

**Electrical and Computer Engineering Department
University of Puerto Rico at Mayagüez**



**COMMUNICATION THEORY I
MATLAB CLASSWORK 02
DTMF Time-Sampled Signal Generation**

For

Prof. Domingo Antonio Rodríguez
Electrical and Computer Engineering Department
University of Puerto Rico at Mayagüez
domingo.rodriguez1@upr.edu

<Date>

MCW01 – Due: Friday, Oct. 08, before 11:50 PM
DTMF Time-Sampled Signal Generation

The objective of this MATLAB based homework is the generation of **DTMF** time-sampled signals consisting of a sequence of ten pulses, each pulse of duration equal to one second. A pulse consists of an “**ON**” or active section, when the signal is being transmitted, and an “**OFF**” or inactive section, when the signal is turned off or set equal to zero.

The pulse time period, T_p , of the **ON**, T_{on} , plus the **OFF**, T_{off} , sections of each pulse has a total duration of one second. Thus, the generated signal has a total duration of ten seconds. All pulses in a generated sequence have the same duty cycle, $C_D = T_{on}/T_p$, which is the ratio of the time the signal is **ON** over the full period of a pulse (**1 sec.**).

Fig. 01 is a depiction of a DTMF signal which was generated using the attached **m-script** file “s000g00dc12dtmf” provided below. See **first line of the m-script file** for the name of the file. This **Fig. 01** has a duty cycle equal to $C_D = 1/2$. **Fig. 02** is a depiction of a DTMF signal which was generated using the attached **m-script** file “s000g00dc38dtmf” provided below. See **first line of the m-script file** for the name of the file. This **Fig. 02** has a duty cycle equal $C_D = 3/8$.

Notice that in this last **Fig. 02**, the duty cycle is obtained by dividing the number of samples of the **ON**, T_{on} , section, which in this case is equal to **3072**, by the number of samples of the pulse time period, T_p , which is equal to **8192**. Remember that, for every DTMF word or tonal sequence generation, the number of samples of the **ON**, T_{on} , section, plus the number of samples of the **OFF**, T_{off} , section must equal the number of samples of the pulse time period, T_p , which is always equal to **8192** samples. Remember also that to calculate the time duration of any of the sections (“**ON**”, “**OFF**”) it is necessary to multiply the number of samples of the section by the sampling time; for instance, $T_{on} = \#samples * T_s$.

Tasks to Perform

Task 01.- (10 points): Proceed to create an m-script files to generate tonal sequences similar to the one generated in **Figures 1 & 2**, but with duty cycles **one-eighth**.

Task 02.- (10 points): Proceed to create an m-script files to generate tonal sequences similar to the one generated in **Figures 1 & 2**, but with duty cycles **one-eighth**, this time using your own [DTMF symbol sequence](#).

Task 03.- (10 points): Proceed to create m-script files to generate tonal sequences similar to the ones generated in **Figures 1 & 2**, but with duty cycles **one-quarter**.

Task 04.- (10 points): Proceed to create m-script files to generate tonal sequences similar to the one generated in **Figures 1 & 2**, but with duty cycles **one-quarter**, this time using your own [DTMF symbol sequence](#).

Task 05.- (15 points): Proceed to create m-script files to generate tonal sequences similar to the one generated in **Figures 1 & 2**, but with duty cycles **three-quarters**.

Task 06.- (15 points): Proceed to create an m-script files to generate tonal sequences similar to the one generated in **Figures 1 & 2**, but with duty cycles **three-quarters**, this time using your own [DTMF symbol sequence](#).

Task 07.- (15 points): Proceed to create m-script files to generate tonal sequences similar to the one generated in **Figures 1 & 2**, but with duty cycles **seven-eighths**.

Task 08.- (15 points): Proceed to create m-script files to generate tonal sequences similar to the one generated in **Figures 1 & 2**, but with duty cycles **seven-eighths**, this time using your own [DTMF symbol sequence](#).

```

%s000g00dc12dtmf
clear all
close all
Fs=8192;
Ts=1/Fs;
%V=10;           %Time Transmission window (TW)
t=0:Ts:(81920*Ts)-Ts; %Time axis for TW
tt=0:Ts:4096*Ts-Ts; %Pulse time tone "ON" width
tz=0:Ts:4096*Ts-Ts; %Pulse time zero "OFF" width
s1=cos(2*pi*697*tt)+cos(2*pi*1209*tt);
s3=cos(2*pi*697*tt)+cos(2*pi*1477*tt);
s8=cos(2*pi*852*tt)+cos(2*pi*1336*tt);
s0=cos(2*pi*941*tt)+cos(2*pi*1336*tt);
sz=0*tz; %Pulse signal segment "OFF"
s=[s1 sz s3 sz s8 sz s8 sz s3 sz s3 sz s1 sz s0 sz s0 sz s1 sz];
plot(t,s)
axis([0 max(t) -max(abs(s)) max(abs(s))])
xlabel('Time in Seconds')
ylabel('Amplitude')
title('DTFM Message or Word of Order or Length L=10 and Duty Cycle=1/2')
sound(s,Fs)

