FOURTH SEMESTER BTECH DEGREE EXAMINATION, 2017
CS202: COMPUTER ORGANISATION & ARCHITECTURE

Time:3hrs**SCHEME** Max. Marks:100

PART A
(Answer all questions. Each carries 3 marks)

1. **What are the basic instruction types. Give examples.**

Ans :

Basic Instruction Types:

Instruction Type	Syntax	Eg	Description
Three Address	Operation Source1,Source2,Destination	Add A,B,C	Add values of variable A ,B & place the result into c.
Two Address	Operation Source,Destination	Add A,B	Add the values of A,B & place the result into B.
One Address	Operation Operand	Add B	Content of accumulator add with content of B.

2. **Explain different types of software.**

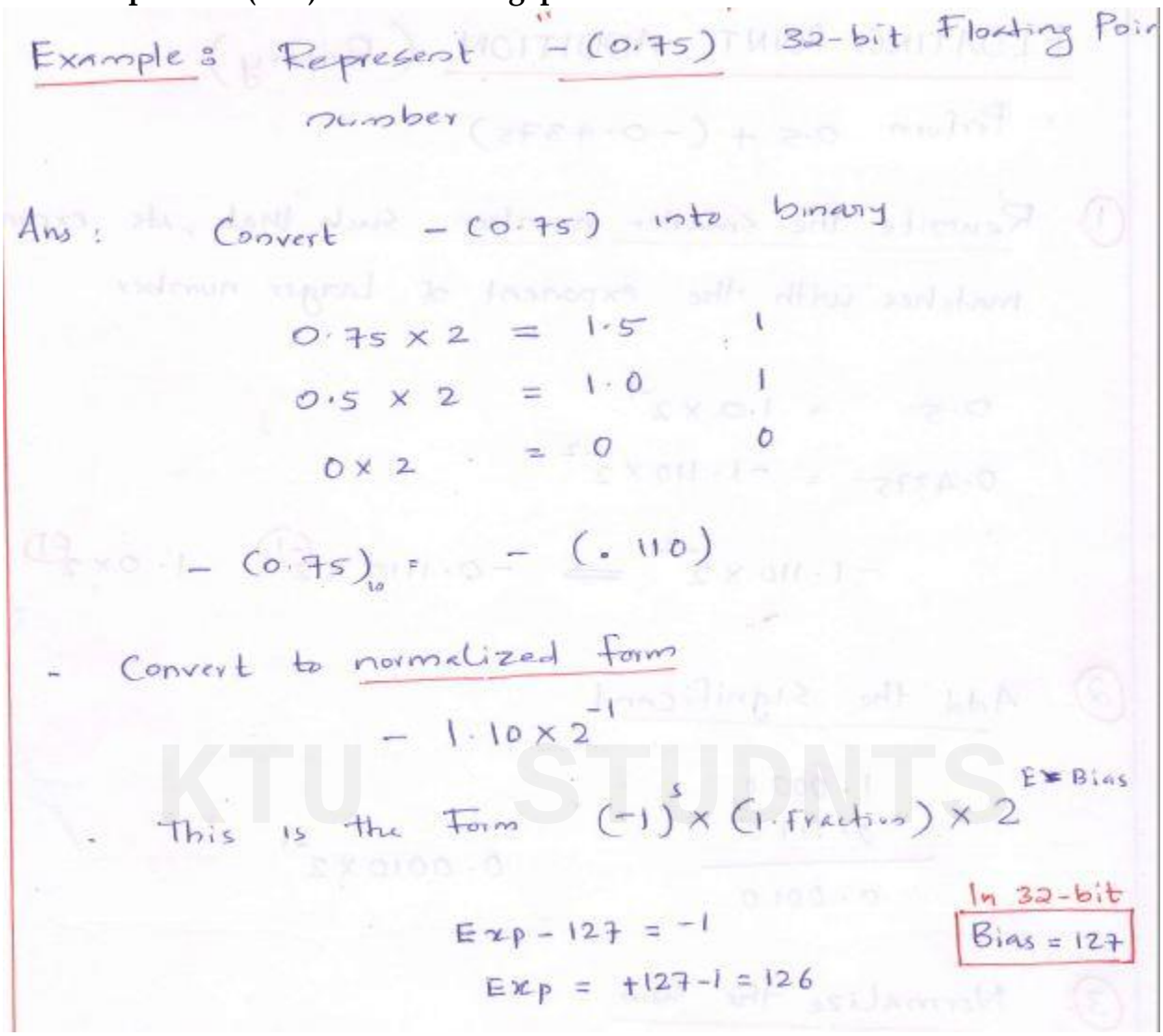
Ans :

- System Software is a collection of programs that are executed as needed to perform function such as,
- Receiving & Interpreting user commands.
- Entering & editing application program and storing them as files in secondary Storage devices.
- Managing the storage and retrieval of files in Secondary Storage devices.
- Running the standard application such as word processor, games, and spreadsheets with data supplied by the user.

- Controlling I/O units to receive input information and produce output results.
- Translating programs from source form prepared by the user into object form.
- Linking and running user-written application programs with existing standard library routines.

- **System software:** helps run the computer hardware and computer system
- Eg : OS, Device drivers
- **Programming software:** helps a programmer in writing computer program and software using different programming languages
- Eg : Editors, compilers, interpreter, linker,
- **Application software:**Allow end user to accomplish one or more specific tasks
- Eg: industrial automation, business software, Educational software

3. **Represent -(0.75) 32-bit floating point number**



Example : Represent -(0.75) 32-bit Floating Poin number

Ans : Convert -(0.75) into binary

$0.75 \times 2 = 1.5 \quad 1$

$0.5 \times 2 = 1.0 \quad 1$

$0 \times 2 = 0 \quad 0$

$-(0.75)_{10} = -(.110)$

- Convert to normalized form

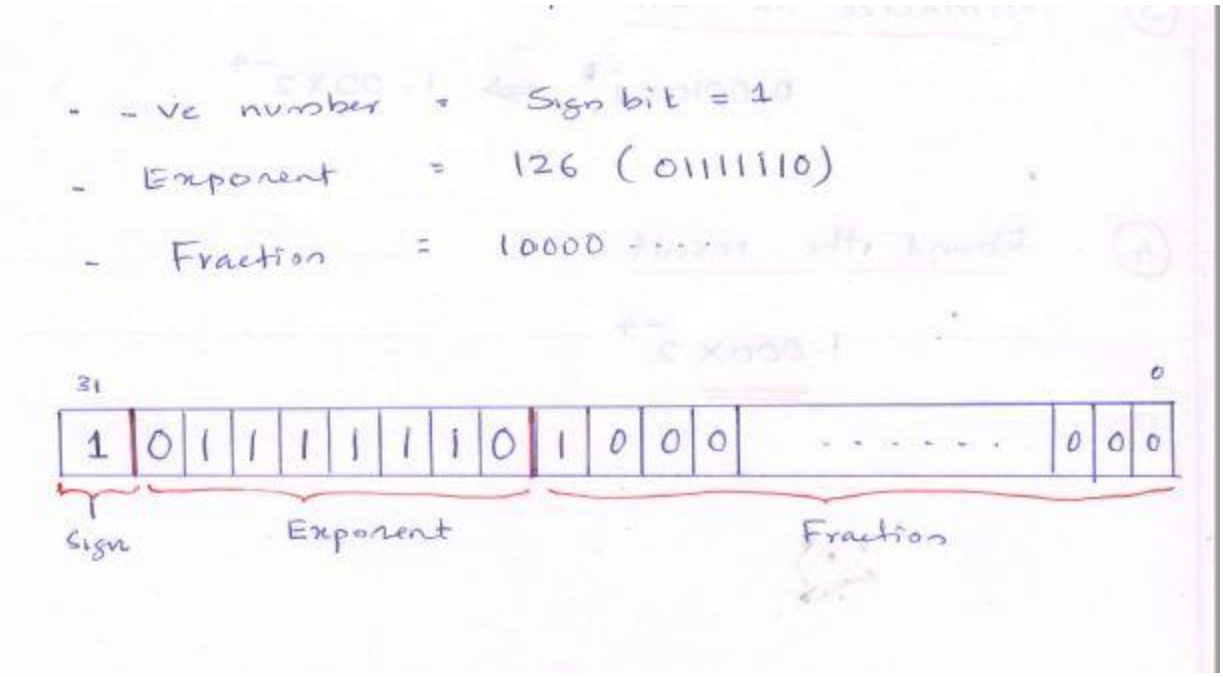
-1.10×2^{-1}

- This is the Form $(-1)^S \times (1.\text{fraction}) \times 2^{E-\text{Bias}}$

In 32-bit
Bias = 127

$Exp - 127 = -1$

$Exp = +127 - 1 = 126$



4. **Design a 4x4 array multiplier.**

ARRAY MULTIPLIER

- Binary multiplication of unsigned operands can be implimented in a combinational, two dimensional, logic array, for the 4-bit.

