Department : CSE

Program : B.Sc in CSE

Course No : CSE 3215

Course Title : Microcontroller Based system Design

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Student no : 170204105

Signature and Date :

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Answer to the question no: 1 (a)

Embedded system: An embedded system is a combination of computer hardware and software design for a specific function.

An embedded system is a microprocessor-based computer hardware system with software that is designed to perform a dedicated function, either as an independent system or as a part of a large system.

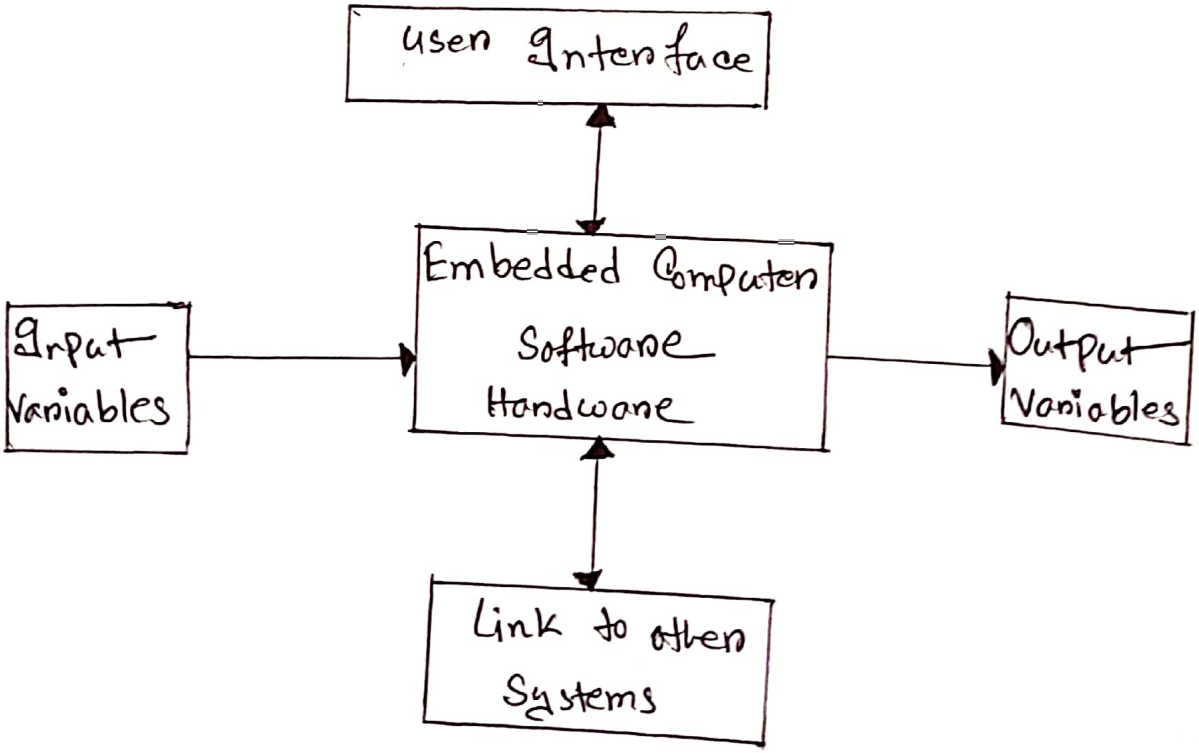

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Fig: A basic block diagram of embedded system

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The importance of using embedded system:

(i) It is able to cover a wide variety of environments

(ii) Less likely to encore errors

(iii) Offers an enhanced performance

(iv) It has very few interconnections

(v) It is small in size

(vi) It has a fast operation

(vii) Offers improved product quality

(viii) It has a low power operation

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Discussing the importance of using embedded system in our day-to-day life.

(a) Requires real time performance:

Embedded system must meet various timing and other constraints. They are imposed on it by the real-time natural behavion of the external world.

(b) Reliability:

This measure of the survival probability of the system when the function is critical during the run time.

(c) Fault-Tolerance:

It is the capability of a Computer to survive in the presence of faults

Flexibility:

It's building systems with built-in debugging opportunities which allows remote maintenance.

Portability:

Portability is a measure of the ease of using the same embedded software in various environments.

Real-Life examples of embedded system:

Home → Washing machine, Microwave, sewing machines

Office and commence: Photocopier, Printer, security system

Motor car: Door mechanism, Engine control, Brakes, Air bag

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Answer to the question no: 1(b)

Distinguish between Microprocessor and microcontroller is given below:

Microcontroller	Microprocessor
1. Computer on a chip	1. CPU on a chip
2. Used in automatically controlled devices.	2. Mainly used in designing purpose systems.
3. Less computation capacity compared to microprocessor.	3. Computation capacity is very high.
4. Usually used for simple tasks.	4. Can perform complex tasks
5. Microcontroller based system can perform single or very few tasks.	5. Microprocessor based systems can perform numerous tasks.
6. No need for external components to make a system	6. For a complete system, external component need to be connected.
7. Less costly	7. Overall system cost is high
8. Less power consumption	8. Higher power consumption

(b)

Microcontroller	Microprocessor
9. Lower clock frequency, usually in MHz.	9. Higher clock frequency, usually in GHz.
10. Use more special function registers.	10. Use less special function registers.
11. It is mainly used in MP3 players, washing machine.	11. It is used in Personal Computers.
12. Based on Harvard architecture.	12. Based on Von Neumann model.
13. Often power-saving mode.	13. Don't have power saving features.

