Department: CSE

Program: B.SC in CSE

Course No: CSE 3215

Course Title: Microcontroller Based System Design

Examination: Final

Semester: Spring 2020

Student ID: 170204004

Signature and date: Rukaiya 30.05.21

ID:170204004
Course No: CSE3215
Sign: Rukaiya

Answer to 1. (b)

The differences between microprocessor and microcontroller are stated below:

Microprocessor	Microcontroller
CPU on a chip	Computer on a chip.
Mostly used in designing general purpose systems.	Used in automatically controlled devices.
~~computationa~~ computational capacity is very high.	Less computation capacity compared to microprocessors.
Can perform complex tasks.	Usually used for simpler tasks.
Microprocessor based systems can perform numerous tasks	Microcontroller based systems can perform single or very few tasks.
For a complete system, external components need to be connected.	No need for ~~exp~~ external components to make a system.
~~Less Overal~~ Higher power ~~consup~~ consumption and overall system cost is high.	Less power consumption and less costly.
higher clock frequency, in ~~MHz~~. GHz	Lower clock frequency, usually in ~~GHz~~ MHz
Uses less special function registers.	Use more special function registers

ID:170204004
Course No: CSE 3215
Signs: Rukaiya

Ans to 1(a)

An embedded system is an electronic system that uses a CPU chip but this is not general purpose work station. It uses microprocessor or microcontroller or custom design chip. These systems are such that, they do not appear to be computers ~~becau~~ because the complexity is hidden from the user. Embedded systems are vital to modern society. Given that they are built for specific applications, they enable design and optimizations that makes it possible for us to enjoy the benefit of technology in our daily lives. ~~In~~ We can not picture modern society without embedded systems.

Some of the examples are discussed below:

ATMs (Automated Teller Machine): It is one the systems that changed the banking perspective drastically. It is a computerized device used in banking. One can access and perform their trandions without going to the bank. It comprises of a card reader for detecting cards and accessing their informations.

Automatic washing Machines:
It ~~includes~~ is an embedded system that includes washer and dryers. It makes our daily lives easier, as washing ~~ed~~ clothes can be done by this embedded system. It consists sensors, ~~and~~ ~~and~~ motors, and a keypad and display for input and output actions.

Vending Machines:
These are very simple embedded system, that ~~makes~~ takes in money and provides ~~4~~ us with food, ~~sn~~ snack, water etc.

ID: 170204004
Course: CSE 3215
Sign: Rukaiya

Ans: to 1(C)

```
SETB PSW.3
MOV R1,#55H
MOV R2, #56H
MOV R3, # 57H

SETB psw.4
MOV RO, # 2H
MOV R2, #4H
```

In RAM location 9, A and B there is 55H, 56H and 57H and in location 18 and 1A, there exists data ~~dat~~. 2H and 4H.

```
MOV SP, #4FH

PUSH 9
PUSH A
PUSH B
PUSH 18
PUSH 1A
```

54	4H
53	2H
52	57H
51	56H
50	55H

Stack

ID: 170204004

Course No: CSE3215

Sign: Rukaiya

Answer to 7(a)

The differences between the erasing process of EPROM and EEPROM are discussed below:

EPROM	EEPROM
Deletion of the contents takes upto 20 minutes	~~Deletion~~ Deletion of content takes almost no time, deletes the contents instantly.
Uses UV radiation to erase	Applies electrical methods to erase
While erasing, the chip must be removed from the socket.	It does not require the removal of the chip from the system board while erasing.
The entire content of the device is erased, when erasing any content.	Any desired byte can be erased.
Erasing procedure is relatively difficult and time consuming.	~~E~~ The process of ~~ear~~ erasing is more easier, fast and efficient.

Answer to 7(b)

There are many limitations in using IR sensors, like the inability to use them in sunlight due to interference. It can make make outdoor application or dark indoor applications difficult. The infrared rays emitted can be absorbed if the object is dark and cause mis readings. On the other hand, Ultrasonic sensors work using sound waves, so detecting objects is not affected by as many factors. Therefore, ultrasonic sensors are much more ~~rela~~ reliable than IR sensors while measuring distances.

