Department: Computer Science & Engineering

Program: B.Sc. in CSE

Course No: CSE 3215

Course Title: Microcontroller Based System Design.

Examination: Semester Final

Semester (Session): Spring 2020

Student ID: 170204070

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Ans to the Question no – 01

1(a)

1) a) In Home we use washing machine that is an embedded system. To do same work more and more we use embedded system. ~~In~~ In washing machine it Washes cloth daily. We set timer and then it take & water & then soak them finally by spinning it washes our cloth. So, washing machine saves our most valuable time by washing our cloths automatically.

Air bag system in car / automobiles. It is also an embedded system that maintain hard real time. when any accident occurs Air bag come out and minimize impact and saving our lives.

Microwave. In Microwave oven we can bake our foods and Making delicious dishes. This Microwave oven is also an embedded system. Baking cake, Pizza, Making other delicious dishes using this. So, we can say, embedded system is

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Very important in our day to day lives.

1(b)

1)b) The distinguish between a micro controller and a microprocessor are given below—

Micro Controller	Microprocessor
(i) Computer on a chip	(i) CPU on a chip
(ii) Used on automatically controlled device like embedded system. ex: Washing machine, Microwave etc.	(ii) Mainly used in designing general purpose system.
(iii) Usually used for simple task.	(iii) Can perform complex task
(iv) Use for doing some ~~work~~ work, so, less computation capacity than Microprocessor.	(iv) Since doing lot of task, so, Computation capacity is very high.
(v) ~~Micro~~ Can perform single or very few task	(v) Can perform numerous task
(vi) In Microcontroller there have Processor, memory, I/O Peripherals. In some micro controller there also have internal memory. If need can add external memory also. so it is more like a complete system	(vi) To build a complete system using micro processor external component need to be connected.

(vii) Micro controller is less Cost	(vii) In Micro processor to build complete system overall cost is high
(viii) Less power Consumption	(viii) High power Consumption
(ix) Lower clock frequency usually in MHz.	(ix) Higher clock frequency usually in GHz.
(x) Micro Controller used more special function register than Micro processor	(x) Micro processor use less special function register.

1(c)

1(c) Answer:

```
CLR  PSW.4
SETB PSW.3  // Select bank 1.

MOV R1, #55H;
MOV R2 #56H;
MOV R3, #57H;
SETB PSW.4  //Select Register Bank 3
 MOV R0, #2H;
 MOV R2, #4H;
```

~~R1 of bank 1, from location~~

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· Content of Ram location

0F	R7
	⋮
0B	57
0A	56
09	55
08	R0

Bank 1

1F	R7
	⋮
1B	R3
1A	R4
19	R1
18	2

Bank 3

Since I used default stack location Bank no-1, So, I need to set SP.

```
MOV SP, #4FH
PUSH 9
PUSH 0AH
PUSH 0BH
PUSH 18
PUSH 1AH
```

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

Stack

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Ans to the Question no – 03

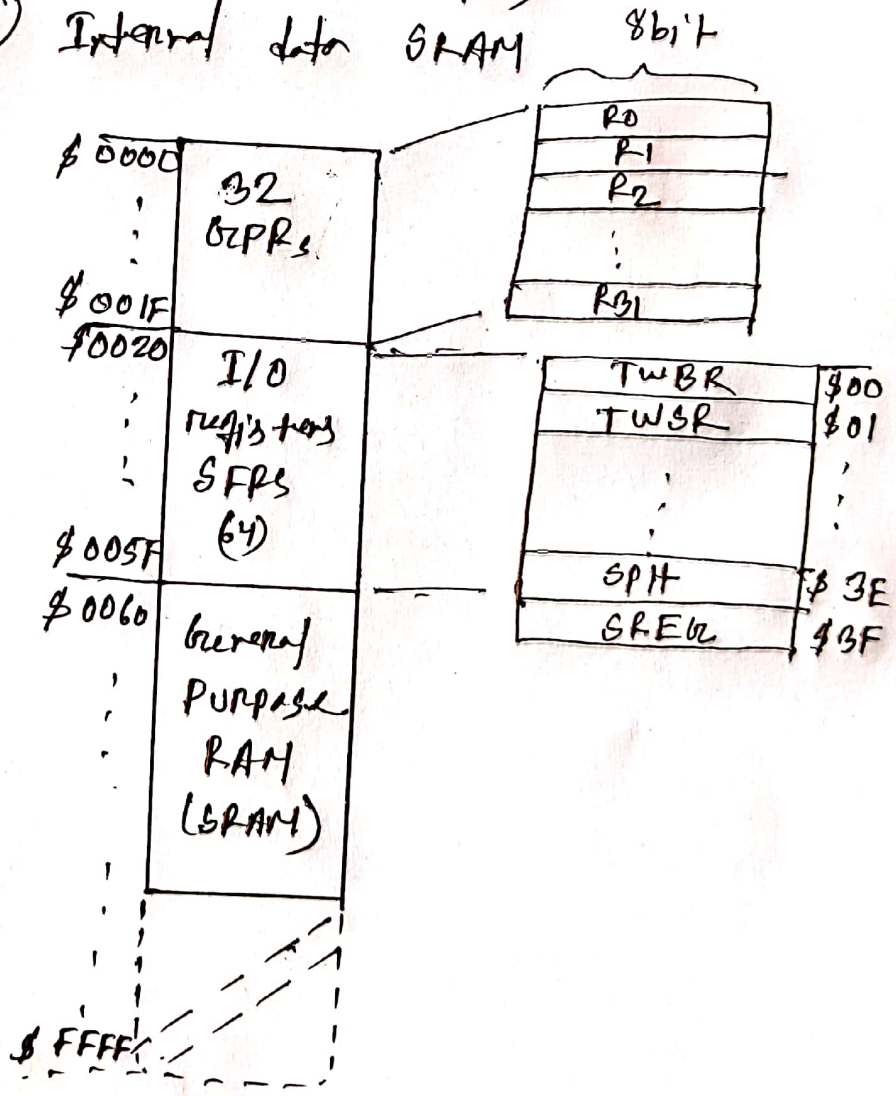
3(a)