```

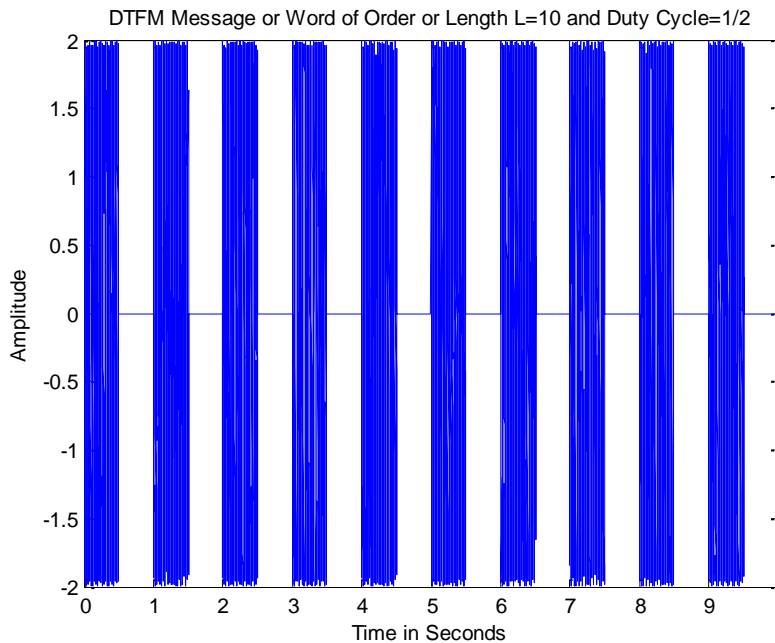


Fig. 01: DTMF Signal Generation with Duty Cycle=1/2

```

%s000g00dc38dtmf
clear all
close all
Fs=8192;
Ts=1/Fs;
%V=10;           %Time Transmission window (TW)
t=0:Ts:(81920*Ts)-Ts; %Time axis for TW
tt=0:Ts:3072*Ts-Ts; %Pulse time tone "ON" width
tz=0:Ts:5120*Ts-Ts; %Pulse time zero "OFF" width
s1=cos(2*pi*697*tt)+cos(2*pi*1209*tt);
s3=cos(2*pi*697*tt)+cos(2*pi*1477*tt);
s8=cos(2*pi*852*tt)+cos(2*pi*1336*tt);
s0=cos(2*pi*941*tt)+cos(2*pi*1336*tt);
sz=0*tz; %Pulse signal segment "OFF"
s=[s1 sz s3 sz s8 sz s8 sz s3 sz s3 sz s1 sz s0 sz s0 sz s1 sz];
plot(t,s)
axis([0 max(t) -max(abs(s)) max(abs(s))])
xlabel('Time in Seconds')
ylabel('Amplitude')
title('DTFM Message or Word of Order or Length L=10 and Duty Cycle=3/8')
sound(s,Fs)

```

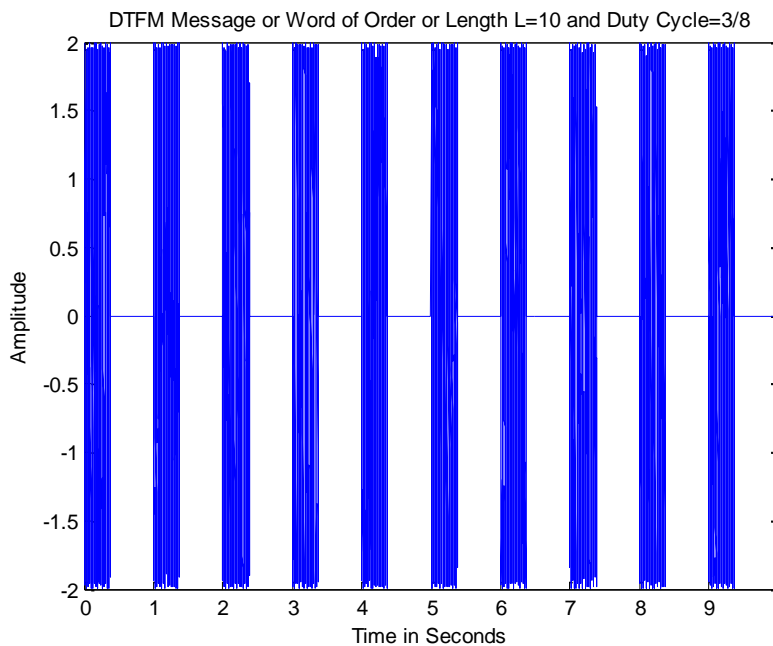


Fig. 02: DTMF Signal Generation with Duty Cycle=3/8

REMARKS:

A.- This homework does not require a written report. All that is required is for each group to send a **.zip** folder with the requested eight (8) m-script files, with the required TAT document in **.PDF** format, as well as this document, both, in **.DOCX** and **.PDF** formats. A total of **11 documents**, nothing else, should be sent inside the **.zip** folder.

B.- The names of each of the m-script files with the given **DTMF word** or **tonal sequence** should be as follows:

Sxxxgyydc12dtmf

Here yy refers to the **group number**. The number **12**, for example, here refers to “**1** over **2**” or the value of the duty cycle. Use the following name for your sequence.

Sxxxgyydc12dtmfo

Each tonal sequence generated with your own DTMF symbol sequence must be unique. Thus, the tonal sequence for **Task 02** must be different from the tonal sequence for **Task 04**, **06**, or **08**.

C.- Name of **.zip** folder and the name of the **e-mail subject**:

INEL4301_MCW02_Sxxx_GpYy

E-mail to: domingo.rodriquez1@upr.edu

STANDARD TABLE FOR DEMERITS

01.- Script file does NOT execute well	-05 pts.
02.- Correct script file NOT included	-05 pts.
03.- Task assignment table NOT included	-05 pts.
04.- Unzipped folder does NOT have same name	-05 pts.
05.- Missing INEL4301_MCW02_Sxxx_GpYy.docx	-03 pts.
06.- Missing INEL4301_MCW02_Sxxx_GpYy.pdf	-03 pts.
07.- Missing class section number sxxx	-03 pts.
08.- Missing student's group number gpyy	-03 pts.
09.- Missing script or program number pgzz	-03 pts.
10.- Missing or incorrect e-mail subject name	-03 pts.