ID:170204004

Course No: CSE3215

Sign: Rubaiya

Given that, speed of sound = 344 m/s

Distance of the round trip = 1200 m

$$\text{time taken for round trip} = \frac{\text{Distance of roundtrip}}{\text{speed of sound}}$$

$$= \frac{1200 \times 2}{344}$$

$$= 3.488 \cancel{\times 2} = 6.98 \text{ s}$$

$$\text{time taken for hitting the obstacle} = \cancel{\frac{3488 \times 2}{2}} = \frac{6.98}{2}$$

$$= \cancel{1.744\text{s}}\ 3.49 \text{ s}$$

For the under water calculation:

$$\text{time taken for the roundtrip} = \frac{\text{Distance of the round trip}}{\text{speed of sound under water}}$$

$$= \cancel{1200}$$

$$\text{speed of sound under water} = \frac{\text{Distance of roundtrip}}{\text{time taken}/2}$$

$$= \frac{1200 \text{ m}}{\frac{1500}{2} \text{ milliseconds}}$$

$$= \frac{1200 \times 2}{1.5} \text{ m/s}$$

$$\cancel{= 800 \text{ m/s}} \quad = 1600 \text{ m/s}$$

(~~Ans~~)

Ans to question 7.C

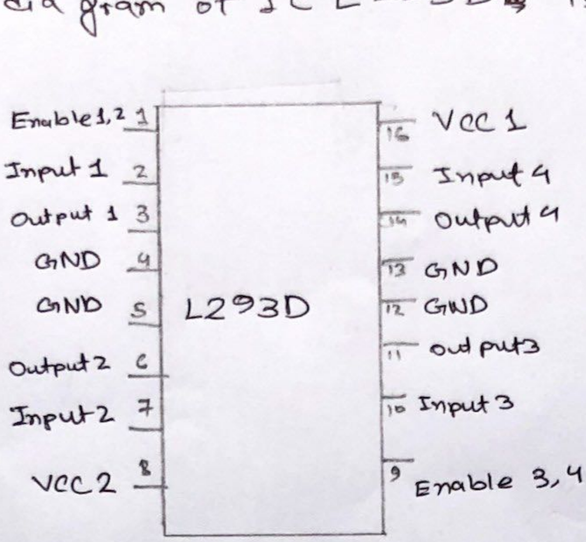
An motor driver IC is an integrated circuit chip which is usually used to control motors in an autonomous robot. It acts as an interface. Motor driver IC L293D is one of the most commonly used motor drive IC. They can be used to run two DC motors. It has 16 pins, with 8 pins on each side for controlling a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor. The IC consists of two H-bridges.

ID: 170204004

Course No: CSE 3215

Sign: Rukaiya

The pin diagram of IC L293D is given below:



Pin No and Characteristics

1 - Enable 1,2 when it is high the left part of the IC will work.

2 - INPUT 1, when ~~High~~ high the current will flow through output 1

3 - OUTPUT 1, this pin should be connected to one of the terminal of motor.

4,5 - Ground pins.

6 - OUTPUT 2, should be connected to one of the terminal of motor.

7 - When high current will flow through OUTPUT 2.

8, - VCC 2, this is the voltage which is supplied to the motor.

16 - VCC 1, this is the power supply to the IC.

15. - INPUT 4, when high current will flow through OUTPUT 4.

14 - OUTPUT 4, should be connected to one ~~to~~ of the terminal of motor.

13,12 - ground pins.

11 - OUTPUT 3, should be connected to one of the terminal of motor.

10 - INPUT 3, which high current will flow through OUTPUT 3

9 - Enable 3-4, when HIGH the right part of the IC will work.