Answer: AVR data memory is composed of three parts

(i) General purpose Registers ($R_0, R_1, \ldots R_{31}$)

(ii) I/O Memory (64 byte)

(iii) Internal data SRAM



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3(b)

SREG → Status Register

7	6	5	4	3	2	1	0
I	T	H	S	V	N	Z	C

Given that,

for Global interrupt enable I = 1

LDI R20, 60
LDI R21, 30
ADD R20, R21

60 = 0 0 1 1 1 1 0 0
30 = 0 0 0 1 1 1 1 0

(+) 90 = 0 1 0 1 1 0 1 0

R20 = 01011010

~~H=1~~ ~~Decimal~~

H = 1 [Because there is carry from D_3 to D_4]

N = X [Since 60 & 30 both unsigned Numbers]

Z = 0 [Since result is not zero]

C = 0 [No carry from D_7 bit]

V = X [don't care because 60 & 30 both unsigned numbers]

S = X [don't care because 60 & 30 both unsigned number]

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BST R20, 4

↳ T = 1 because, R20 = 0 1 0 1 1 0 1 0

Now,

GREG will be

7	6	5	4	3	2	1	0
1	1	1	X	X	X	0	0

3(c)

3(c) Answer: We all know that the status register is a hardware register that contains information about the state ~~of the pro~~ after every instruction execution. Suppose, there is a instruction that, ADD R18, R20. Then after this execution status register contains its state like the Half carry, Sign bit, ~~of~~ overflow bit, Negative or not, Zero or not, Carry exists or not etc information contains in the ~~Or~~ status register.

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Then in this status register information can be used for altering program flow in order to perform conditional operations.

Status register in 8051.

In 8051 PSW or Program status word Contains the status information

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
CY	AC	--	RS1	RS0	OV	--	P

CY → Carry flag. This carry flag set whenever there is carry out from D_7 bit. This flag is affected after an 8-bit addition or subtraction. By using SETB C we can set carry bit and CLR C to clear carry bit

AC → Ac stands for Auxiliary carry flag. If there is any carry from D_3 to D_4 During ADD or Sub operation, the the bit of Ac is set. Otherwise it is cleared.

P → Parity flag. It counts No of 1's in Accumulator. if A (Accumulator) Contains even number 1's, P=0

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~~Otherwise~~ for odd no of 1's, P = 1.

OV → Overflow flag. It affect only for signed operation (ADD/SUB) arithmetic. This flag is set when ever the result of a signed operation is too large, causing the higher order bit to overflow into sign bit

RS1 & RS0 used for bank selection.

III Status Register in AVR:

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
I	T	H	S	V	N	Z	C

I → Global interrupt enable.
used for enable or disable interrupt. 1 means enabled & 0 means disabled.

T → Bit Copy Storage.
The instruction BLD & BST,
BLD → Bit Load from ~~register~~ T to register
BST → Bit store from register to T.

H → Half carry flag. Like Auxiliary carry in 8051, useful in BCD Arithmetic. Carry From D_3 to D_4 is ~~called~~ set Half carry.

