <u>"sample"</u>**
**(Results part of the answers pages is separate from the questions because some students may not be able to sign, scan and upload the question pages.)**

Name-Surname:
Student No:
Signature:

**Answers – Page #1:**

**Results Part:**

(Fill in the blanks)

1- x[402]=

2- X[k]={ }

3- x(t)=

4- y[n]={ }

5- y[n]={ }

6- y[0]= , y[1]= , y[2]= , y[3]=

7- Timer Interrupt @Ts:
X = Read (ADC)

Return

Name-Surname:
Student No:
Signature:

**Answers – Page #2:**

8- $f_c$= [Hz]

9- y(t)=

10- x(t)=

11- <a<

12- $T_0$=

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**Calculations Part:**

1- ….

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2-