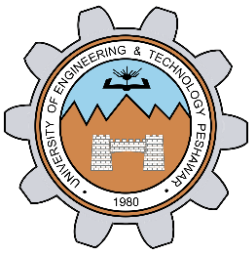
MICROPROCESSOR BASED SYSTEM DESIGN

TASK 10



Spring 2021

CSE307 MBSD

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Class Section: **B**

"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Student Signature: _____

Submitted to:

Dr. Bilal Habib

Sunday, July 11, 2021

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Task:

In this project you are required to interface an ADC and DAC, to 89C51 microcontroller as shown below in figure 1.

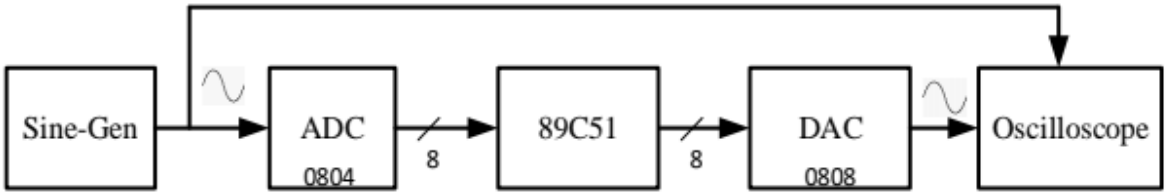
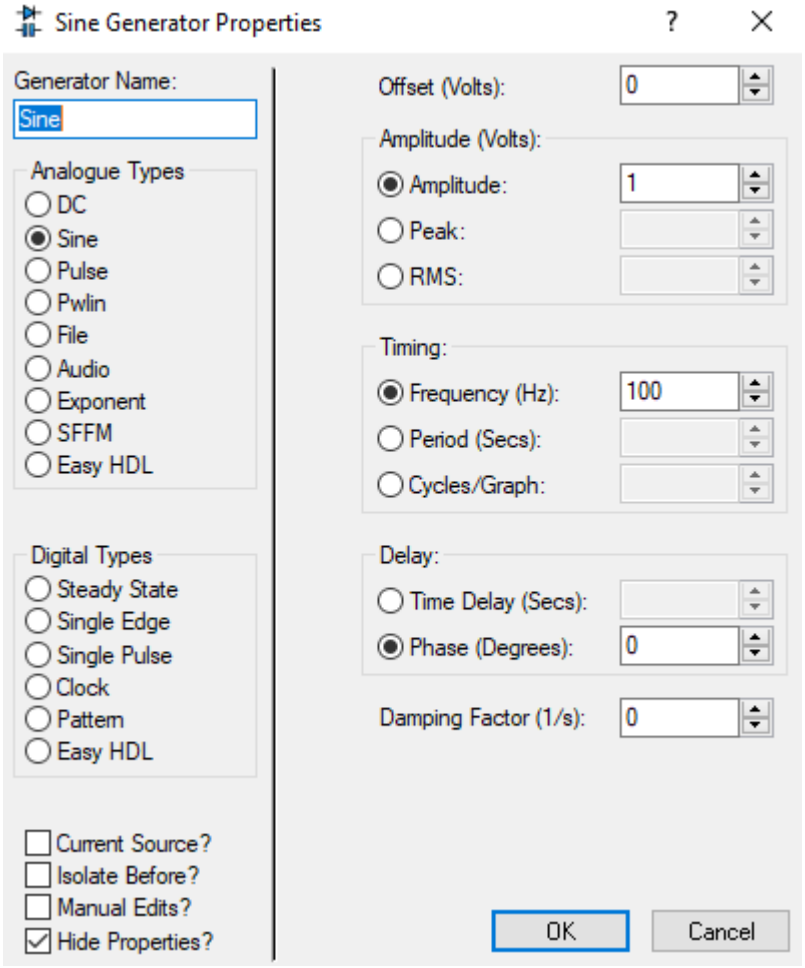