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S → Sign bit.
for Add / Sub between signed number
$S = N \oplus V$ where N = Negative flag
V = Overflow flag

V → Overflow flag
the overflow flag used to detect errors in signed arithmetic operation.
if there is carry from D_6 to D_7 but no carry from D_7, V is set.
if there is carry from D_7 but no carry from D_6 to D_7, V is set.

N → Negative flag
Set when in signed operation (ADD/SUB)
MSB = 1 ; for MSB = 0 result is positive & N is clear

Z → Zero flag
Zero flag set when the result is zero.

C → Carry flag
Carry flag set if there was carry from the MSB of the result.

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Ans to the Question no 4.)

4(a)

4) a) Answer:

A Voltage follower is a special type of non-inverting amplifier.

As we all know that a voltage follower is an operational amplifier circuit which has a voltage gain of 1.

Voltage follower

This means that the OP-amp does not provide any amplification to the signal. So, the voltage follower act as a buffer.

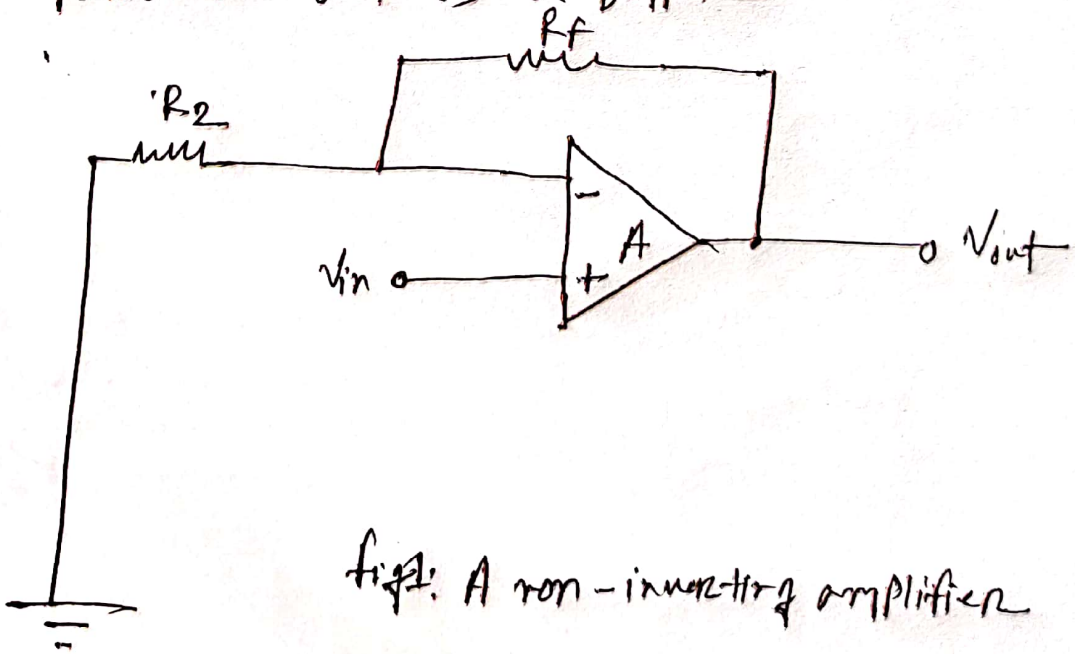


fig: A non-inverting amplifier

To make a non inverting amplifier to a voltage

follower we need to make the feedback register $R_f = 0$ and $R_2 = \infty$

Now, the fig 1 look like as below,

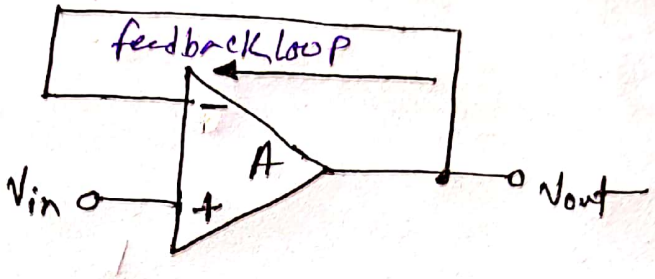


fig2: ~~feed~~ Voltage follower

As, $R_f = 0$ and $R_2 = \infty$

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

Therefore, gain $A_v = \frac{V_{out}}{V_{in}} = 1$

—

4(b)

4(b) Answer: Offset Null: Input offset voltage is defined as the voltage that must be applied between the two input terminals of an Operational amplifier to null or bring the output voltage to 0 zero. The offset

null effectively applies this voltage to ensure that the offset is remove the output.