ID: 170204004

Course No: CSE3215

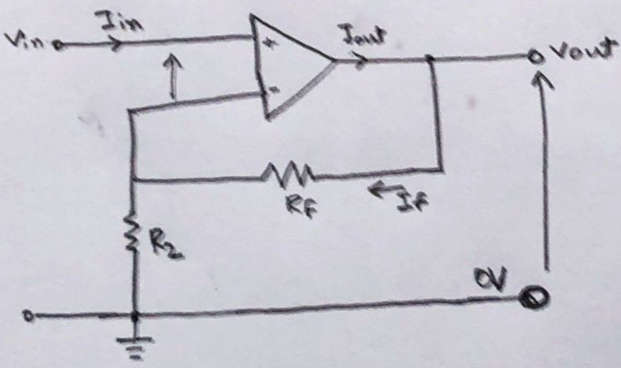
Sign: Rukaiya

Relay:

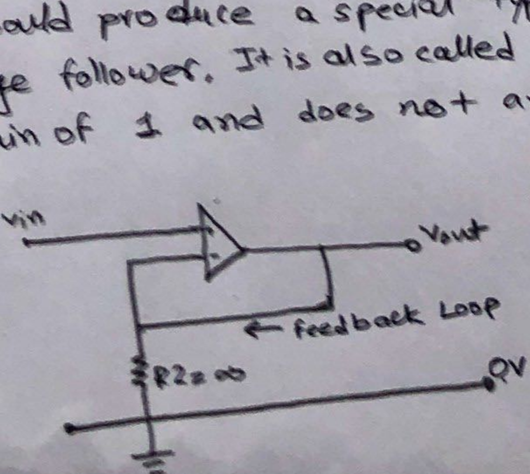
A relay is an electric switch that turns on or off based on an external electric signal. The only difference between relay and normal switches in our home is that instead of a human being operating it, the switching is controlled by an external electrical signal. When the signal is applied, the switch is on and when the external electric signal is removed, the relay is de-energised and the switch is off.

Answer to No. 4(a)

The diagram below is of non-inverting ~~o~~ Amplifier.



The input voltage, Vin is applied through the ~~possi~~ positive input terminal.
If we make the feedback resistor, R_f equal to zero and resistor R2 equal to infinity, then the circuit would have a fixed gain of 1, as all the output voltage would be on the inverting input terminal. i.e. negative feedback.
Then, this would produce a special type of non-inverting ~~aplifier~~ amplifier called voltage follower. It is also called a unity gain buffer as it has a gain of 1 and does not amplify the incoming signal.



ID: 1702 04004

Course No: CSE3215

Sign: Rukaiya

As the input voltage Vin is applied to the non-inverting input, the gain of the amplifier can be written as:

$$V_{out} = A(V_{in})$$

$$\therefore \quad Gain = \frac{V_{out}}{V_{in}} = 1$$

Answer to question 4(c)

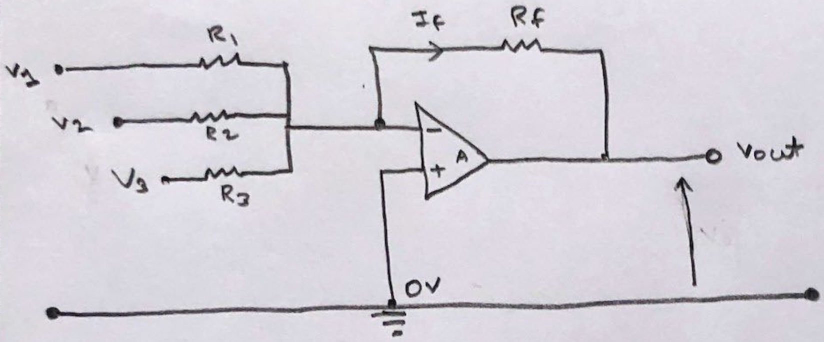


fig: Circuit diagram for summing Amplifier.

Given,

$I_1 = 5mA$

$I_2 = 10\,mA$

$R1 = 2k\Omega$

$R2 = 5k\Omega$

$R3 = 10k\Omega$

$V3 = 10V$

$Rf = 250k\Omega$

Now, $V_1 = I_1 \times R_1 = 5mA \times 2k\Omega = (5\times10^{-3} \times 2\times10^{3}) = 10V$

$V_2 = I2 \times R2 = 10mA \times 5k\Omega = (10\times10^{-3} \times 5\times10^{3})V = 50V$