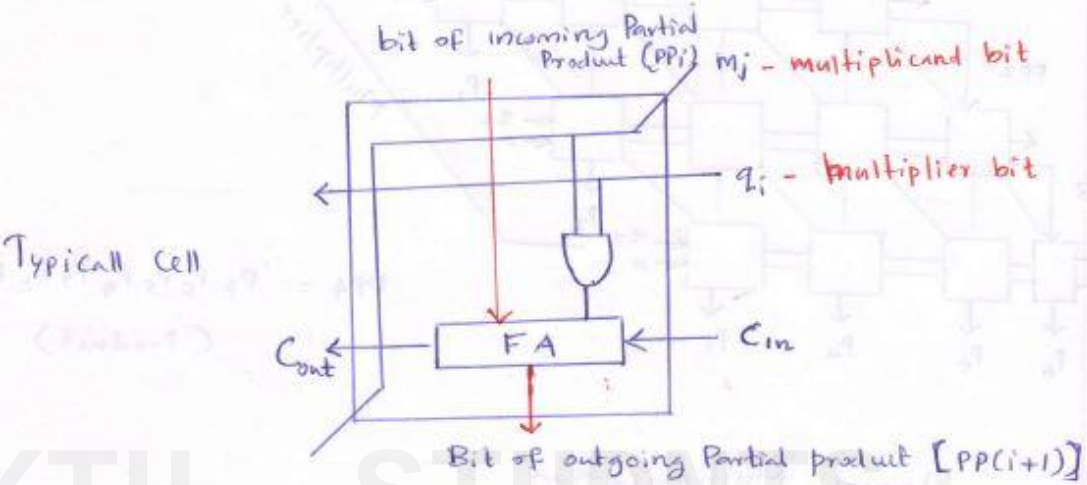
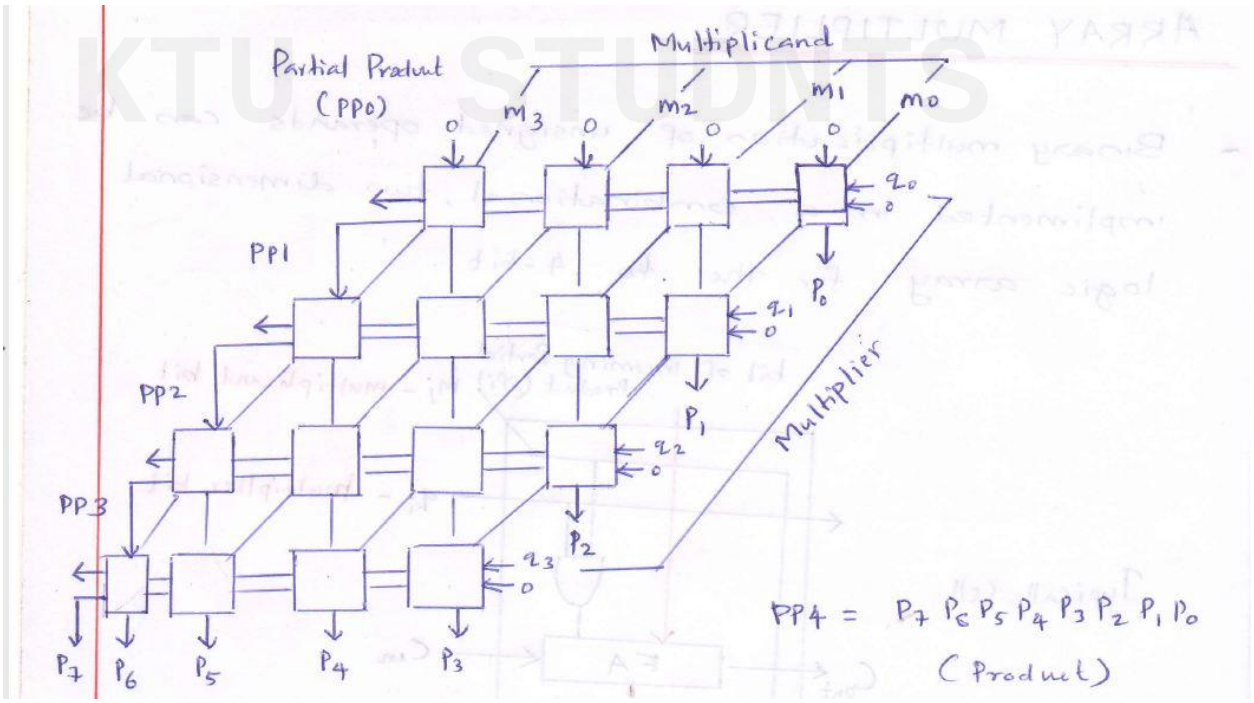


Fig: "Array implimentation"

- The main component in each cell is a full adder

F4.

- The AND gate in each cell determine whether a multiplicand bit m_j is added to incoming Partial Product bit, based on the value of multiplier bit q_i
- Each row i, add the multiplicand the incoming Partial product PP_i, to generate the outgoing Partial product $PP_{(i+1)}$, if $q_i = 1$.
- If $q_i = 0$, PP_j Passed Vertically downward unchanged
- PP_0 is full 0's and PP_4 is desired Product



4x3=12

PART B
(Answer any two. Each carries 9 marks)

5. a) **Consider the program**

Move N,R1

Clear R0

Add next number to R0

Decrement R1

Branch >0

Move R0, SUM

What is the target address of branch instruction in relative addressing mode? (Assume that the word length is 32 bits and the memory is byte addressable)

Ans :

i Move N,R1

i+4 Clear R0

i+8 Add next number to R0

i+12 Decrement R1

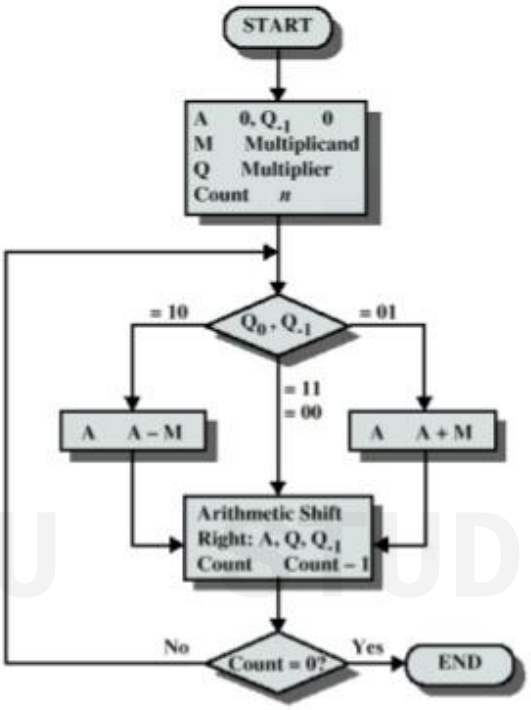
i+16 Branch >0

i+20 Move R0, SUM

- Assume that three instruction of the loop body, starting at LOOP are located at memory location i+8, i+12, i+16
- Hence the updated content of PC at the time of branch target address is generated will be i+20
- To branch to location LOOP(i+8)
- The offset value needed is X= - 12 …… (5)

b) **Explain Booth's Multiplication algorithm with example .**

Booth's Algorithm



Example : Multiply "2x-3" using Booths multiplication

Iteration	Steps	Multiplicand	Product	Q_0	Q_{-1}
0	Initial values	0010	0000	1101	0
1	1c: 10 ⇒ P = P−M	0010	1110	1101	0
	2: Shift Product Right	0010	1111	0110	1
2	1b: 01 ⇒ P = P+M	0010	0001	0110	1
	2: Shift Product Right	0010	0000	1011	0
3	1c: 10 ⇒ P = P−M	0010	1110	1011	0
	2: Shift Product Right	0010	1111	0101	1
4	1d: 11 ⇒ No operation	0010	1111	0101	1
	2: Shift Product Right	0010	1111	1010	1

2 → 0010
3 → 0011
−3 → 1101

2x − 3 = −6

6 → 0110
−6 → 1001
1
−6 → 1010

……..(4)

5. a)**Explain the functional Units of a Computer.**

A computer consists of 5 main parts.