In IC LM741 (op-amp IC) when we give same input to terminal 2 (Inverting Input) or to terminal 3 (Non-Inverting Input) we should get output of 0V. But the real opamps have some amount of output offset voltage. So to make the output zero, when some signal applied to pin 2 and 3 we give offset voltage by connecting a pot between offset pin and ground and adjust the offset voltage to make the output zero.

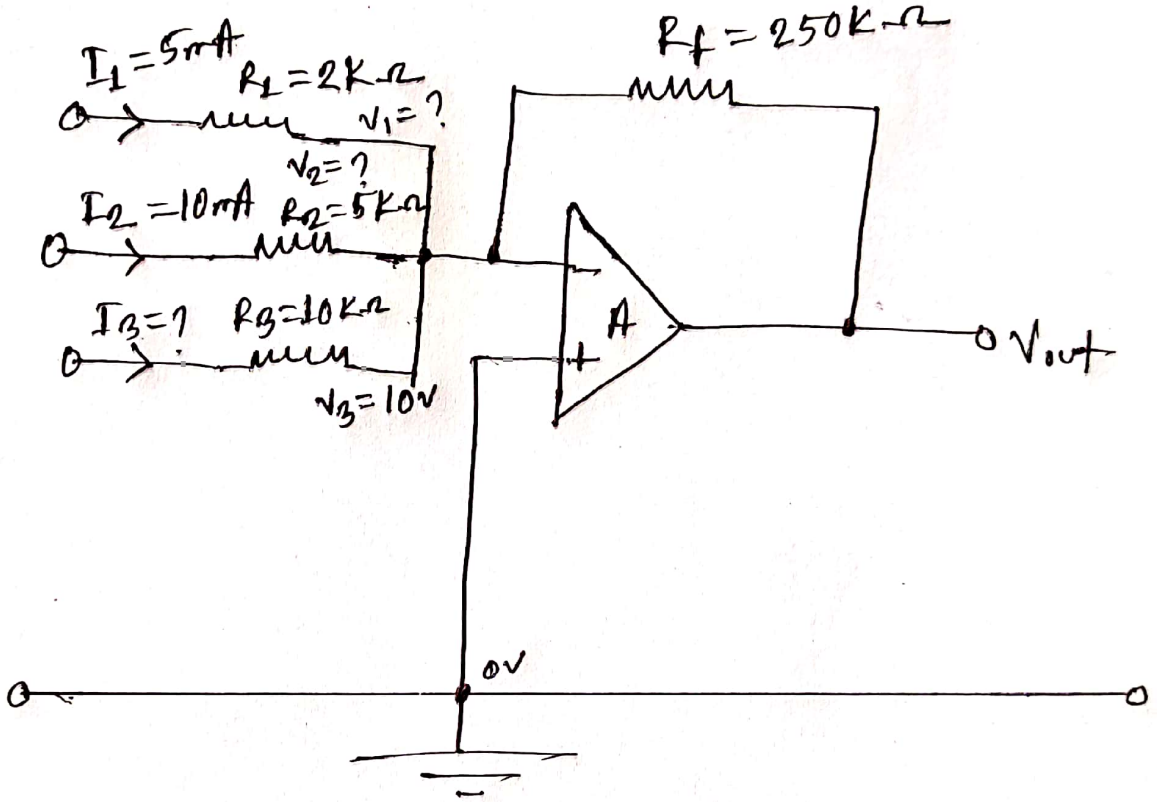
—

~~4d(c)~~

~~4(c) Answer:~~

4(c)

4(c) Answer:



$$\therefore V_1 = I_1 \times R_1 = (5 \times 10^{-3} \times 2 \times 10^3)V$$
$$= 10V$$

$$\therefore V_2 = I_2 \times R_2 = (10 \times 10^{-3} \times 5 \times 10^3)V$$
$$= 50V$$

$$\therefore I_3 = \frac{V_3}{R_3} = \frac{10V}{10 \times 10^3 \Omega} = 1mA$$

for Summing amplifier we know that,

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

$$= 250 \times 10^3\left(\frac{10}{2\times10^3} + \frac{50}{5\times10^3} + \frac{10}{10\times10^3}\right)$$

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

So, ~~Vout~~ $V_{out} = -4000\,V = -4\,KV$

(Answer)

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Ans to the Qustion no - 06

6(a)

6) (A) Answer:

Advantages of I2C over UART and SPI given below —

1. I2C is a serial ~~Comm~~ Communication protocal allow to connect multiple master and multiple slave (not more than 1008). But in SPI that allows only simple master and multiple slave.
On the other hand Universal Asynchronous Receiver/Transmitter (UART) ~~is allows~~ dosnot allows multiple slave or multiple master system

2. I2C Uses only two wires, But in SPI uses 4 wires (MOSI, MISO, SCLK, SS/CS) so, I2C is better ~~perfor~~ than SPI. Here, UART also use two wires for TX, Rx.

