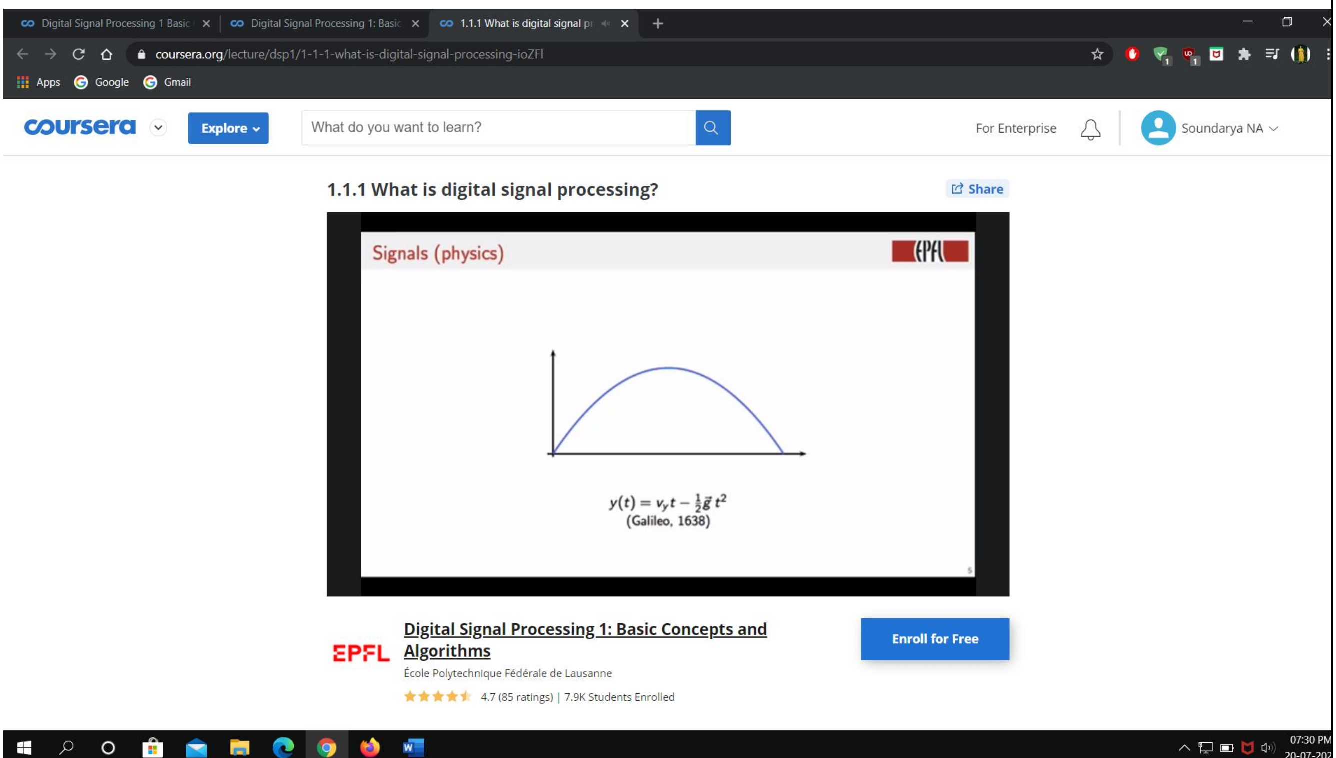
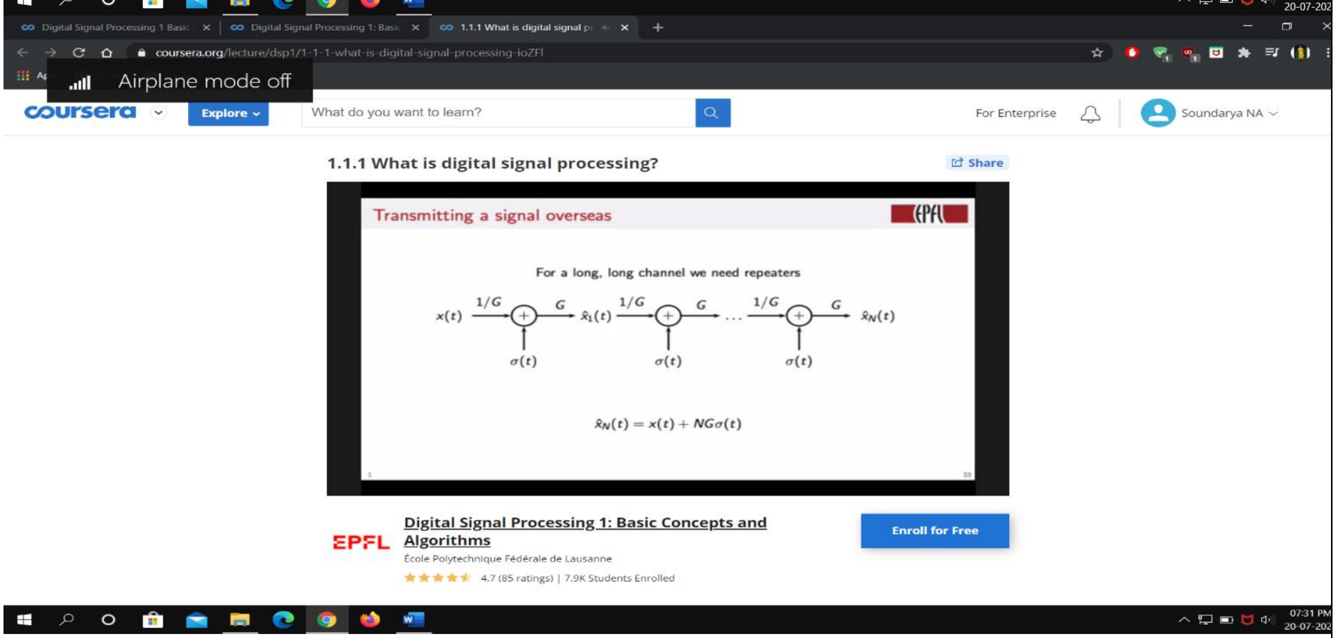
DAILY ASSESSMENT FORMAT