- Input
- Memory
- Arithmetic and logic
- Output
- Control Units

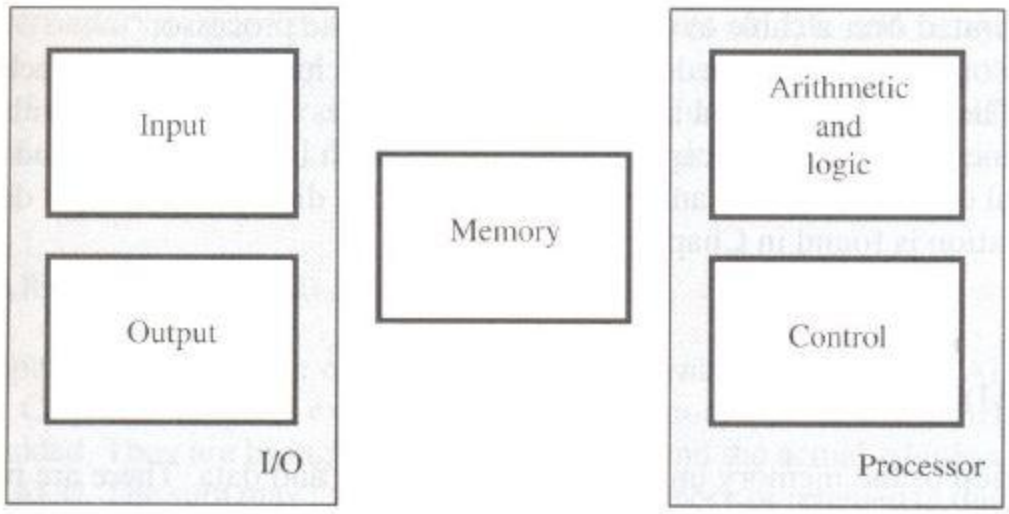


Figure 1.1 Basic functional units of a computer.

Input Unit

- Computers accept coded information through input units, which read the data.
- Whenever a key is pressed, the corresponding letter or digit is automatically translated into its corresponding binary code and transmitted over a cable to either the memory or the processor.
- Some input devices are

- Joysticks
- Trackballs
- Mouse
- Microphones

Memory Unit

- It stores the programs and data.

- There are 2 types of storage classes
- Primary
- Secondary
- Primary Storage:
- It is a fast memory that operates at electronic speeds.
- Programs must be stored in the memory while they are being executed.
- The memory contains large no of semiconductor storage cells.
- Each cell carries 1 bit of information.
- The Cells are processed in a group of fixed size called Words.
- To provide easy access to any word in a memory, a distinct address is associated with each word location.
- Addresses are numbers that identify successive locations.
- The number of bits in each word is called the word length.
- The word length ranges from 16 to 64 bits.

❖ There are 3 types of memory. They are

❖ RAM(Random Access Memory)

❖ Cache memory

❖ Main Memory

ALU

❖ Most computer operations are executed in ALU.

❖ Consider a example,

❖ Suppose 2 numbers located in memory are to be added. They are brought into the processor and the actual addition is carried out by the ALU. The sum may then be stored in the memory or retained in the processor for immediate use.

❖ Access time to registers is faster than access time to the fastest cache unit in memory

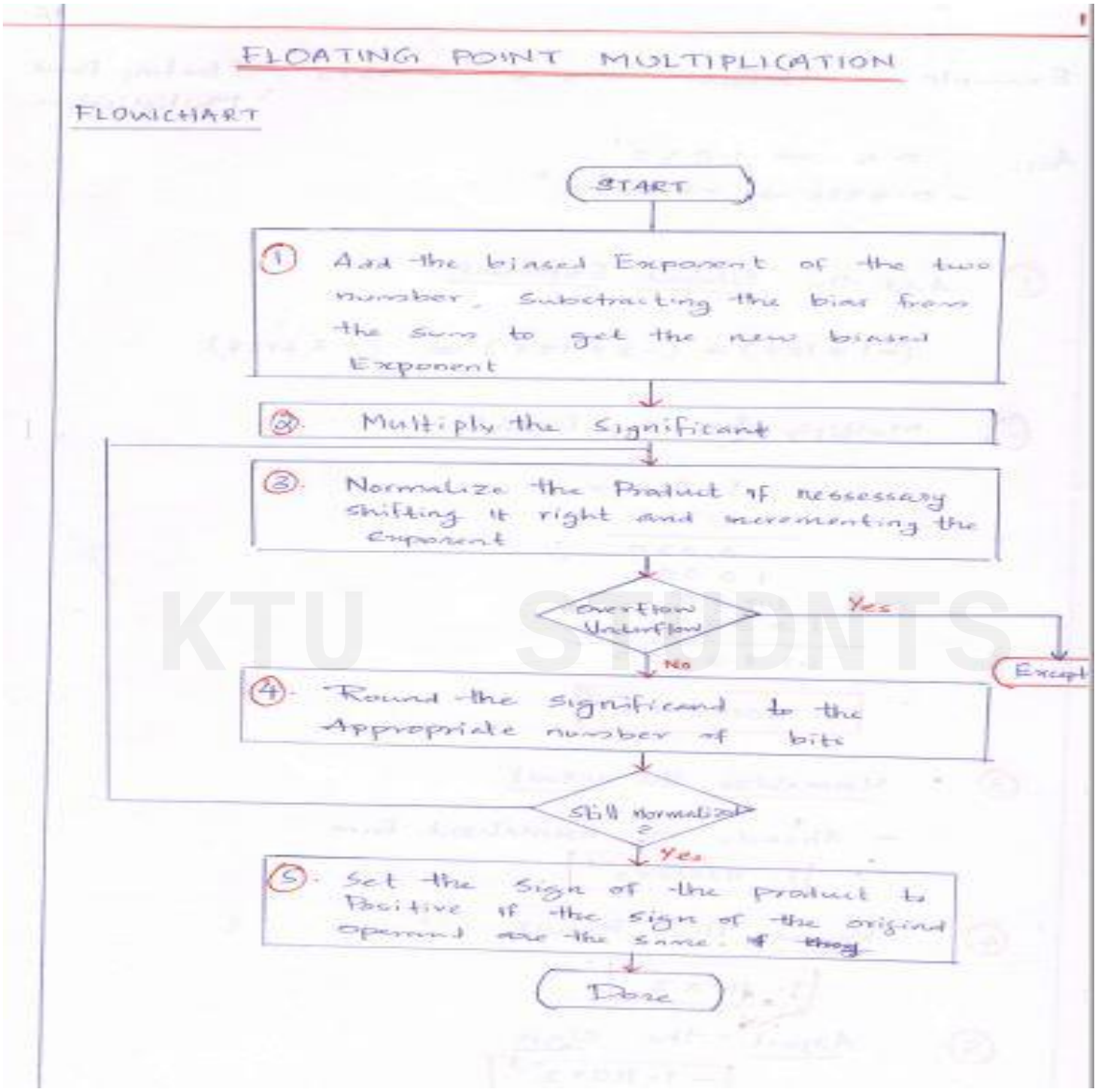
OUTPUT UNIT

- Its function is to send the processed results to the outside world.
- Eg. Printer
- Printers are capable of printing 10000 lines per minute but its speed is comparatively slower than the processor.