3. In I2C it allows multiple master to controlling multiple slave or multiple

& master controlling single or multiple slaves. On the other hand SPI only allows a single master to controlling single or multiple slaves. In UART it does not allows multiple master or multiple slave. Here, single master controlling single slave.

In I2C, ACK/NACK bit gives confirmation that each frame is transmitted successfully. But in SPI or UART does not any ACK/NACK bit. But UART has parity, start & stop but but not efficient of ACK/NACK bit of I2C.

In I2C, the hard ware design is less complicated than UART ~~or~~ and SPI. Since SPI use 4 wires so its Hard ware is much more complicated than UART & I2C

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6(b)

6(b) Answer: Serial Peripheral Interface (SPI) is an interface bus or communication protocol commonly used to send data between micro-controller and small peripherals such as shift registers, sensors and SD cards.

SPI can be setup to operate with a single master and a single slave and it can also controlled multiple slave. there are two ways to connect multiple slaves to the master.

1. Separate SS line
2. Single SS line.

1. Seperate SS line: In this way each slave will need seperate SS line to connect with master.

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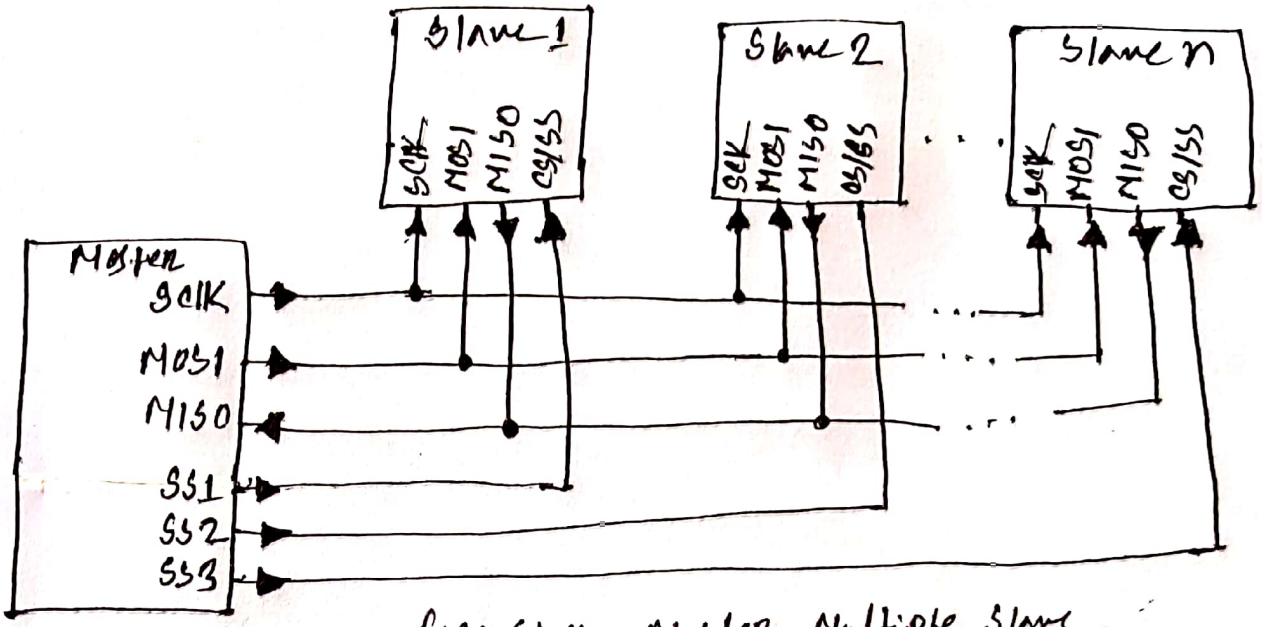

fig: Single Master Multiple Slave (seperate SS line)

Here, Master output Slave Input also connected so, when at a time two Slave activated ~~that will~~ two Slave will try to ~~give~~ talk on the same MISO, resulting garbage data. So to avoid that only one time one Slave select (SS) will low others remain high. Low Slave. Then ~~+~~ activated.

2. Single SS line: Some ports prefer to be daisy-chained together, with the MISO (output) of going to the MOSI (input) of the next. In case, a single SS line goes

the slaves. Once all the data sent, the SS Line is raised, which cause all the slave activated simultaneously. This often use daisy chained shift registers and addressable LED drivers.