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Answer to the Question no:1(c)

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

SETB PSW.4
MOV R0,#2H
MOV R2,#4H
```

In RAM Location 9, A and B there exists now 55H, 56H and 57H and in location 18 and 1A, there exists data 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

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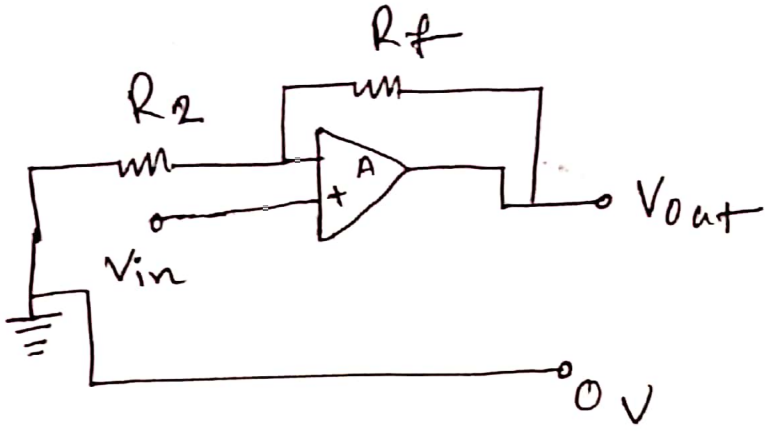
Answer to the Question no-4 (a)



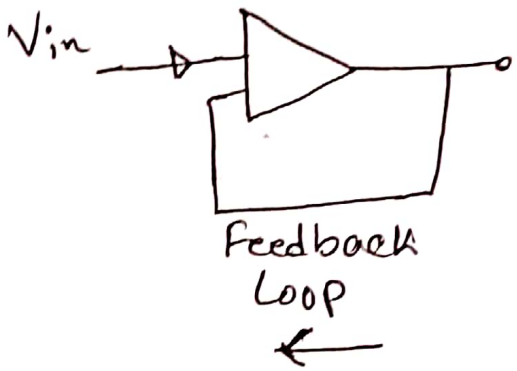
This circuit is a special type of non-inverting amplifier circuit.

The input voltage, Vin is applied through the positive input terminal

If we made the feedback resistor, R equal to zero, ($Rf = 0$) and resistor R2 equal to infinity, ($R2 = \infty$) then the circuit would have a fixed gain of "1" as all the output voltage would be present on the inverting input terminal (negative feedback)

(8)

This would then produce a special type of non-inverting ~~input, th~~ amplifier circuit called a "Voltage follower" or also called a "unity gain buffer".



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

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

(9)

Therefore Gain, $(A_V) = \frac{V_{out}}{V_{in}} = 1$

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Answer to the question no - 4(B)

Offset Null: Input offset voltage is defined as the voltage that must be applied between the two input terminals of an op-amp to null or bring the output voltage to zero.

The offset null effectively applies this voltage to excuse that offset is removed from the output.

The use of the offset null pins in OP AMP:-

An OP amp is a differential amplifier. This means it amplifies the difference in voltage between the two pins. Because of this fact, its output should be 0V when there is no difference between its inputs.