CONTROL UNIT

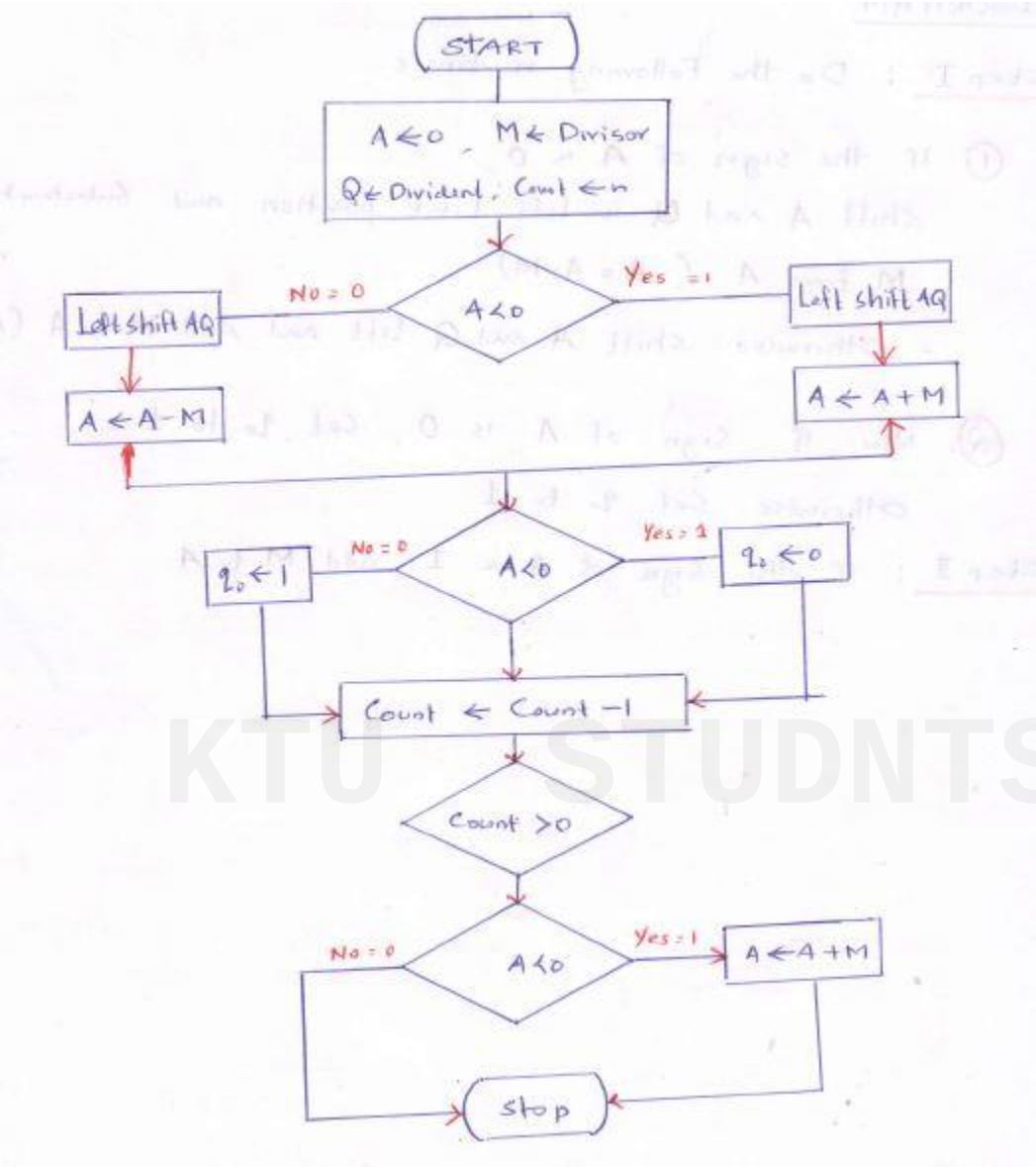
- The operations of Input unit, output unit, ALU are co-ordinate by the control unit.
- The control unit is the Nerve center that sends control signals to other units and senses their states.
- Data transfers between the processor and the memory are also controlled by the control unit through timing signals. ……(5)

b) **Give the flow chart of floating point multiplication**



…….(4)

6. **Explain Non-restoring method of division with an example**.



Non-Restoring Division

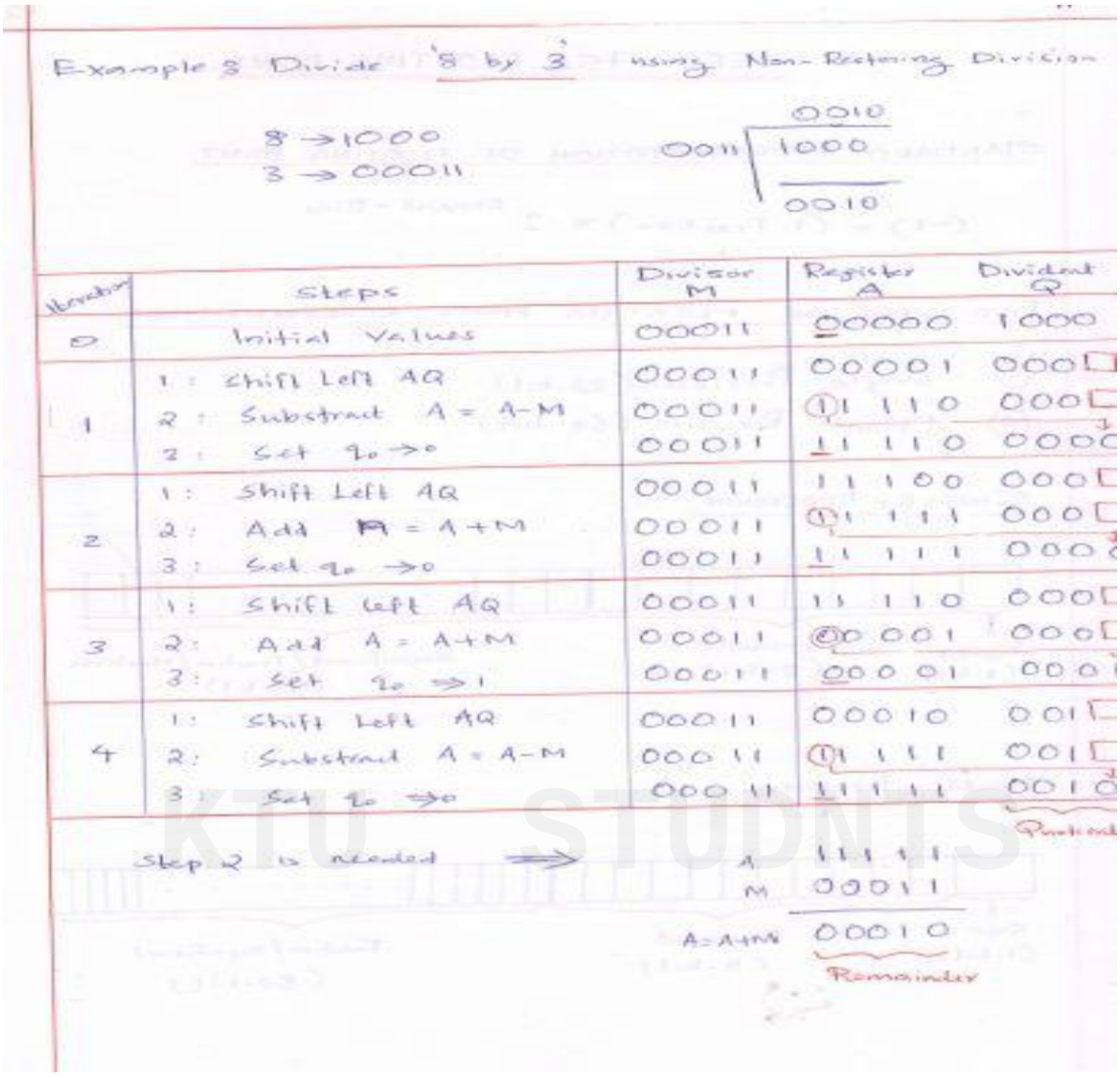
ALGORITHM

Step I : Do the Following n times

(1) If the sign of A is 0,
shift A and Q is left 1-bit position and Substract M from A (A = A-M)
- Otherwise shift A and Q Left and Add M to A (A=

(2). Now, If Sign of A is 0, Set q_0 to 1
Otherwise Set q_0 to 1

Step II : If the sign of A is 1, add M to A



2x9=18

PART C
(Answer all questions. Each carries 3 marks)

7. **What is mean by Exceptions? What are the types of exceptions.**

Ans :

Exceptions:

- An interrupt is an event that causes the execution of one program to be suspended and the execution of another program to begin.
- The Exception is used to refer to any event that causes an interruption.