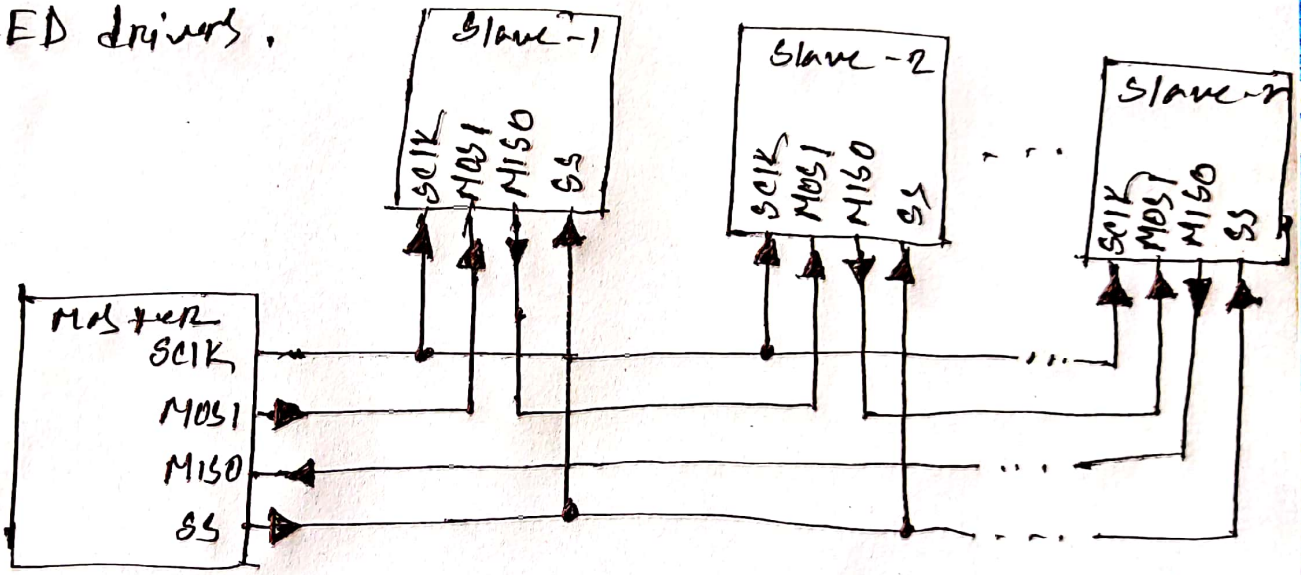

fig: Single master Multiple Slave (Single SS line)

6(c)

6(c) ~~Sol~~ Answer: The steps of UART Communication is given below

1. The transmitting UART receives data in parallel from the data bus.

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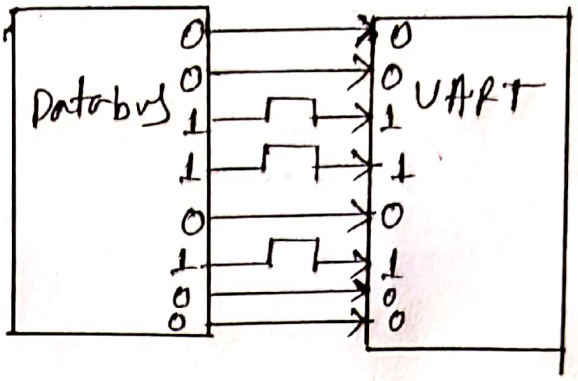
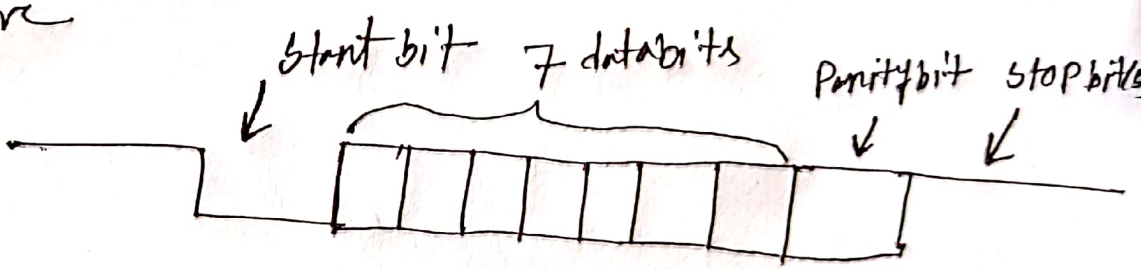
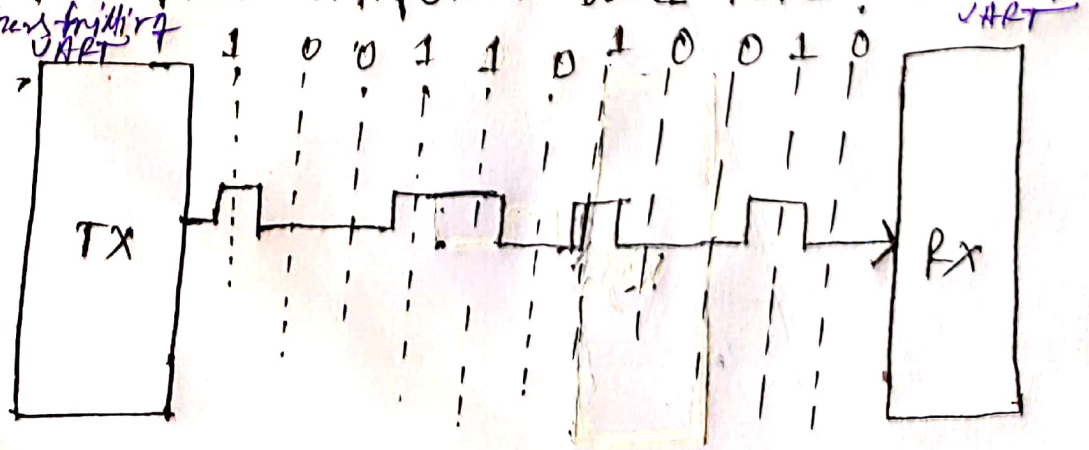


