BIRZEIT UNIVERSITY

Birzeit University

Department of Electrical and Computer Engineering

ENCS438-Second Exam

Student Name:_____ **ID:**_____

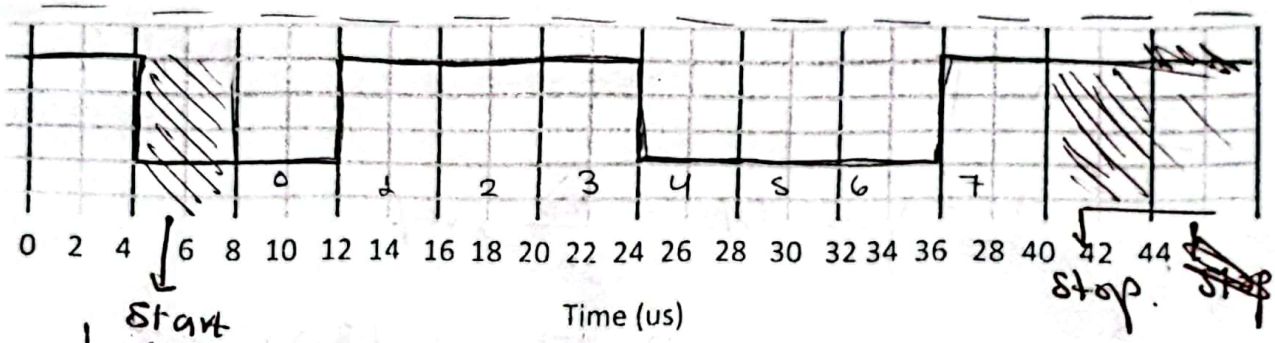
Q#1 (10 points):

1- Explain briefly, how is it possible to communicate with several slaves using I2C? (2 points)

1. Send from Master the start sequence.
2. followed by 7 bit slave address & the R/W bit set to zero.
3. once the slaves send Ack, Master send the data.

7 6 5 4 3 2 1 0
1 0 0 0 1 1 1 0
128 64 32 16 8 4 2 1

2- Assume using 250000 bps, 8-bit data, 1 stop bit, no parity. Draw the UART waveform when the decimal value 142 is sent. Indicate the first and last bit.(4 points)



↳ Start ⇒ low
~~and~~ end ⇒ high

3- Explain briefly, why do we need a drive circuit (e.g., using a transistor) when connecting a motor to a microcontroller (2 points)

it's a part of signal Conditioning of high power since using Transistor as switch this help controlling the motor. < controll high current in the motors. >

4- What is a servo motor? (2 points)

↳ an electromechanical device that produce torque and velocity Based on the supple current & voltge ⇒ it's closed loop system, has feedback.

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ENCS438- Interfacing Techniques

First Hour Exam

Student Name: Student ID: Sec:

Question#1: (8 points)

1- Write a portion of code to generate a PWM signal with frequency 2kHz and duty cycle 20%. using CTC mode.

```
OSB
= 16x10^6 / (0.5)x10^-3
  1024
⇒ 7.88
void setup( )
pinMode (9, output);
no interrupts( );
```

```
TCCR1B=0
TCCR1B |= B00000101;
TIMSK1 = B00000010; → interrupt();
void Loop( ){
OCR1A = 7.88 ;
ISR (Timer_1_vec) { Analog (9,51);
```

duty cycl ⇒ 20%.

d ⇒ 20/100 (255) 1024

d = 51 205

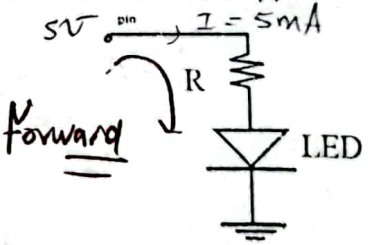
2- Write one use of each of the following memories in Arduino board (or ATMEGA328P): Flash memory, SRAM, EEPROM.

```
# include (TimerOne.h)
void setup( )
  pinMode (10, output)
Timer1.initialize (500);
Timer1.pwM (10, 51);   — 205
```

3- What is the value of R so that the current in the diode is 15 mA when 5 Volt is applied at the pin.

$$R = \frac{5 - 0.7}{15mA} \Rightarrow$$

$$0.286K = 286\,k$$



ABCD
10 11 12
16 8 4 2 1

4- We have the following code:

DDRB=0x3C ⇒ 0011 1100 (7 6 5 4 3 2 1 0)

PORTB=3

Which pins are input and which pins are output? In PortB pin(0,1,6,7) are input, pin(2,3,4,5) are output

For output pins, are they HIGH or LOW?

- they am Low

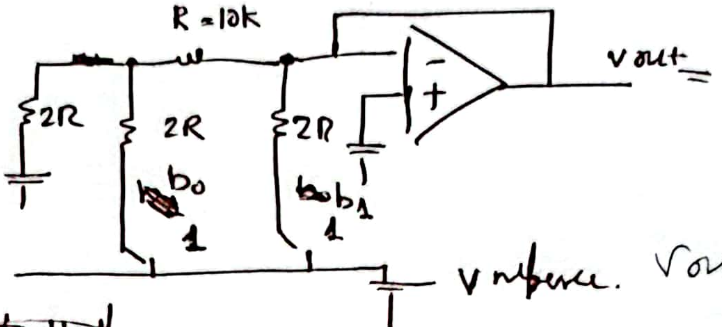
Question#2: (15 points)

$\Rightarrow V_o = \frac{3 \times 5}{2^2} \Rightarrow \frac{15}{4}$

A-

1- Draw a 2-bit R-2R ladder DAC with the resistor R=10k Ohm and the resistor 2R=20 k Ohm. Assume that logic 1 is 5 Volt and logic 0 is 0 Volt, what is the output voltage for the input 3.