Kinds of exception:

- Recovery from errors
- Debugging
- Privileged Exception

Recovery From Errors:

- Computers have error-checking code in Main Memory , which allows detection of errors in the stored data.
- If an error occurs, the control hardware detects it informs the processor by raising an interrupt.
- The processor also interrupts the program, if it detects an error or an unusual condition while executing the instance (ie) it suspends the program being executed and starts an execution service routine.
- This routine takes appropriate action to recover from the error.

Debugging:

- System software has a program called debugger, which helps to find errors in a program.
- The debugger uses exceptions to provide two important facilities
- They are
- Trace
- Breakpoint

Privileged Exception:

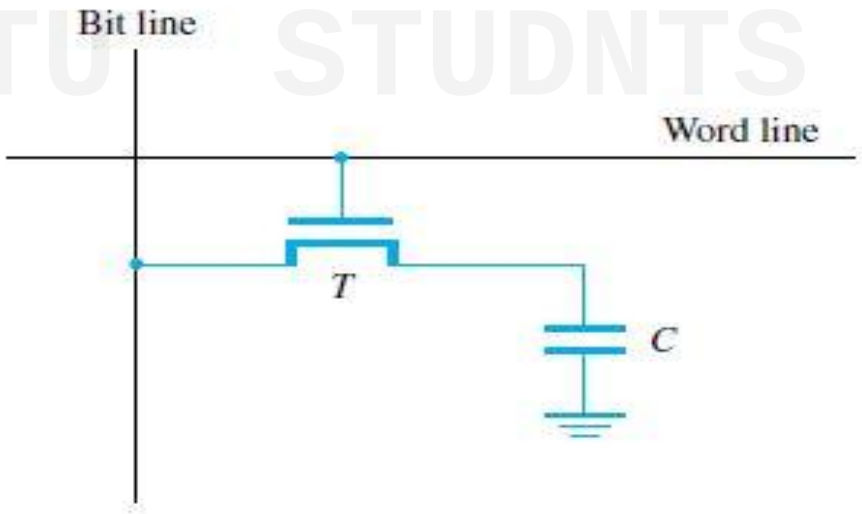
- To protect the OS of a computer from being corrupted by user program certain instance can be executed only when the processor is in supervisor mode. These are called privileged exceptions.
- When the processor is in user mode, it will not execute instance (ie) when the processor is in supervisor mode, it will execute instance.

8. **What are the three methods of controlling interrupts.**

- Disabling interrupt
- Ignoring interrupt
- Special interrupt request line

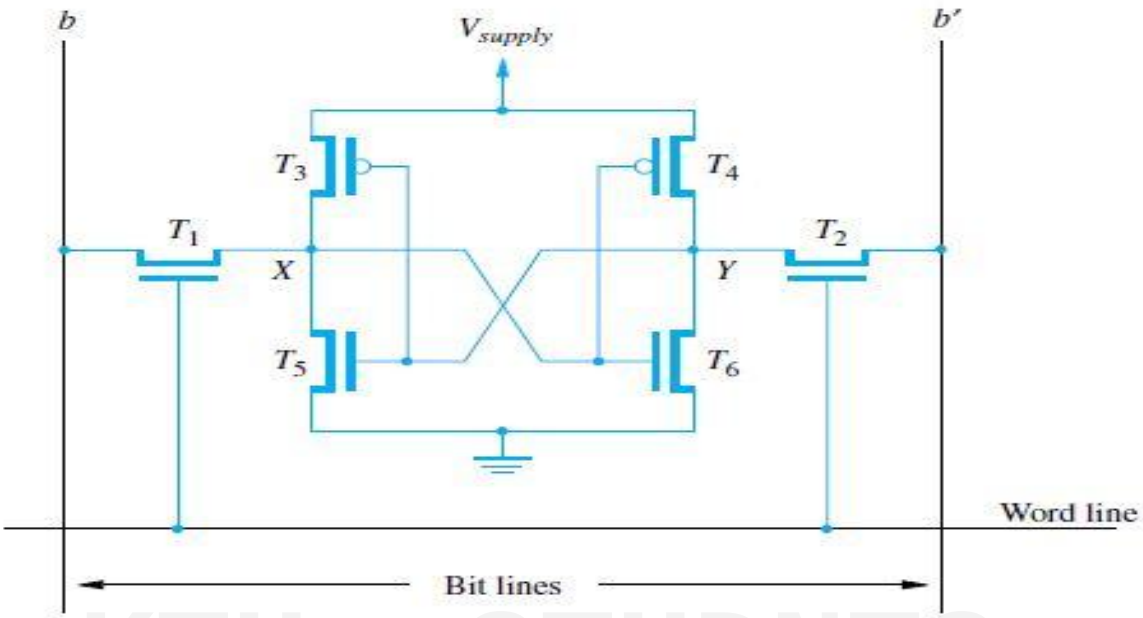
9. **How information stored in Dynamic cell. Illustrate with help of figure**

- Less expensive RAM's can be implemented if simplex calls are used such cells cannot retain their state indefinitely. Hence they are called Dynamic RAM's (DRAM).
- The information stored in a dynamic memory cell in the form of a charge on a capacitor and this charge can be maintained only for tens of Milliseconds.
- The contents must be periodically refreshed by restoring by restoring this capacitor charge to its full value



- In order to store information in the cell, the transistor T is turned "ON" & the appropriate voltage is applied to the bit line, which charges the capacitor.
- After the transistor is turned off, the capacitor begins to discharge which is caused by the capacitor's own leakage resistance.
- Hence the information stored in the cell can be retrieved correctly before the threshold value of the capacitor drops down.

10. **Briefly explain CMOS Cell.**



- Transistor pairs (T3, T5) and (T4, T6) form the inverters in the latch.
- In state 1, the voltage at point X is high by having T5, T6 on and T4, T5 are OFF.
- Thus T1, and T2 returned ON (Closed), bit line b and b will have high and low signals respectively.
- The CMOS requires 5V (in older version) or 3.3.V (in new version) of power supply voltage.
- The continuous power is needed for the cell to retain its state

4x3=12

PART D
(Answer any two. Each carries 9 marks)

11. a) **What is DMA? Describe how DMA is used to transfer Data from peripherals**

Ans :

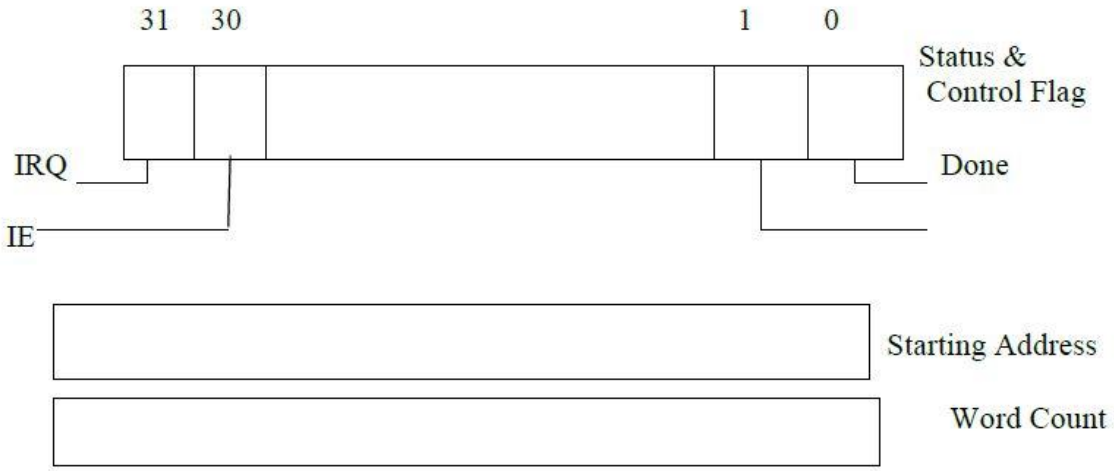
- A special control unit may be provided to allow the transfer of large block of data at high speed directly between the external device and main memory , without continous intervention by the processor. This approach is called **DMA.**
- DMA transfers are performed by a control circuit called the **DMA Controller**.
- To initiate the transfer of a block of words , the processor sends,

 Starting address

 Number of words in the block

 Direction of transfer.

- When a block of data is transferred , the DMA controller increment the memory address for successive words and keep track of number of words and it also informs the processor by raising an interrupt signal.
- While DMA control is taking place, the program requested the transfer cannot continue and the processor can be used to execute another program.
- After DMA transfer is completed, the processor returns to the program that requested the transfer



R/W □ Determines the direction of transfer .