2. The transmitting UART adds the start bit, Parity bit, and the stop bit(s) to the data frame



transmission efficiency 7/10 or, 70%

3. The entire packet is sent serially from the transmitting UART to the receiving UART. The receiving UART samples the data at the pre-configured baud rate.



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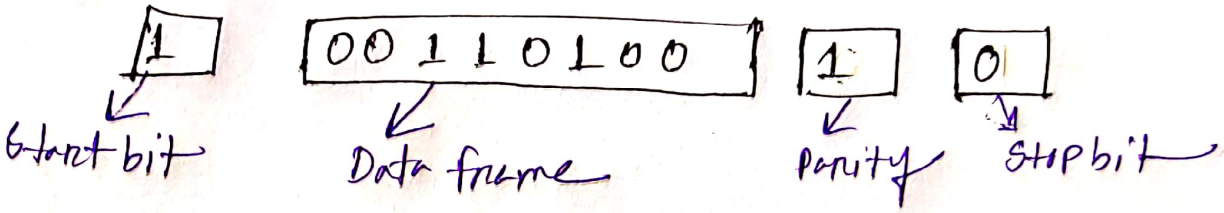
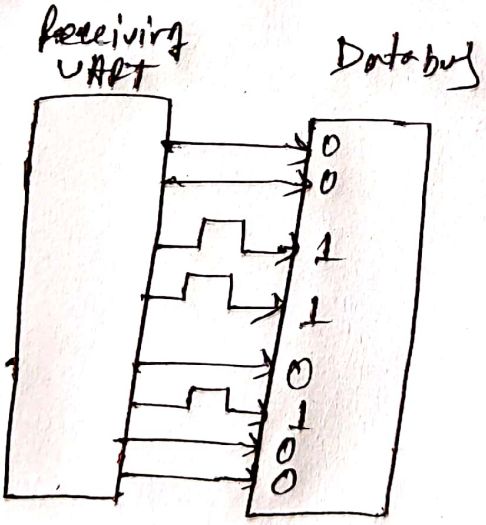
4. The receiving UART discards the start bit, Parity bit and Stop bit from the data frame



5. The receiving UART converts the serial data back into parallel and transfer to the data bus on the receiving end



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Ans to the Question no - 7

7(a)

7(a) Answer:

Erasing process of EPROM & EEPROM given below

EPROM	EEPROM
(i) In EPROM, UV light is used to erase the EPROM's content.	(i) In EEPROM, electric signal is used to erase the content of EEPROM.
(ii) In EPROM, UV radiation take 15 - 20 minutes to erase the content.	(ii) In EEPROM, erasure consume 5 milisecond time for erasing content. So, erasing process is much more faster than EEPROM
(iii) EPROM chip need to remove from its socket on the system board and place it in EPROM erasure ~~to~~ equipment to erase EPROM chip.	(iii) The main advantage of EEPROM is, one can erase the content of EEPROM while it is still in the system board.

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~~Ans to 1~~

7 (b)

7(b) Answer:

Sonar sensor: An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending a sound wave at specific frequency and listening for that sound wave to bounce back.

IR sensor: An Infrared (IR) sensor is used to detect obstacles in front or to differentiate between colour depending on the configuration of the sensor.

Since IR use only for detecting object sometimes IR can not ensure the light will come back because in black surface light will completely absorbed.