~~then,~~ $V_3 = I_3 \times R_3$

$$I_3 = \frac{V_3}{R_3} = \frac{10}{10\times10^{3}} = 1\,mA$$

Now,

$$V_{out} = -\left(\frac{Rf}{R1}\times V_1 + \frac{Rf}{R_2}\times V_2 + \frac{Rf}{R_3}V_3\right)$$

$$= -\left(\frac{250K}{2K}\times 10 + \frac{250K}{5K}\times 50 + \frac{250K}{10K}\times 10\right)$$

$$= -4000V$$

ID: 170204004

Course No: CSE 3215

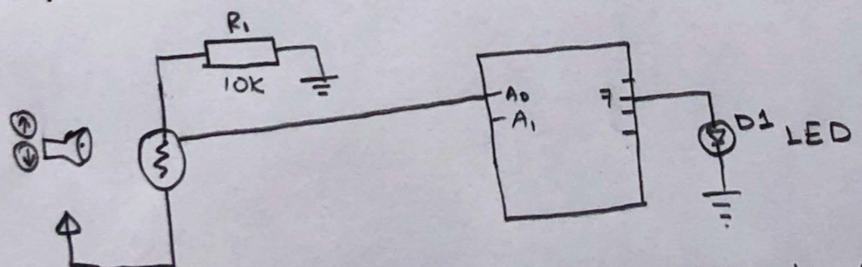
Sign: Rukaiya

Answer to question 4(b)

Input ~~offes~~ offset voltage is the voltage that must be applied between two input terminals of an op amp to null or bring the output voltage to zero. The offset null effectively applies this voltage to ensure that the offset is removed from the output. Most of the op amp has an offset voltage at the output even if the input voltages are same. To make the output voltage zero, the offset nulling method is used. The op amp offset null capacity is used to null any small DC offsets at the outputs. Offset null connections present on many ~~opera~~ op amp chips can be used to null ~~the~~ any offset appear. Therefore the Offset Null pins are used to clear the offset, ~~voltage~~ and bring the output voltage to zero

Answer to question 5(a)

The ~~nece~~ necessary ~~diagram~~ design for the Lamp Post is given below:



The code for making it functional is given below:

```
int LDR = A0;
int LED = 7;
int data;
void setup (){
  pinMode (LED, OUTPUT);
}
```

ID: 170204004
Course No: CSE3215
Sign: Rukaiya

```
void loop (){
  data = analogRead (LDR);
  if (data > 300)
  {  digitalWrite (LED, LOW);
     delay (1000);
  }
  else {
  digitalWrite(LED, HIGH);
  delay (1000);
  }
}
```

Ans to question . 5(b)

A sensor is a device which detects one form of energy and converts ~~it to~~ the data to electrical energy. For example, microphone.

Passive sensors require an external power source to operate which is called an ~~exit~~ excitation signal. The signal is modulated by the sensor to produce an output signal. For example, a thermistor does not generate any electrical signal, by passing an electrical current through it, its resistance can be measured by variation in the current or voltage ~~acer~~ across it.

Active ~~sensors~~ sensors are those which do not require any power source for their operation. They work on energy conversion principle. They produce an electrical signal proportional to the input, examples: thermocouple.

ID: 170204004

Course No: CSE 3215

Sign: Rukaiya

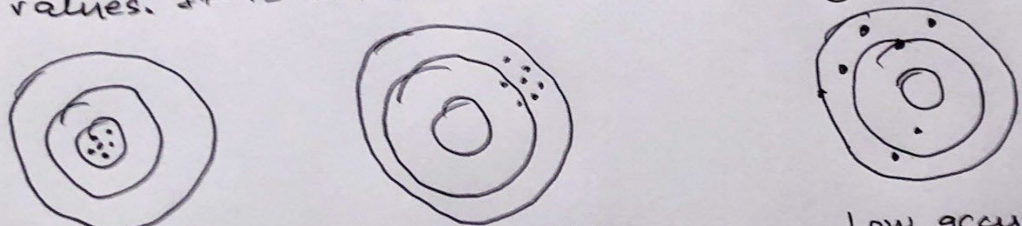
Characteristics of Sensors:

1. Range: It is the maximum or minimum value of physical variable that the sensor can sense or measure. For example RTD for the measurement of temperature has a range of − 200C to 800°C

2. Span: It is the difference between the maximum and minimum value of input. For RTD it is 800−(−200) = 1000°C

3. Accuracy: The error in measurement is ~~occur~~ specified in accuracy. It is the difference between measured value and true value.