When

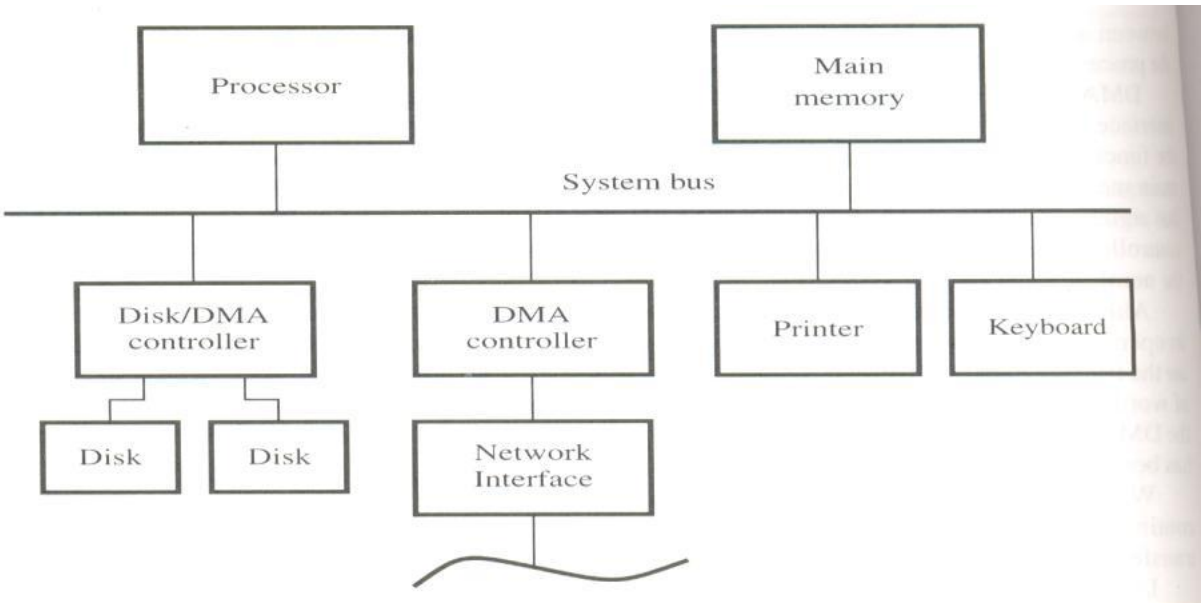
R/W =1, DMA controller read data from memory to I/O device.

R/W =0, DMA controller perform write operation.

Done Flag=1, the controller has completed transferring a block of data and is ready to receive another command.

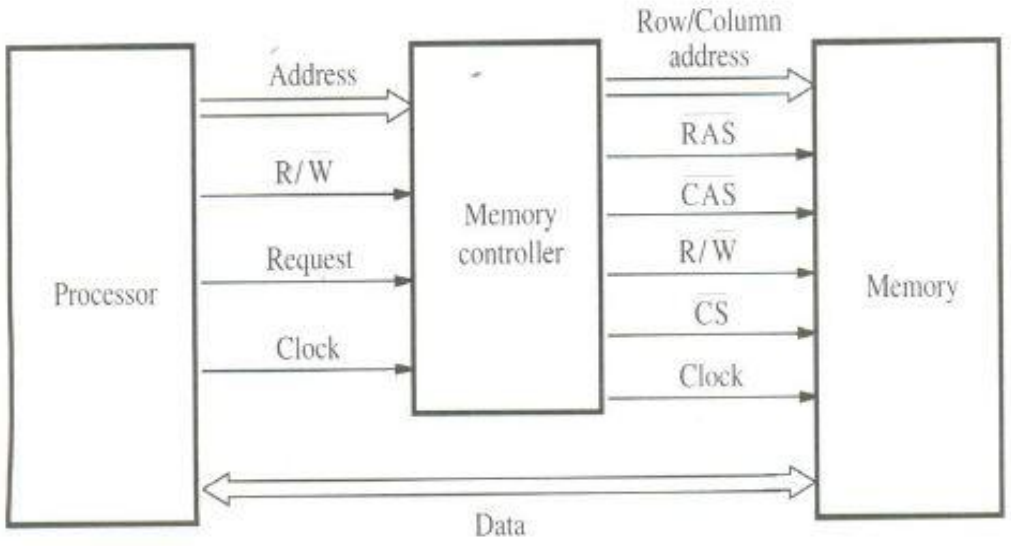
IE=1, it causes the controller to raise an interrupt (interrupt Enabled) after it has completed transferring the block of data.

IRQ=1, it indicates that the controller has requested an interrupt.



- A DMA controller connects a high speed network to the computer bus . The disk controller two disks, also has DMA capability and it provides two DMA channels.
- To start a DMA transfer of a block of data from main memory to one of the disks, the program write s the address and the word count inf. Into the registers of the corresponding channel of the disk controller.
- When DMA transfer is completed, it will be recorded in status and control registers of the DMA channel (ie) **Done bit=IRQ=IE=1**. ……(5)

b) **Discuss about use of memory controller**
Ans :



- The Controller accepts a complete address & R/W signal from the processor, under the control of a Request signal
- Request signal indicates that a memory access operation is needed.
- The Controller then forwards the row & column portions of the address to the memory and generates RAS &CAS signals.
- It also sends R/W &CS signals to the memory. …….(4)

12. **Explain briefly about PCI and USB Bus.**

- 3rd module

13. **What are the different types of ROM**

- Different types of non-volatile memory are,

❖ PROM

❖ EPROM

❖ EEPROM

❖ Flash Memory

PROM

- PROM allows the data to be loaded by the user.
- Programmability is achieved by inserting a "fuse" at point P in a ROM cell.
- Before it is programmed, the memory contains all 0's
- The user can insert 1's at the required location by burning out the fuse at these locations using high-current pulse.
- Merit:
- It provides flexibility.
- It is faster.
- It is less expensive because they can be programmed directly by the user.

EPROM

- In an EPROM cell, a connection to ground is always made at „P" and a special transistor is used, which has the ability to function either as a normal transistor or as a disabled transistor that is always turned „off".
- This transistor can be programmed to behave as a permanently open switch, by injecting charge into it that becomes trapped inside.
- Erasure requires dissipating the charges trapped in the transistor of memory cells. This can be done by exposing the chip to ultra-violet light, so that EPROM chips are mounted in packages that have transparent windows

Merits:

- It provides flexibility during the development phase of digital system.
- It is capable of retaining the stored information for a long time.

Demerits:

- The chip must be physically removed from the circuit for reprogramming and its entire contents are erased by UV light

EEPROM

Merits:

- It can be both programmed and erased electrically.
- It allows the erasing of all cell contents selectively.

Demerits:

- It requires different voltage for erasing ,writing and reading the stored data.

- In EEPROM, it is possible to read & write the contents of a single cell.
- In Flash device, it is possible to read the contents of a single cell but it is only possible to write the entire contents of a block.
- Prior to writing, the previous contents of the block are erased.
- Eg. In MP3 player, the flash memory stores the data that represents sound.
- Single flash chips cannot provide sufficient storage capacity for embedded system application.
- There are 2 methods for implementing larger memory modules consisting of number of chips. They are,
- Flash Cards
- Flash Drives.

Merits:

- Flash drives have greater density which leads to higher capacity & low cost per bit.
- It requires single power supply voltage & consumes less power in their operation.

