Philadelphia University

Faculty of Engineering

Student Name:
Student Number:
Serial Number:

Second Exam, Firs Semester: 2019/2020
Dept. of Communication & Electronics Engineering

Course Title:	Signals and Systems	**Date:**	07/01/2020
Course No:	650320+640543	**Time Allowed:**	50 minutes
Lecturer:	Dr. Qadri Hamarsheh	**No. Of Pages:**	4

Instructions:

- **ALLOWED**: pens, calculators and drawing tools (**no red color**).
- **NOT ALLOWED**: Papers, literatures and any handouts. Otherwise, it will lead to the non-approval of your examination.
- **Shut down** Telephones, and other communication devices**.**

Please note:

- *This exam paper contains 4 questions totaling 20 marks +2 Bonus*

Basic Notions*: The aim of the questions in this part is to evaluate the required minimal student knowledge and skills. Answers in the pass category represent the minimum understanding of basic concepts: Mathematical Models of LTI continuous and discrete systems, Convolution and their computation methods and representations; Fourier series representations.*

Question 1 **Multiple choices (circle the most appropriate one):** ***(5 marks)***

1) For a discrete LTI system, the **system response** can be written in terms of convolution as

a)	$y[n]=h[n]*x[n]=\sum_{k=-\infty}^{\infty}h[k]x[k]$
b)	$y[n]=h[n]*x[n]=\sum_{k=-\infty}^{\infty}h[n+k]x[n-k]$
c)	$y[n]=h[n]*x[n]=\sum_{k=-\infty}^{\infty}h[k]x[n-k]$
d)	$y[n]=h[n]*x[n]=\sum_{k=-\infty}^{\infty}h[k]x[n+k]$

2) If $\boldsymbol{h1}, \boldsymbol{h2}$ and $\boldsymbol{h3}$ are cascaded (**series connection**), and $\boldsymbol{h1} = \boldsymbol{u(t)}$, $\boldsymbol{h2} = \boldsymbol{exp(t)}$ and $\boldsymbol{h3} = \boldsymbol{sin(t)}$, find the **overall impulse response**

- **a)** $\boldsymbol{sin(t) * exp(t) * u(t)}$
- **b)** $\boldsymbol{sin(t) + exp(t) + u(t)}$
- **c)** $\boldsymbol{u(t) * sin(t)}$
- **d)** **all of the mentioned**

3) The linear time-invariant system with $h(t)=4e^{-2t}u(t)$

- **a)** **Stable, causal, and memeoryless**
- **b)** **Stable, but not causal**
- **c)** **Stable, causal, but has memory**
- **d)** **Not stable**

4) What is the equation $\mathbf{x(t)} = \sum_{\mathbf{k}=-\infty}^{\infty} \mathbf{D_k e^{jk\omega t}}$ called?

- **a)** **Analysis equation**
- **b)** **Synthesis equation**
- **c)** **Frequency domain equation**
- **d)** **Discrete equation**

5) Choose the condition from below that is **not** a part of **Dirichlet's conditions**

a)	**If it is continuous then there are a finite number of discontinuities in the period T**
b)	**It has a finite number of positive and negative maxima in the period T**
c)	**It has a finite average value over the period T**
d)	**It is a periodic signal**

***Familiar and unfamiliar Problems Solving**: The aim of the questions in this part is to evaluate that the student has some basic knowledge of the key aspects of the lecture material and can attempt to solve familiar and unfamiliar problems of Mathematical Models of LTI continuous and discrete systems, Convolution and their computation methods and representations; Fourier Series representations.*

Question 2 ***(6 marks)***

a) For each impulse response listed below, determine whether the corresponding system is memoryless, causal, and stable. ***(3 marks)***

1) $\boldsymbol{h[n] = cos(\frac{\pi}{8} n)\{u[n] - u[n - 10]\}}$
2) $\boldsymbol{h(t) = e^{-2t} u(t - 1)}$

Solution

b) Given the following two rectangular sequences, ***(3 marks)***

$$x[n] = \begin{cases} 1 & n = 0,1,2 \\ 0 & otherwise \end{cases}$$

And

$$h[n] = \begin{cases} 0 & n = 0 \\ 1 & n = 1,2 \\ 0 & otherwise \end{cases}$$

Find the convolution sum of these two sequences using the "**Array Method**"

Solution

Question 3 ***(8 marks)***

a) Determine the Fourier's Series representation (**Exponential Fourier series**) for the following signal. ***(2 marks) Bonus***

$$\boxed{x(t) = \cos(2\pi t) + 4\sin(6\pi t)}$$

Solution

b) Determine the **trigonometric Fourier series coefficients** for the signal $f(x)$ given as ***(6 marks)***

$$\boxed{f(x) = x - x^2 \text{ in } -\pi \le x \le \pi}$$

Solution

Question 4 **(3 marks)**

Consider the following two **DT** sequences $\boldsymbol{x}[\boldsymbol{k}]$ and $\boldsymbol{h}[\boldsymbol{k}]$ specified in

$$x[k] = \begin{cases} -1 & k = -1 \\ 1 & k = 0 \\ 2 & k = 1 \\ 0 & \text{otherwise} \end{cases} \quad \text{and} \quad h[k] = \begin{cases} 3 & k = -1, 2 \\ 1 & k = 0 \\ -2 & k = 1, 3 \\ 0 & \text{otherwise.} \end{cases}$$

Compute the convolution $\boldsymbol{y}[\boldsymbol{k}] = \boldsymbol{x}[\boldsymbol{k}] * \boldsymbol{h}[\boldsymbol{k}]$ using **MATLAB**.

Solution

GOOD LUCK