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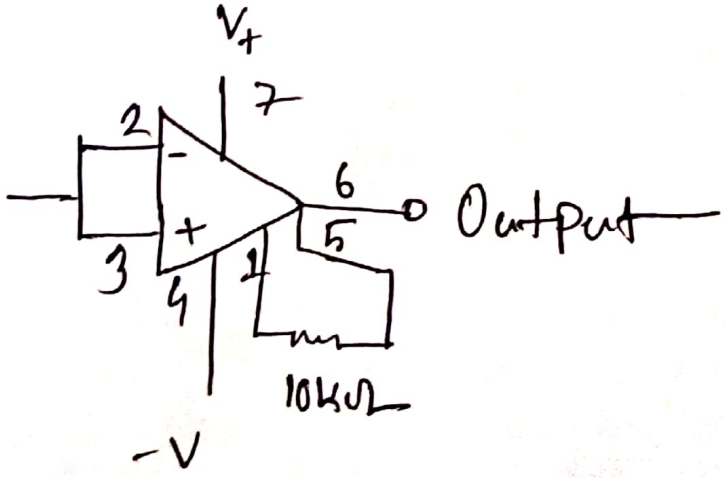
In real life OP amps, the output is only 0V when the inputs differ by a small amount known as the input offset voltage. Normally OP amps come with offsed, so that voltage must be applied to one terminal in order for the voltages to be equal and thus for there to be 0 output. This is why OP amps have offset null pins. To make the voltages exactly equal one must apply the same voltage to both pins and place a potentiometer to one of the pins and change the resistance until the output is 0V.

(11)



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Answer to the question no: 4(c)

For summing amplifier,

Given that,

$I_1 = 5mA = 0.005\ A$

$I_2 = 10mA = 0.01\ A$

$V_3 = 10\ V$

$R_1 = 2K\Omega = 2000\ \Omega$

$R_2 = 5K\Omega = 5000\ \Omega$

$R_3 = 10K\Omega = 10000\ \Omega$

$R_f = 250K\Omega = 250000\ \Omega$

Find, V_1, V_2, V_3 and V_{out}

Now,

$V_1 = I_1 \times R_1 = 0.005 \times 2000 = 10V$

$V_2 = I_2 \times R_2 = 0.01 \times 5000 = 50V$

Again,

$V_3 = I_3 \times R_3$

$\Rightarrow I_3 = \frac{10}{10000} = 0.001\ A$

Now,

$$V_{out} = -\left(\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3\right)$$

$$= -\left(\frac{25000}{2000}\times 10 + \frac{25000}{5000}\times 50 + \frac{25000}{10000}\times 10\right)$$

$$= -(1250 + 2500 + 250)$$

$$= -4000\ V$$

$\therefore V_{out} = -4000V$

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Circuit Diagram for the summing Amplifier

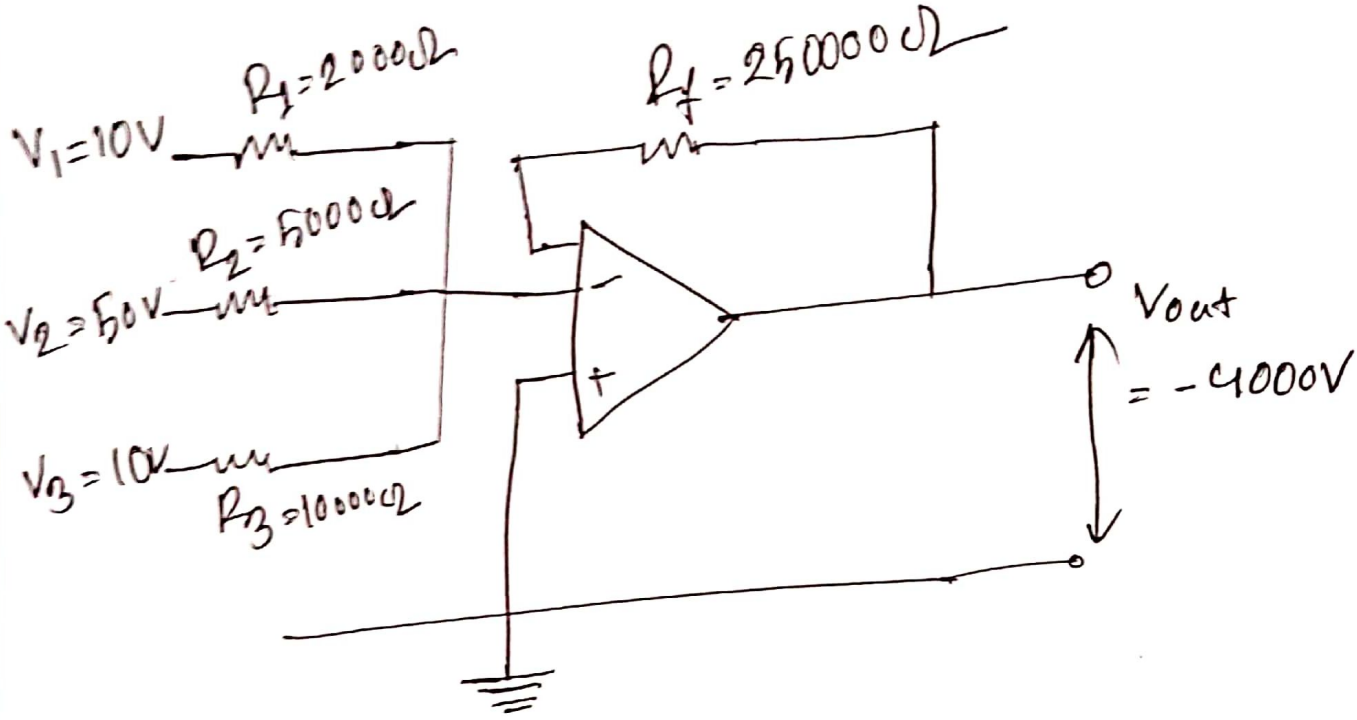

Fig : Summing Amplifier.

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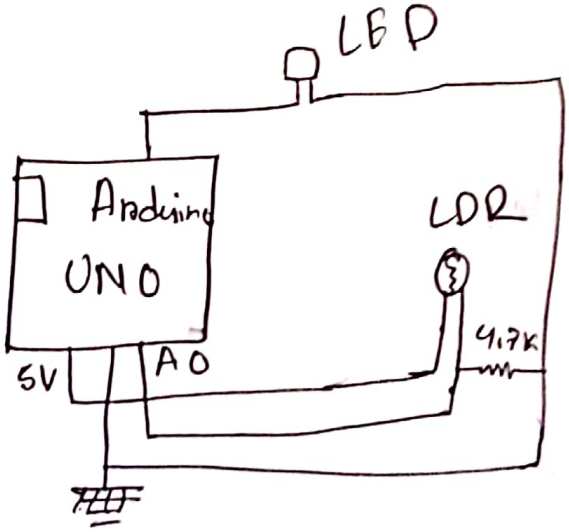
Answer to the question no - 5(A)

Required Components:

(i) LDR
(ii) LED
(iii) 4.7 k Register
(iv) Bread Board
(v) Connecting Wires
(vi) Arduino UNO

Design



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Code:

```
#include <softwareSerial.h>
int sensonPin = A0;
int SensonValue = 0;

int led = 8;
Void setup (){
PinMode (led, OUTPUT);
Serial.begin (9600);
}
Void loop(){
senson value = analogRead (sensonPin);
Serial.Println( SensonValue);
if(SensonValue <250)
{
  digitalWrite (led, High);
  delay (1000);
}
 digital Write (led, LOW);
 delay (SensonValue);
}
```

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Answer to the question no: 5 (b)

Active Senson: An active senson is a naden instrument used for measuring signals transmitted by the senson that were reflected.

Active remote sensons creates their own electromagnetic energy that is transmitted from the senson towards the terrain, interacts with the terrain producing a backscatter of energy and is recorded by the remote senson's receiver.

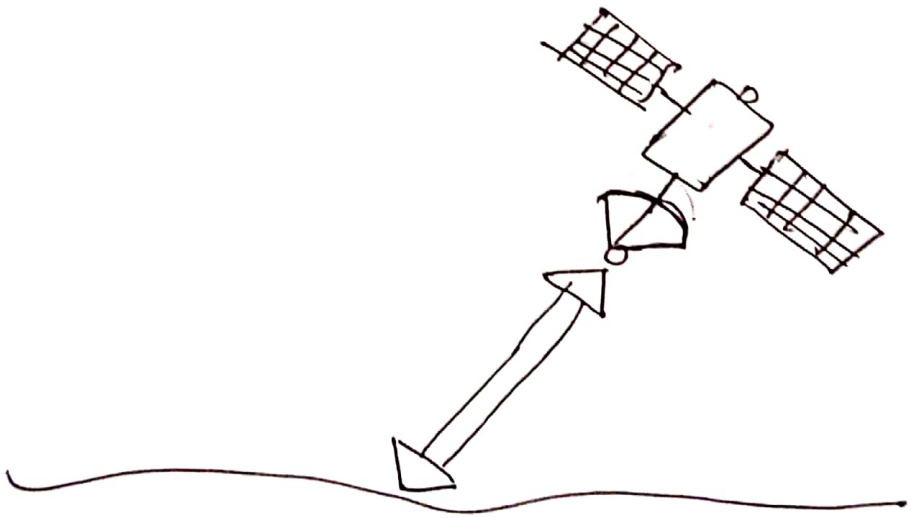

Fig: Active senson

Passive sensors: A Passive senson is a micnowave instnument designed to neceive and to measune natunal emissions produced by constituents of the Eanth's sunface and it's atmosphene.

Passive senson de~~fects~~ the natunally emitted micnowave enengy with in its field of view. Passive senson include nadiometens, which are devices used for measuning the nadiat flux of electnomagnetic nadiation.

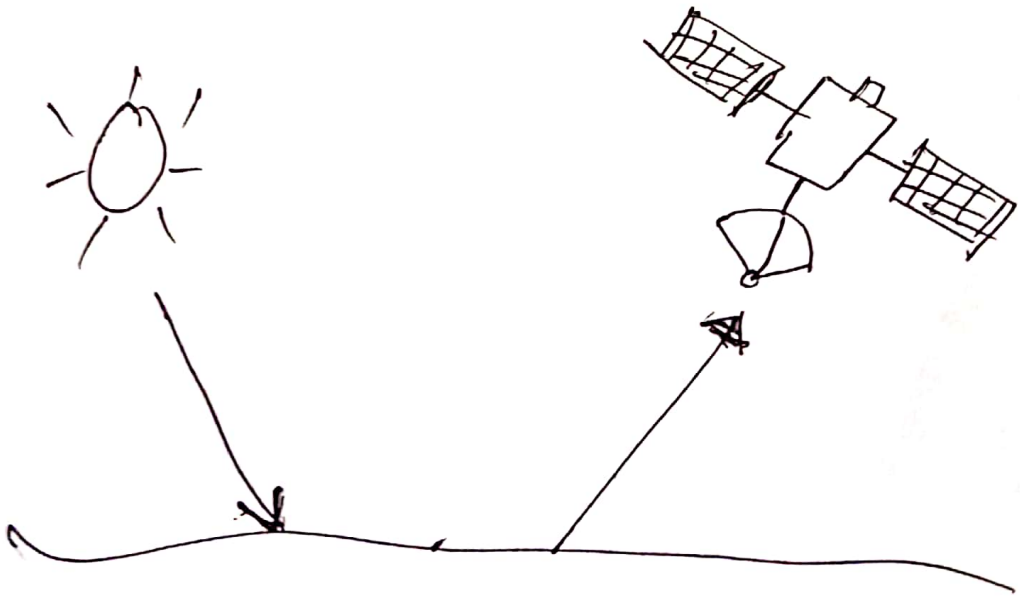

Fig: Passive Senson

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Explaining the characteristics of sensors:

(i) **Resolution:** It is the minimum change in input that can be sensed by the sensor