4. Precision: It is defined as the closeness among a set of values. It is different from accuracy.



high accuracy
high precision

high precision
low accuracy

low accuracy
low precision.

5. Sensitivity: It is the ration of change in output to change in input. If Y is the output quantity to an impact of X input, then sensitivity is:

$$S = \frac{dY}{dX} = \frac{\Delta Y}{\Delta X}$$

6) Dead band: The dead band or dead space of a transducer is the range of impact value for which there is no output.

7. Resolution: It is the minimum change in ~~imp impa~~ input that can be sensed by the sensor.

8. Reproducibility: The ability of the sensor to produce the same output when same input is applied.

9. Linearity - Non linearity: Input values or output values ~~that~~ lies on a straight line or not.

10. Response Time: It is generally expressed as the time at which the output reaches a certain percentage of its final value, in response to a step change of the input.

Answer to 3(a)

In AVR the data memory is composed of 3 parts:

(1) GPRs (General Purpose Registers)

- AVR have many registers for arithmatic and logical operations
- Majority of them are ~~8~~ 8 bit registers.
- There are 32 general purpose registers. They are R0-R3 and are located in the lowest location of memory address.

(2) I/O memory (SFRs):

- This is dedicated to specific functions, such as status Registers, timers etc.
- It is made of 8 bit registers.
- In AVRs with more than 32 I/O pins there is also ~~a~~ extended ~~are~~ I/O memory.

(3) Internal Data SRAM:

- while registers are used to perform calculations, SRAM is used to store data during run time.

- SRAM memories that are not directly accessable to the CPU like registers are.
- the size of SRAM can vary from chip to chip.

Answer to 3(b)

LDI R20, 60 ; R20 is loaded with 60 in hex.

LDI R21, 30 ; R21 is loaded with 30 in hex

ADD R20, R21 ; Add operation between R20 and R21 The result is stored in R20.

60h in binary = $(0110\ 0000)_2$

30h " " = $(0011\ 0000)_2$

$$\begin{array}{r} 0110\ 0000 \\ 0011\ 0000 \\ \hline 1001\ 0000 \end{array}$$

BST R20, 4 ; store bit 4 from R20 to the T flag.

The value of SREG in AVR after execution:

Bit	D7							D0
SREG	1	1	0	1	0	1	0	0

ID: 170204004
Course No: CSE 3215
Sign: Rukaiya

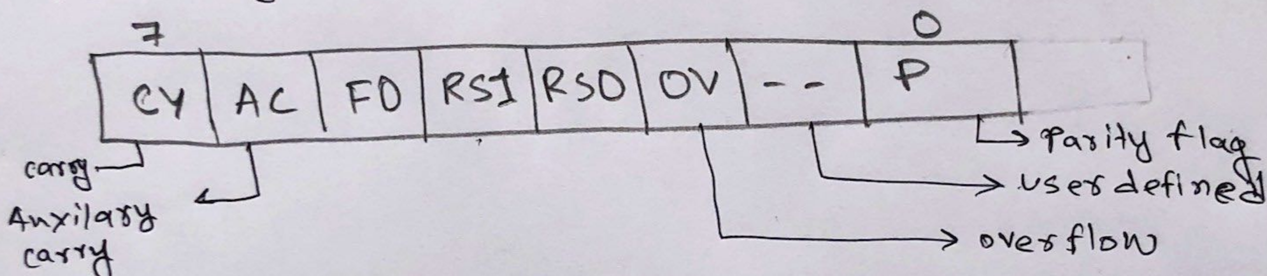
Ans: to 3.(c)

The status register ~~is~~ contains information about the state of the processor. It lets an instruction take action contingent on the outcome of the previous ~~instruction~~ instruction.

for 8051:

The program status word (PWS) ~~regigst~~ register is an 8 bit register. It contains ~~~~ status bits that reflect the current CPU state.

PSW Register:



For AVR: The status register is of 8 bit. Each of the conditional flag can be used to perform conditional ~~~~ branch.