Flash Cards:

- One way of constructing larger module is to mount flash chips on a small card.
- Such flash card have standard interface.
- The card is simply plugged into a conveniently accessible slot.
- Its memory size are of 8,32,64MB.
- Eg: A minute of music can be stored in 1MB of memory. Hence 64MB flash cards can store an hour of music. …….**9x2=18**

PART E
(Answer any four. Each carries 10 marks)

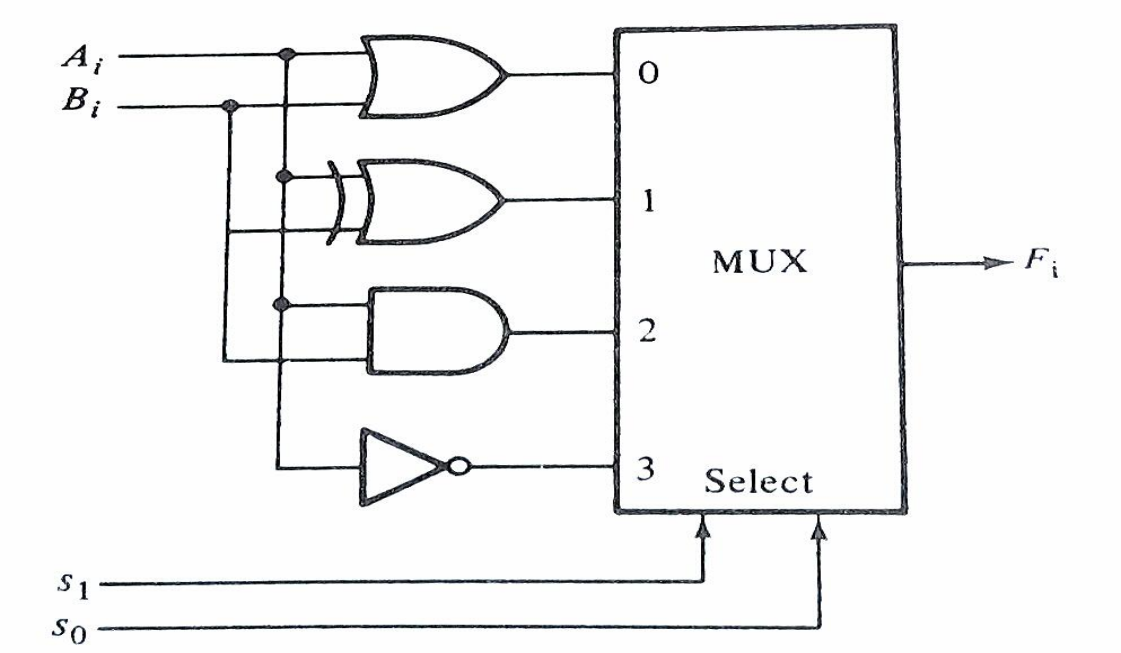
14. **Explain different types of micro-operations**

- **Interregister transfer** :- It do not change contents when binary information moves fromone register to another.
- **Arithmeticoperation: -** Performarithmetic operation on numbers stored in registers.
- **Logic operation** :- performs logical AND and OR operations on individual pair of bits.
- **Shift operation** :- specify operations for shift registers.

16. **Explain the design of aArithmetic and logic unit with two selection variables, which performs the basic arithmetic and logic functions**.

17. a) **Explain the design of logic unit**.

- Since all logic operations can be made using AND,OR and NOT (compliment) operations ,it may be convenient to employ a logic circuit with just this operations
- 2 selection lines can select 4 logic operations so, we also use the Exclusive - OR(XOR) function for the logic design



S1	S0	Output	Operation
0	0	Fi = Ai + Bi	OR
0	1	Fi = Ai ⊕ Bi	XOR
1	0	Fi = Ai Bi	AND
1	1	Fi = Ai'	NOT

(5)

b) **Explain the block diagram of 4 bit ALU**

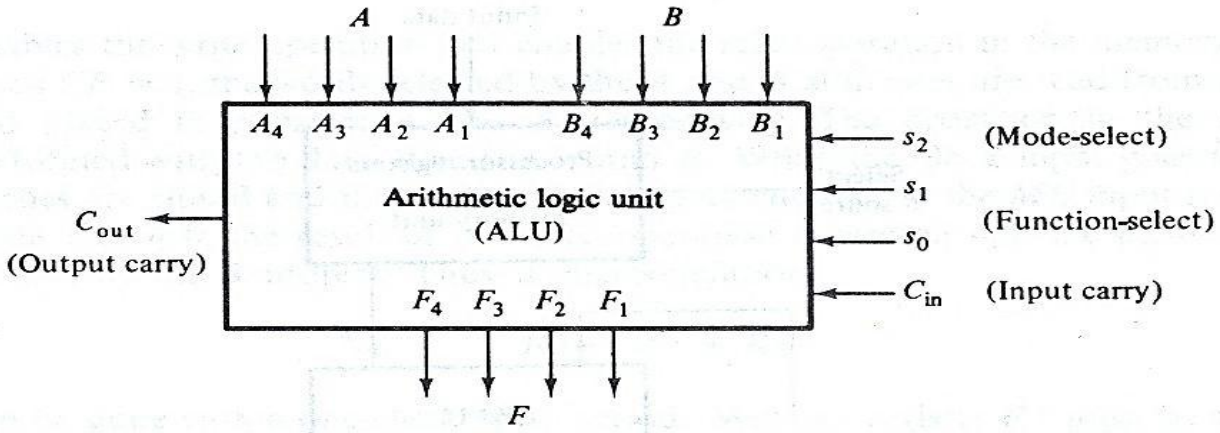


Figure 9-5 Block diagram of a 4-bit ALU

- Figure shows the block diagram of a 4 bit ALU ,
- the 4 data input from A is combined with the input B to generate the output F
- *The mode select input* S_2 distinguishes b/w arithmetic and logic operations
- The two function select input S_1 and S_0 specify the particular arithmetic or logic operation to be generated
- With three selection variable it is possible to specify four arithmetic operation(with S_2 in one state) and four logic operations (with S_2 in other state)
- the input carry in the least significant position of an ALU is quit often used as a fourth selection variable that can double the number of arithmetic operation
- In this way its is possible to generate four more operation, for a total 8 arithmetic operations…….. (5)

18.a)**Explain about PLA Control**

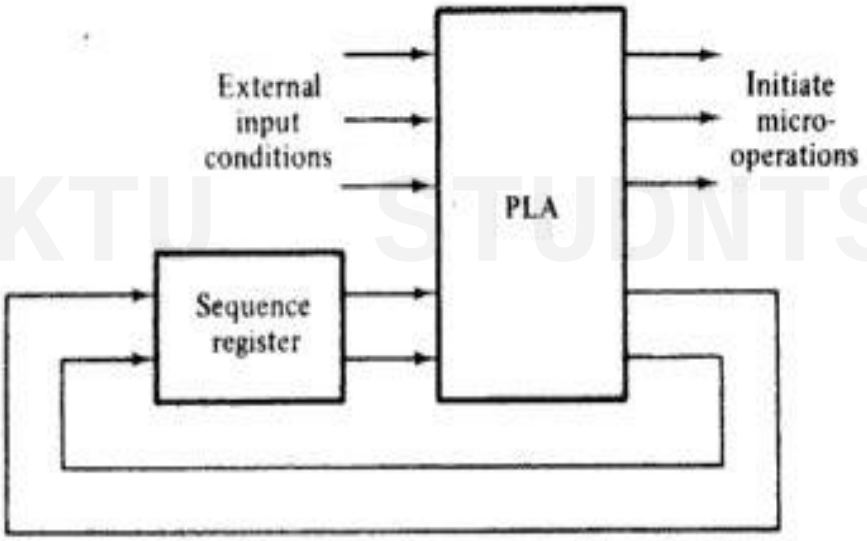


Figure 10-4 PLA control logic

- The purpose of control unit is to initiate a series of sequential steps of micro operations.
- Control variable at given time can be represented by a starting of 1's and 0's called a control word
- A control unit whose control variable are stored in a memory is called a micro programmed control unit