(ii) **Reproducibility:** It is defined as the ability of sensor to produce the same output when same input is applied.

(iii) **Linearity - Nonlinearity:** Input values on output values lie on a straight line or not.

(iv) **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.

(v) **Hysteresis:** It is the difference in output when input is varied in two ways increasing and decreasing.

Answer to the question no : 6(a)

Advantages of I2C over UART and SPI :

① Only uses two wires, SPI uses four wires

② Supports multiple masters and multiple slaves. UART and SPI doesn't support multiple slaves on multiple master system.

③ Hardware is less complicated than with UARTs.

④ I2C is well know and widely used Protocol than UART and SPI.

⑤ ACK/NACK bit gives confirmation that each frame is transferred successfully. But SPI and UART doesn't use ACK/NACK or no acknowledgement that

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the data has been successfully recived.

⑥ flexible, as it supports multiple master on multiple slave system. UART and SPI is less flexible.

⑦ I2C is adaptable than UART and SPI as I2C can adopt to the needs of various slave devices

Answer to the question no : 6(b)

SPI can be set up to operate with a single master and and a single slave. and it can be set up with multiple slaves controlled by a single master. There are two ways to Control the multiple slaves of SPI

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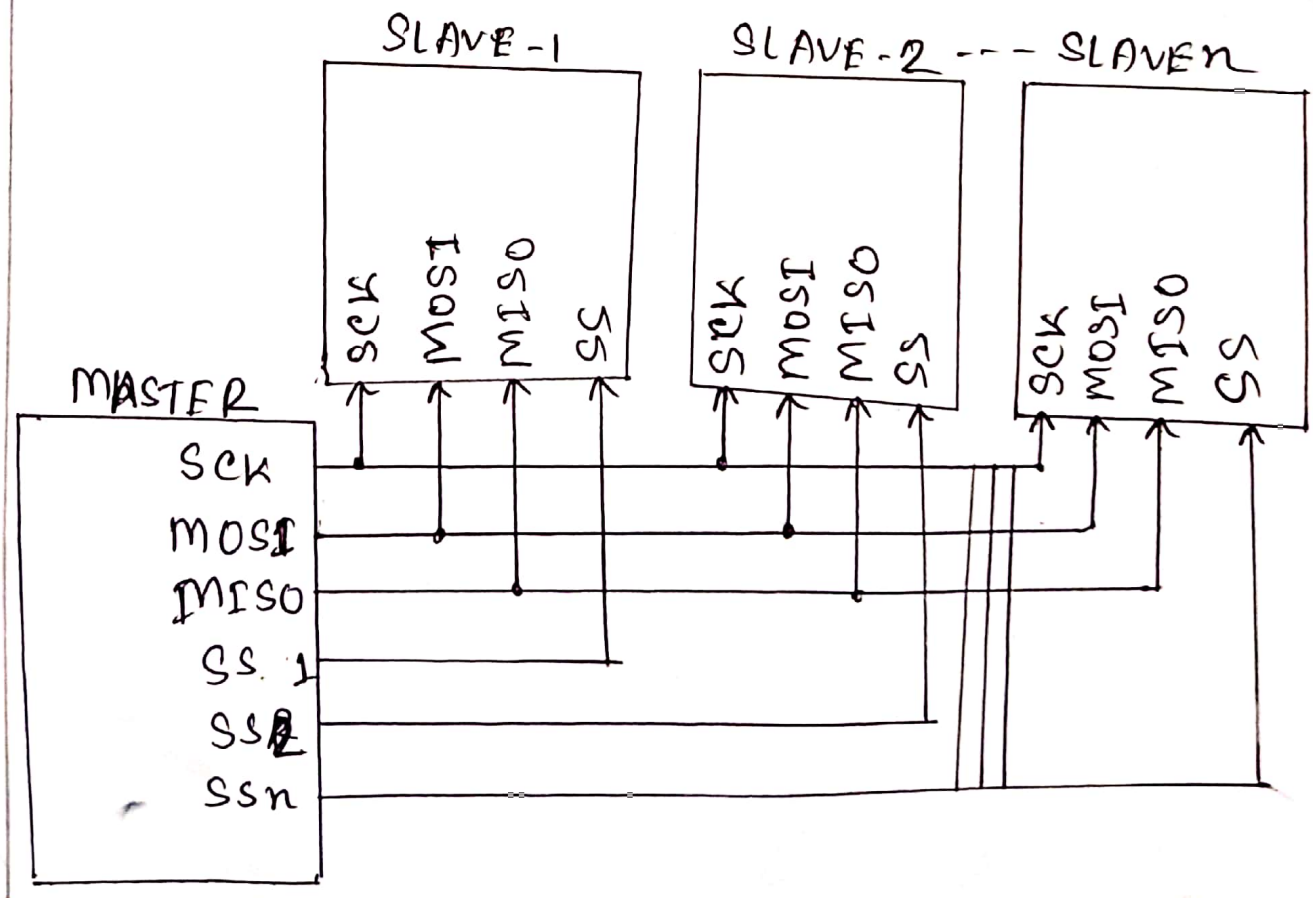
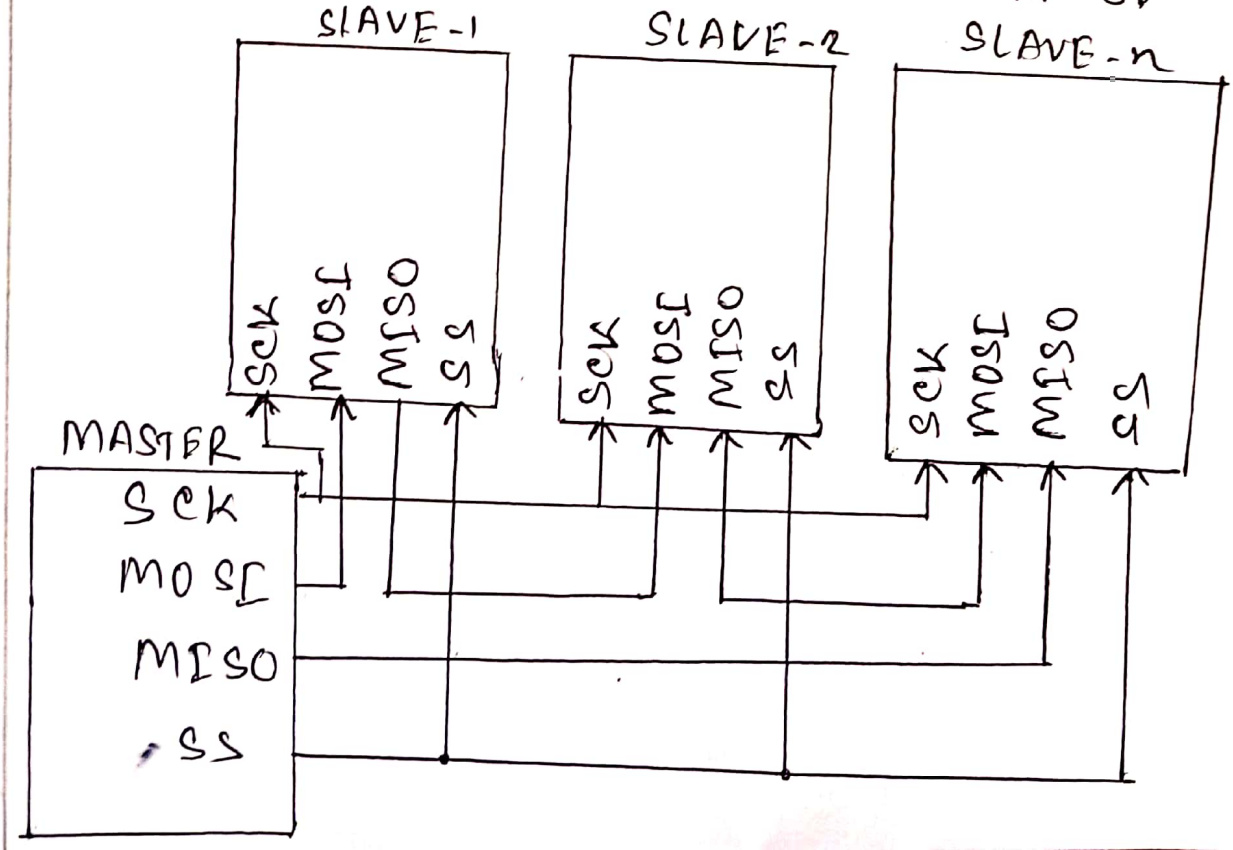