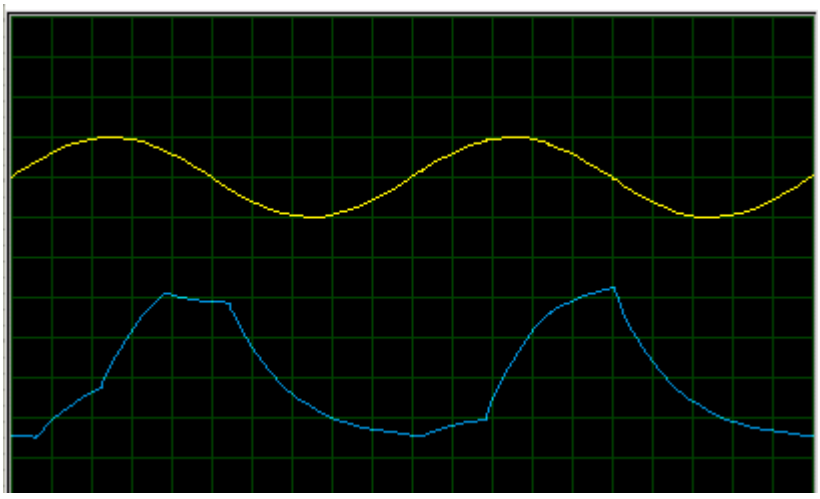
Figure 1: ADC and DAC interfaced to Microcontroller

Show the original sine wave and the final output of DAC on the oscilloscope as shown in figure 1. If you see any distortions in the DAC output, clean them using filters. Written report must have answers of the questions below,

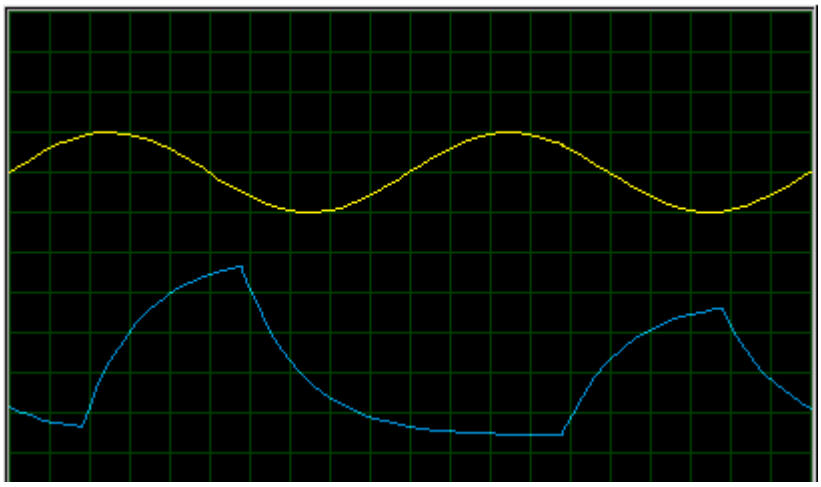
- **Input signal to ADC has a frequency (f_in) of 100Hz. How you supplied it.**
  Answer: I supplied this input frequency by editing the properties of sine generator.



- **What happens if you decrease the sampling rate (fs) from 1K, 0.5K to 0.2K samples per second?**
  Answer: If we decrease the sampling rate from 1k to 0.5K and then to 0.2K, the output signal will be distorted as we are not taking enough samples to reform the original signal.
  Output Signal (fs = 0.5K):



  Output Signal (fs = 0.2K):



- **What reference voltage (V_ref) has been used for ADC?**
  Answer: I have used 1V reference voltage for ADC in this task. I did this by supplying 0.5V at the $V_{ref}/2$ Pin of the ADC.

- **What is the relationship of V_ref to the amplitude of input signal.**
  Answer: The amplitude of input signal varies directly with the reference voltage. For example if Vref = 3V then we can supply an input signal with an amplitude of 3V.

- **What will be the step-size?**
  Answer: We know that Step-size = $Vin/2^n$
  So step-size = $1V/2^8 = 1V/256 = 3.90mV$

- **What is the input voltage range of ADC?**
  Answer: As my reference voltage is 1V so, the input voltage range of my ADC is 0V -1V.

- **Can we increase the frequency of input signal (f_in) to 10KHz, if not then why?**
  Answer: No, we cannot increase the frequency of input signal to 10KHz because we will need a sampling frequency of 1MHz for that, which is practically not possible to achieve.