So, to measuring distance Sonar sensor is

more accurate and preferable.

Here,

given distance = 1200m

Speed of sound (air) = 344 ms^{-1}

So, time taken in Air, $T_1 = \frac{1200 \times 2}{344}$ sec

$= 6.976$ sec

Speed of sound (water) = ?

time taken under water = ~~1500~~ 1500 millisecond

$= 1.5$ second

Speed of sound under water = $\frac{1200 \times 2}{1.5}$ ms^{-1}

$= 1600\ ms^{-1}$

(Answer)

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7(c)

7) c) Answer:

L293D motor driver:

The L293D Motor driver is a 16 ~~PIN~~ Pin IC with eight pin each side dedicated to the controlling a motor. There are 2 Input pins, 2 output pins and 1 enable pin for each motor. L293D Motor Driver consists of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor.

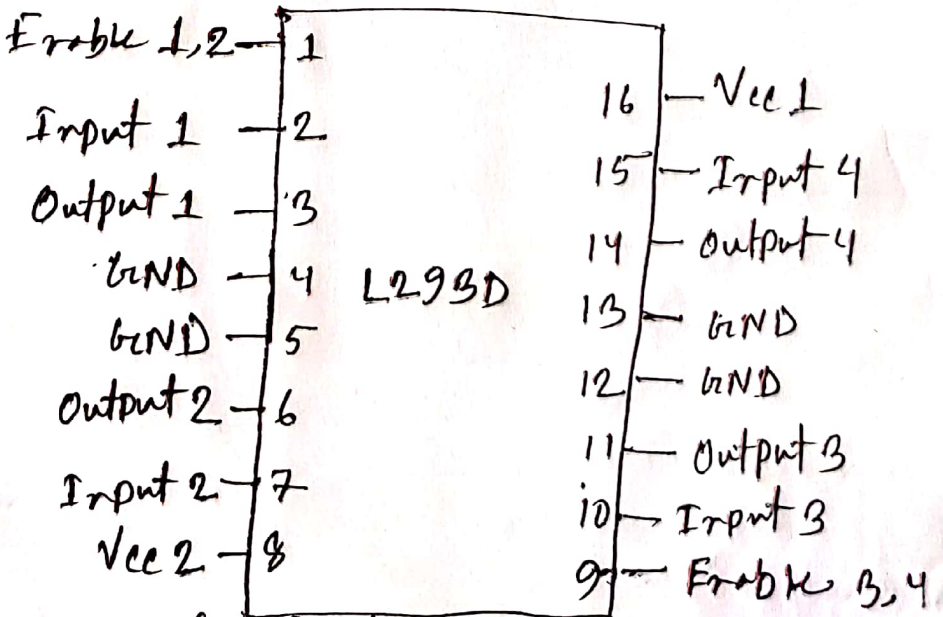

fig: Pin diagram of L293D

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Relay:

A relay is an electrical switch that turns on or off, based on an external electrical signal. It is just like a normal switch that we see in our homes. The only difference between home switch vs relay is, instead of a human being switching on, off the relay switching / controlled via an external electrical signal. when the external electrical signal applied, the relay ~~eng~~ energizes and the switch is on, and when, the external electrical signal is removed, the relay is de-energized and the switch is off.

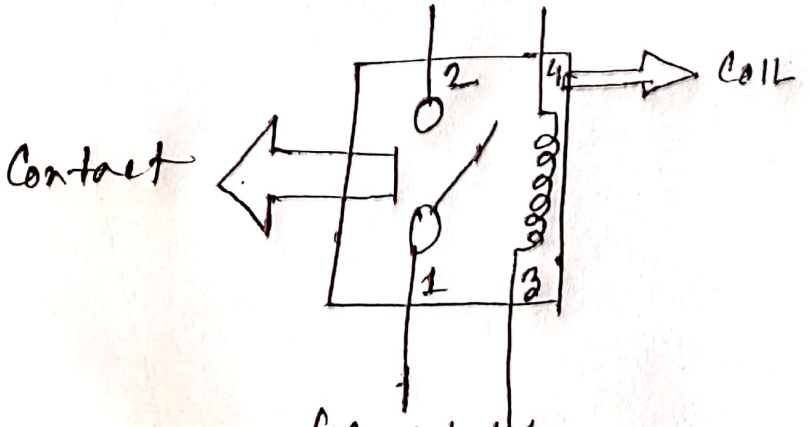

fig: Relay

Relay switching circuit (coil) based up on the DC on AC Voltage.

In the diagram of relay 1 and 2 shows Contacts which are open while 3 and 4 shows Coil. When the coil become energized it become closed and change its state.

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