① Separate SS line: In general each slave will need a separate ss line. To talk to a Particular slave, it is necessary to make that slave's ss line low and keep the rest of them high (don't want two slaves activated at the same time, or they may both try to talk on same MISO line resulting garnble data).



② Single SS line: Some parts preface to be daisy-chained together, with the MISO (Output) of one going to the MOSI (input) of the next. In this case, a single ss line goes to all the slaves. Once all the data is sent, the ss line is raised. which causes all the chips to be activated simultaneously. This is often used for daisy-chained shift registers and address able LED drives.



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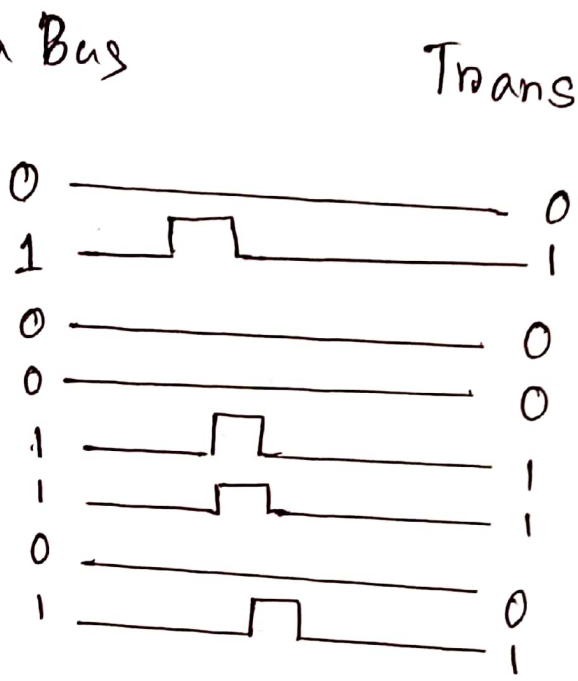
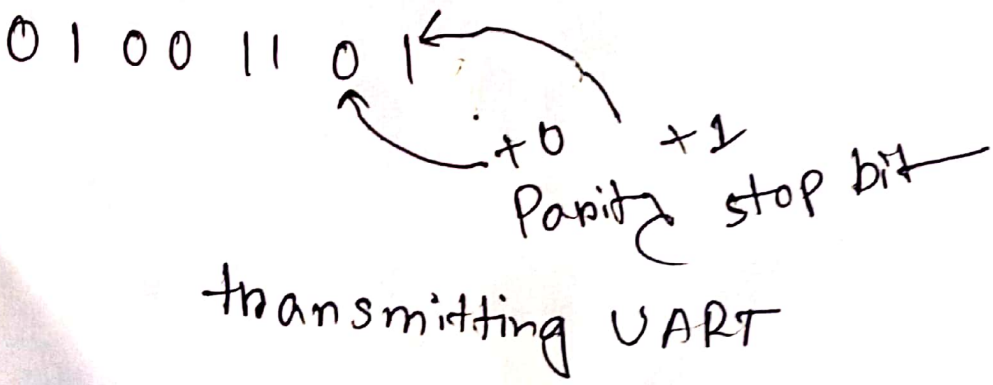
Answer to the Question no - 6(c)

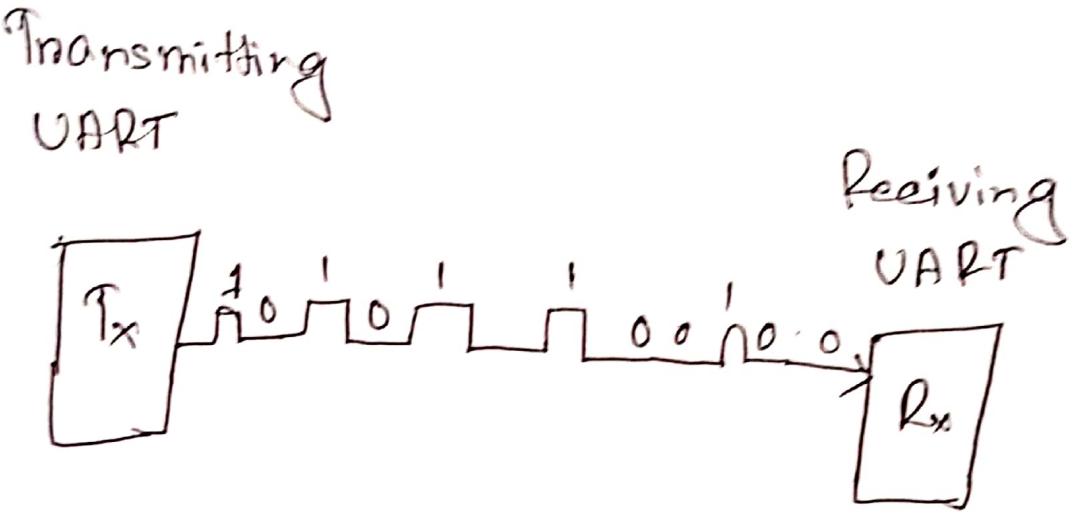
(1) Steps of the UART Communication:
The transmitting UART receives data in parallel from the data bus.



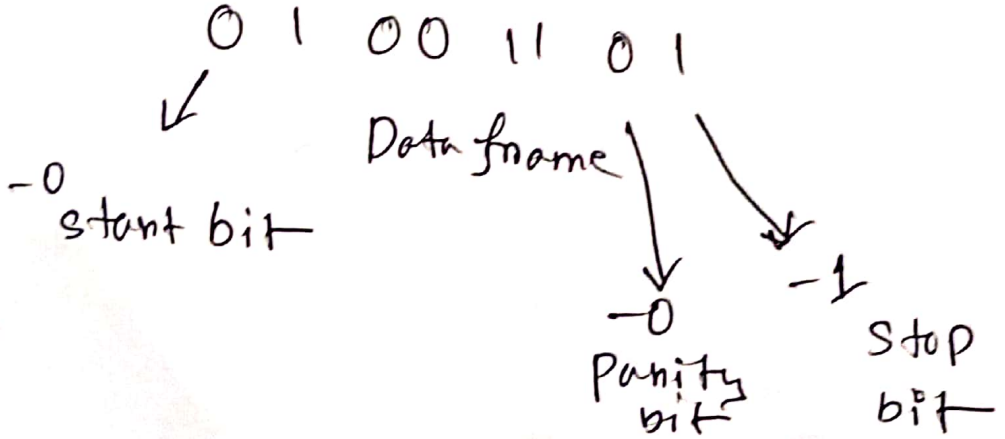
(2) The transmitting UART adds the start bit, Parity bit, and the stop bit(s) to the data frame:



(3) The entire packet is sent serially from the trasmitting UART to the receiving UART The receiving UART samples the data line at the pre configured band rate



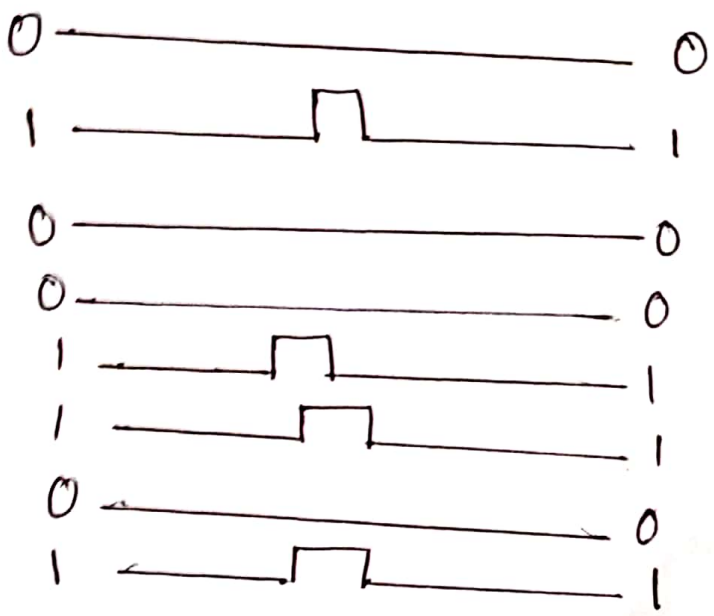
(4) The receiving UART discards the start bit, Parity bit and stop bit from the data frame.



5. The receiving UART Converts the serial data back into parallel and transfers it to the data bus on the receiving end.