- **What is the limit of DAC, how fast it can work?**
  Answer: Number of DAC outputs = $2^n = 2^8 = 256$.
  The setting time of DAC is 150 ns which is very fast.

- **Use Low pass RC filter to clean the output of DAC. Find the optimal values of R and C in this filter.**
  Answer: The input signal frequency is 100Hz and we are using low pass filter, so to block signals of frequency greater than 100Hz our cut-off frequency should be 100Hz.
  $F_c = 1/(2*pi*R*C)$
  100Hz = 1/(2*pi*RC)
  RC = 1/(2*pi*100) = 0.00159
  If we take R = 1K ohm then
  C = 0.00159/1000 = 1.59 uF

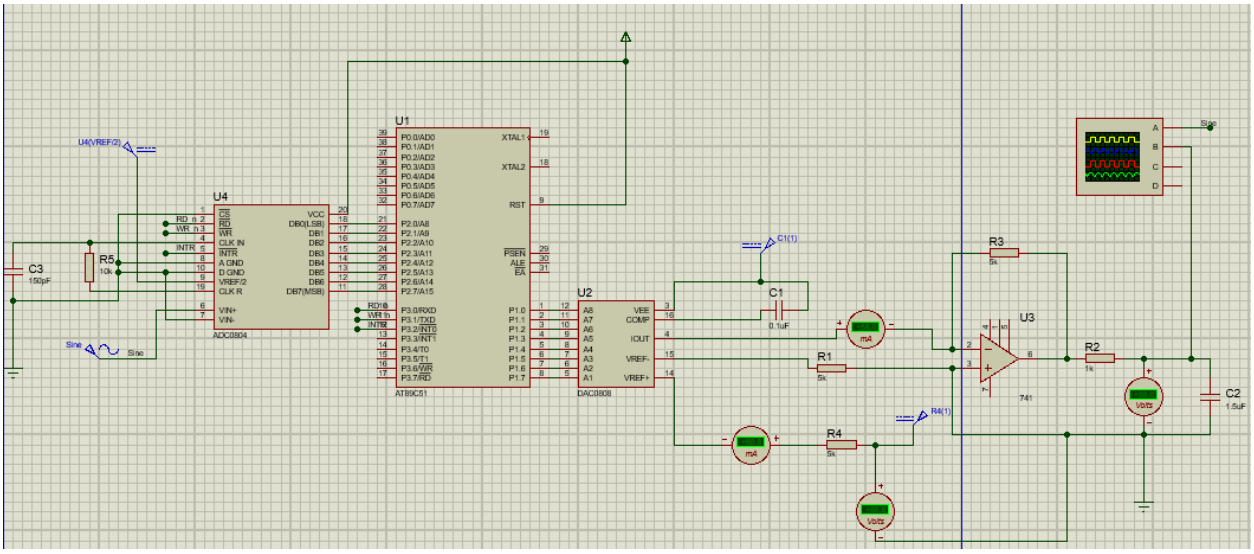
Code:

```
#include <reg51.h>
#include <stdio.h>

sbit RD_n = P3^0; //P3.0 is connected to the RD pin of ADC
sbit WR_n = P3^1; //P3.1 is connected to the WR pin of ADC
sbit INTR = P3^2; //P3.2 is connected to the INTR pin of ADC

void Ext0(void); //Function that is called after the ADC is done with conversion

void main(void)
 {
   P2 = 0xFF; //Set P2 as an input Port
  P1 = 0x00; //Set P1 as an output Port
  INTR = 1; //Set P3.2 as an input pin
  while (1)
  {
     RD_n = 1; //Set the RD pin to High
    WR_n = 0;//WR = Low
    WR_n = 1;//Low-->High
    while(INTR==1); //Wait for the ADC to Convert the given voltage
    Ext0(); //Call the Ext0 function
   }
```

```
 }

void Ext0()
{
  RD_n = 0; //Set the RD pin of ADC from HIGH to LOW
  //The ADC sends the converted value to P2
  P1 = P2; //Send the value at P2 to P1
}
```

Output / Graphs / Plots / Results:

Schematic:



Oscilloscope Output:

Digital Oscilloscope