Date:	20th July 2020	**Name:**	Soundarya NA
Course:	Coursera	**USN:**	4AL16EC077
Topic:	Digital Signal Processing	**Semester & Section:**	8th - B

Image of session





Report:

Introduction to fourier series and fourier transform:

Fourier series:

Fourier series expansion or harmonic analysis extracts appropriately weighted harmonic components from a general periodic waveform. Any function f(x), which is periodic between $-\pi$ and $+\pi$(or L to + L) can be expanded in this interval by a Fourier series. The Fourier series expansion of the function f(x) is defined by

$f(x) = \sum_{n=0}^{\infty} c(n)\, e^{in\pi x/L}$

Fourier transform:

The concept of Fourier series is quite useful for introducing the concept of harmonic analysis, and the concept of the discrete Fourier transform to be discussed later. Next, the standard concepts of the Fourier transform are introduced.

$c(k) = \frac{1}{c} \int_{-\infty}^{+\infty} f(x) e^{ikx} dk$

The Fourier series synthesis equation creates a continuous periodic signal with a fundamental frequency, f, by adding scaled cosine and sine waves with frequencies: f, 2f, 3f, 4f, etc. The amplitudes of the cosine waves are held in the variables: a1, a2, a3, a3, etc., while the amplitudes of the sine waves are held in: b1, b2, b3, b4, and so on. In other words, the "a" and "b" coefficients are the real and imaginary parts of the frequency spectrum, respectively. In addition, the coefficient a0 is used to hold the DC value of the time domain waveform. This can be viewed as the amplitude of a cosine wave with zero frequency (a constant value). Sometimes is grouped with the other "a" coefficients, but it is often handled separately because it requires special calculations. There is no b0 coefficient since a sine wave of zero frequency has a constant value of zero, and would be quite useless.