Receiving UART

Data bus



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Answer to the question no: 7(A)

Comparing the erasing process of EPROM and EEPROM.

EPROM	EEPROM
1. It's contents can be erased using UV-ray & then reprogrammed by an EPROM Burner	1. It's contents can be erased by using high voltage electricity
2. It need EPROM Burner.	2. It does not required any external erasure and programable devices.
3. The chips needs to be physically removed from the socked for erasing the bits.	3. The chip does not need to physically removed from the socket for erasing the bits.

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EPROM	EEPROM
4. It takes upto 20 min for erasing	4. It instantly erase its contents
5. It's erase cycle is 1000	5. It's erase cycle is 100 000

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Answer to the Question no: 7(B)

Out of Sonar Senson and IR senson, sonar. senson is better for measuring distance. We know IR Senson emits infrared lights for measuring distance. So if any block object appears infront of the emmtied light, the black object absorved the light as a result the measuring of distance is not recive any reflected light. But sonar senson used sound to measure distance sending a sound wave towards an object often the sound reflect from that object the sonar records the receiving.

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Given that,

Speed of sound is 344 ms^{-1}

Round trip distance = 1200 m

~~Time~~

$$\text{distance} = \frac{\text{Speed of sound} \times \text{time taken}}{2}$$

$$1200 = \frac{344 \times \text{time taken}}{2}$$

$$\therefore \text{time taken} = \frac{1200 \times 2}{344} = 6.98\,s$$

For under water,

time taken = 1500 ms = 1.5 s

$$\text{distance} = \frac{\text{Speed of sound} \times \text{time taken}}{2}$$

$$= \frac{2 \times 1200}{1.5} = 1600\,ms^{-1}$$

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Answer to the question no: 7(c)

The most commonly used motor drivers is L293E. It has 2 built in H-bridge ~~Cir~~ circuit which are able to control two DC motors simultaneously in both clockwise and counter clockwise direction. It act as an current high amplifier because it take low current signal at its input and provides higher current signal at the output in order to drives different loads e.g stepper motor of DC motors,

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It's features includes large input voltage supply range, large output current, high noise immunity input signals etc.

Relay: A relay is an electrical switch that turns on or off based on an external electrical signals. It is just like a normal switch that we see in our homes. The only difference is that instead of a human being

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Switching it on or off, the switching is controlled via an external electrical signal. When the external signal is applied, the relay energizes and switch is on and when the external signal is removed, the relay is de-energized and the switch is off