3 → 011
4 2 1



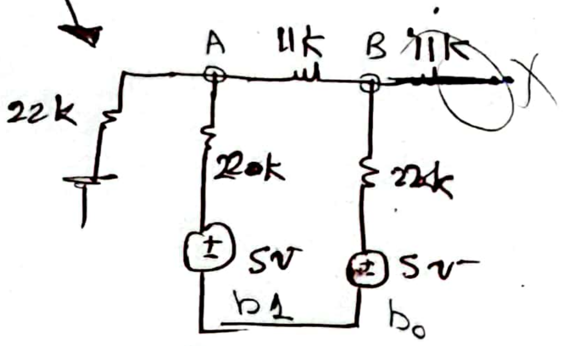
$V_{out} = V_{ref}\left[\frac{b_0}{2} + \frac{b_1}{2^2}\right]$

$= 5\left[\frac{2 \times 1}{2 \times 2} + \frac{1}{4}\right]$

same ~~$V_{out} = \frac{N}{2^n} V_{ref}$~~

$\Rightarrow \frac{15}{4}$

2- Now assume that the resistor 2R= 22 k Ohm, what is the output voltage of the input 3.



Appling nodal one A:

$\frac{V_A}{22k} + \frac{V_A - 5}{22k} + \frac{V_A - V_B}{11k} = 0$

$2V_A - 5 + 2V_A - 2V_B = 0$

$4V_A - 2V_B = 5$ → (1)

Appling nodal on B

$\frac{V_B - 5}{22k} + \frac{V_B - V_A}{11k}$

$\Rightarrow V_B - 5 + 2V_B - 2V_A = 0$

$3V_B - 2V_A = 5$ → (2)

multiple (2) by 2 ⇒

$-2V_B = 5$

$+ \; 6V_B = 10$

$\Rightarrow 8V_B = 15$

$V_B = \frac{15}{4}$

digitalRead in ISR

T= 7 μs

B- Use Normal Mode (Timer Overflow) to read a sensor connected at pin 3 every 7 microseconds. Show the configuration of the registers.

TCNT= 65535 - $\frac{16\times10^6 \times}{8}$

```
Const int pin=3;
Volatile Var;
int Setup( )
  PinMode(pin, output)
  noInterrupts( )
  TCCR1A =0
  TCCR1B =0
  TCNT1 = 65521;
  TCCR1B = (1<<CS11);
  interrupt( );
enable.

ISR (Timer1_OVF_vect)
{
  TCNT1 = 65521;
  Var=DigitalRead(Pin));
  Serial.println(var);
}

Void Loop( ){

}
```

TTNIS k 2

DDRx
0 → inp
1 →

Assume that a sensor is connected to the analogue input A0, use CTC mode to read sensor every 20ms

```
voide setup( )
{
pinMode(A0, input);
noInterrupt( );
TCCR1A=0;
TCCR1B=0;
TCNT1 = 0;
OCRA = 1250;
TCCR1B |=(1<<CS12);
TCCR1B = (1<<WGM12);
TIMSK = (1<< OCIE1A);

ISR (Timer1_COMPA_vect){
   AnalogRead (A0);
}
```

CTC ال... ...

$\Rightarrow OCV \Rightarrow \frac{16\times10^6 (T)}{256}$

$\Rightarrow \frac{16\times10^6 (20)\times10^{-3}}{256}$

$= 1250$

0 1 0 /8
0 1 1 /64
1 0 0
1 0 1

Sta31rt

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BIRZEIT UNIVERSITY

Department of Electrical and Computer Engineering

ENCS438- Interfacing Techniques

Quiz#2

Student Name: / Student ID:

Register level

Use CTC mode to toggle a led which is connected to pin 3 every T seconds. Start with T=1. The delay of changing the state of the LED will be increased after each change of LED state. So, after 1 second, T will be 2 seconds and then after these two seconds, T will be 4 seconds. Then the delay will start to decrease after each change of the LED state until it reaches again 1. This will be repeated.

```
Time = 1
Const int led = 3;   Count = 0
Volatie Count=0, byte X=1,
void setup( ){
  PinMode (led, output);
  digitalWrite(led, HIGH);
  Serial. begin (9600);
  noInterrupts();
  TCCR1A = 0;
  TCC1B = 0;
  TCNT1 = 0;
  OCRA = 15625;
  TCCR1A |= B00000101;
  TCCR1A |= (1<<WGM12);
  TIMSK1 |= (1<< OCIE A);
  interrupts();
}
```

OCRA when one second

$= \frac{16 \times 10^6}{1024}(1) = 15625$

```
ISA (Timer1_Compa_vect){
  digitalWrite( led, digitalRead (led)^1);
  Count = Count + X;
if ((Count <=0) || (Count >=2)){
  X = -X; // desease.
}
if (Count=0)
  Time=1;
if (Count=1)
  Time=2;
if (Count=2)
  Time=4;
OCRA = 15625 * Time;
}
void Loop( ) { }.
```