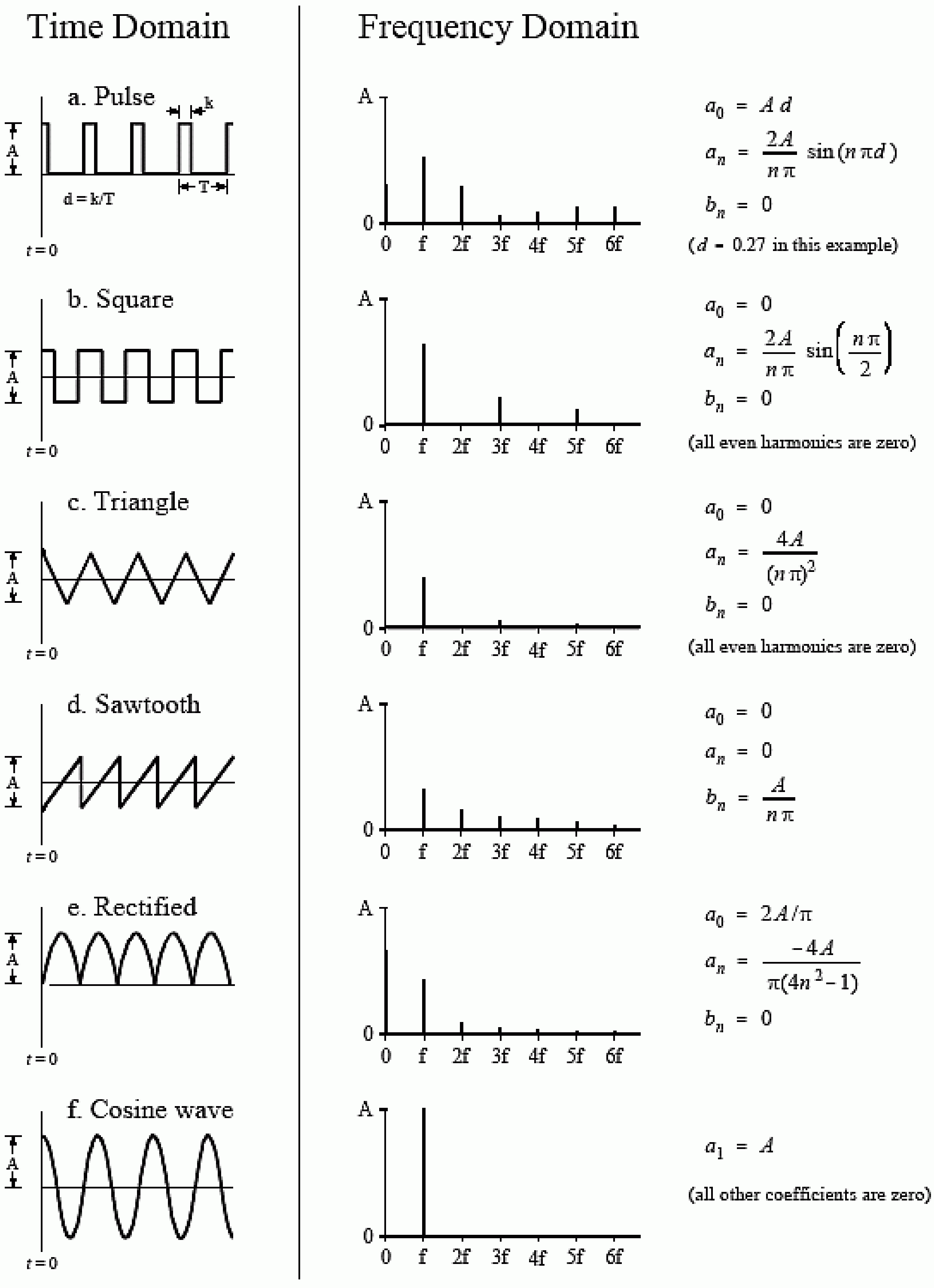


FIGURE 13-10
Examples of the Fourier series. Six common time domain waveforms are shown, along with the equations to calculate their "a" and "b" coefficients.

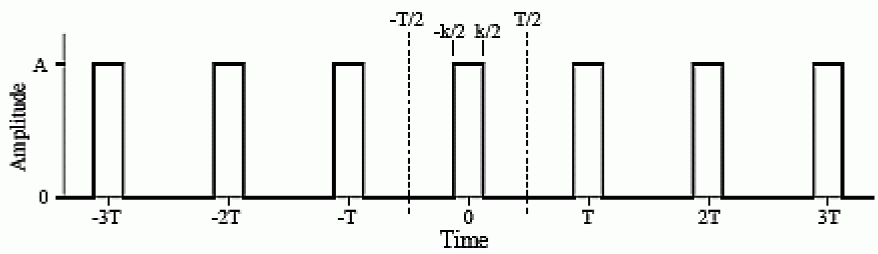


FIGURE 13-11
Example of calculating a Fourier series. This is a pulse train with a duty cycle of $d = k/T$. The Fourier series coefficients are calculated by correlating the waveform with cosine and sine waves over any full period. In this example, the period from $-T/2$ to $T/2$ is used.

Hilbert Transform:

The Hilbert transform of u can be thought of as the convolution of u(t) with the function h(t) = 1/(πt), known as the Cauchy kernel. Because h(t) is not integrable, the integral defining the convolution does not always converge. Instead, the Hilbert transform is defined using the Cauchy principal value (denoted here by p.v.). Explicitly, the Hilbert transform of a function (or signal) u(t) is given by

$$H(u)(t) = \frac{1}{\pi}\ \text{p.v.}\int_{-\infty}^{+\infty} \frac{u(\tau)}{t-\tau}\, d\tau,$$

Fourier series using Python:

```
import numpy as np
import matplotlib.pyplot as plt
resolution = 0.0001
 x = np.arange(-np.pi,np.pi,resolution)# -pi to pi with the interval of 0.0001
 square = np.array(x)
square[range(x.size)] = 0
square[range(int(x.size/2))] = 1
square[range(int(x.size/2), int(x.size))]= 0
 np.trapz(square,x) # integration of f(x)
a0 = (np.trapz(square,x))/ np.pi # dividing by pi which is present out side the integration
 n=1
harm = np.sin(n*x)
mult1 = square*harm
 fund = np.trapz(mult1,x)
 np.trapz(mult1,x)
```

```
b1 = (np.trapz(mult1,x))/np.pi
n=3
harm = np.sin(n*x)
mult2 = square*harm
third = np.trapz(mult2,x)
np.trapz(mult2,x)
b3 = (np.trapz(mult2,x))/np.pi
20*np.log10(abs(third/fund))
plt.subplot(311)
plt.plot(x,square)
plt.xlabel('(x)')
plt.ylabel('f(x)')
plt.title('SIGNAL', fontsize=18)
plt.subplot(312)
plt.plot(x,mult1)
plt.plot(x,square)
plt.xlabel('(x)')
plt.ylabel('sin(1*x)*f(x)')
plt.subplot(313)
plt.plot(x,mult2)
plt.plot(x,square)
plt.xlabel('(x)')
plt.ylabel('sin(3*x)*f(x)')
plt.show()
```