- Each control word of memory is called microinstructions

Sequence of microinstruction is called microprogram…… (5)

b) **Explain Control processing unit**

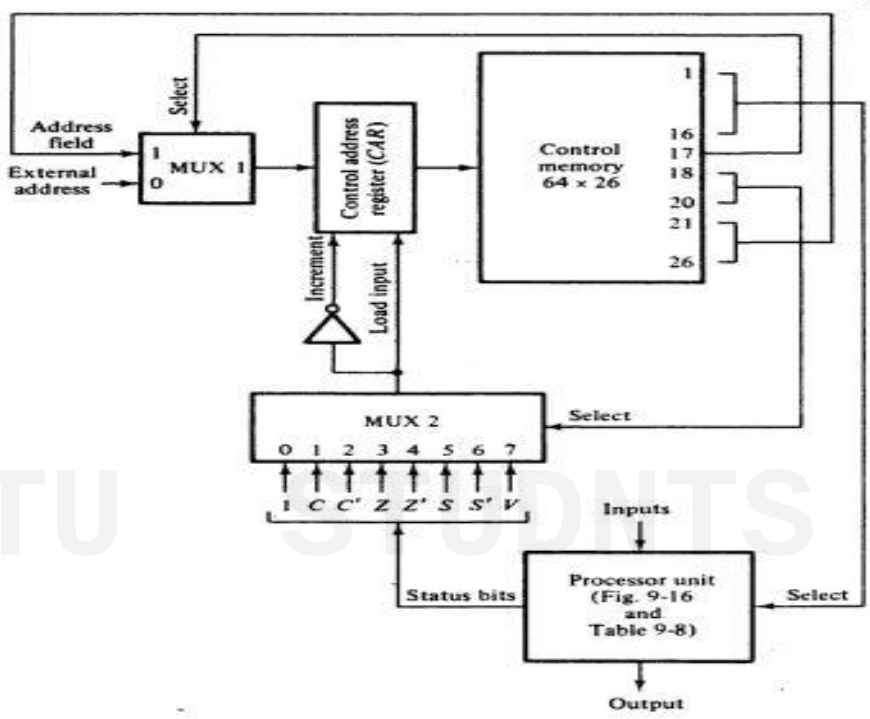


Figure 10-11 Microprogram control for processor unit

……(5)

19. **Explain the different methods of control organization.**

1. **One flip-flop per state method**
2. **Sequence register and decoder method**
3. **PLA Control**
4. **Micro program control**

20. a) **Explain micro programmed control with help of figure**

- The control signals to be activated at any time are specified by a microinstruction, which is fetched from CM.
- A sequence of one or more micro operations designed to control specific operation, such as addition, multiplication is called a **micro program.**
- The micro programs for all instructions are stored in the **control memory**(CM)

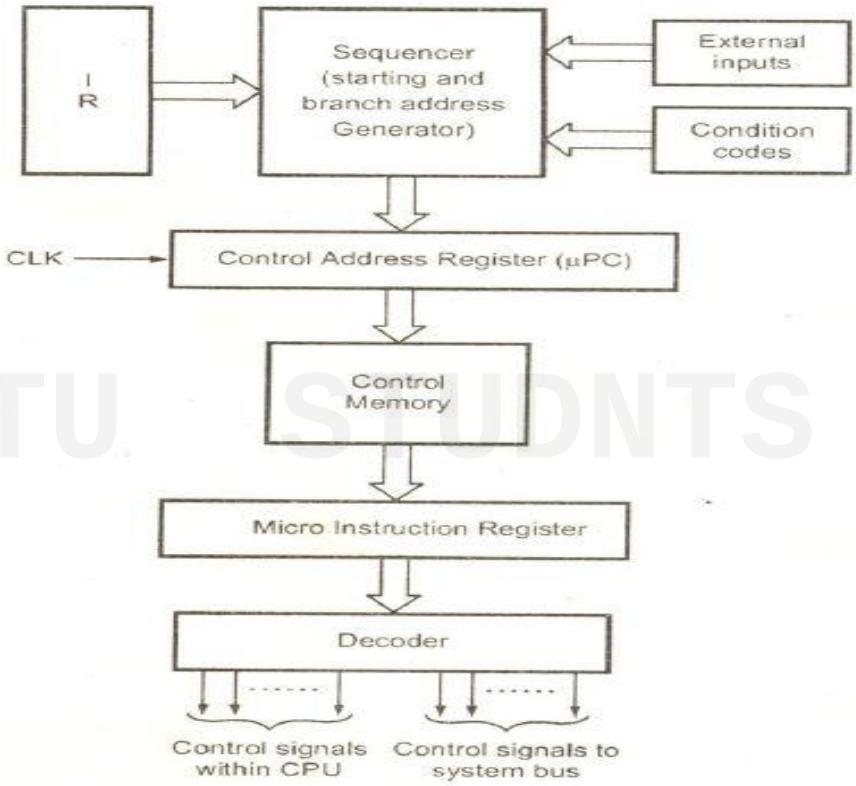


Fig. 3.15 Microprogrammed control unit

- The micro programmed control unit consists of
    - control memory
    - control address register
    - micro instruction register
    - micro program sequencer
- The address where these microinstructions are stored in CM is generated by micro program sequencer/micro program controller.
- The micro program sequencer generates the address for microinstruction according to the instruction stored in the IR.
- The control address register holds the address of the next microinstruction to be read.
- When address is available in control address register, the sequencer issues READ command to the control memory.
- After issue of READ command, the word from the addressed location is read into the microinstruction register.
- Now the content of the micro instruction register generates control signals and next address information for the sequencer.
- The sequencer loads a new address into the control address register based on the next address information

- **Advantages of Micro programmed control**
- It simplifies the design of control unit. Thus it is both, cheaper and less error prone implement.
- Control functions are implemented in software rather than hardware.
- The design process is orderly and systematic
- More flexible, can be changed to accommodate new system specifications or to correct the design errors quickly and cheaply.

- Complex function such as floating point arithmetic can be realized efficiently.
- **Disadvantages**
- A micro programmed control unit is somewhat slower than the hardwired control unit, because time is required to access the microinstructions from CM.
- The flexibility is achieved at some extra hardware cost due to the control memory and its access circuitry. …….. (5)

b)**Explain hardwired control with help of figure**

- The control units use fixed logic circuits to interpret instructions and generate control signals from them.
- The fixed logic circuit block includes combinational circuit that generates the required control outputs for decoding and encoding functions

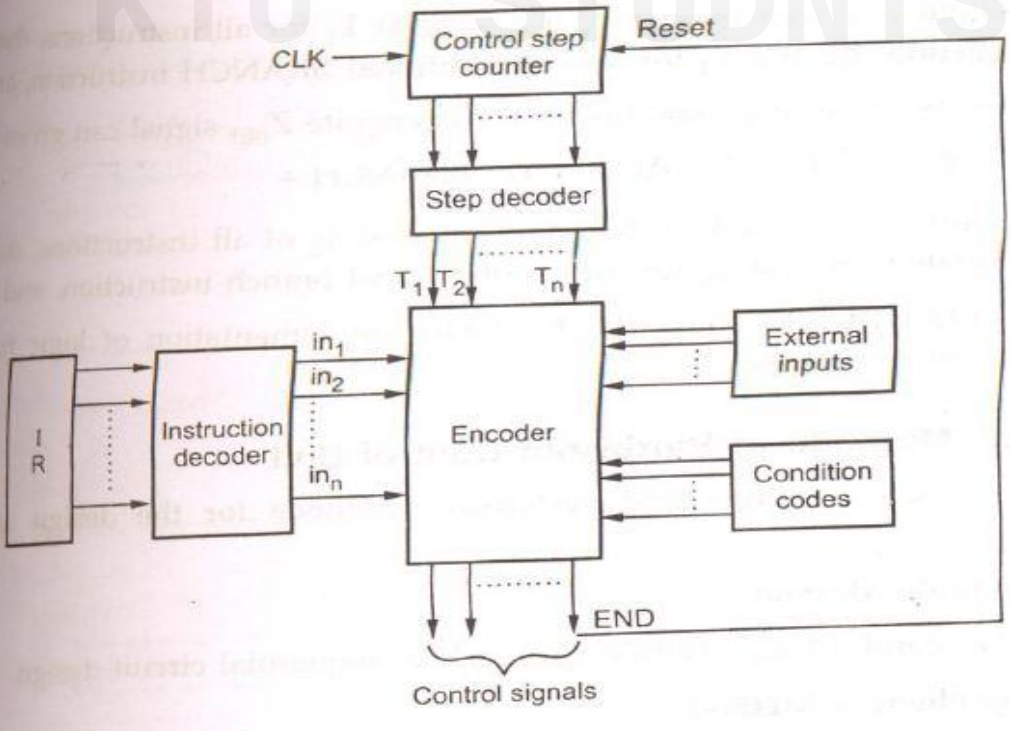


Fig. 3.11 Detail block diagram for hardwired control unit

Instruction decoder

- It decodes the instruction loaded in the IR.
- If IR is an 8 bit register then instruction decoder generates 28(256 lines); one for each instruction.
- According to code in the IR, only one line amongst all output lines of decoder goes high (set to 1 and all other lines are set to 0).

Step decoder

- It provides a separate signal line for each step, or time slot, in a control sequence.

Encoder

- It gets in the input from instruction decoder, step decoder, external inputs and condition codes.
- It uses all these inputs to generate the individual control signals ……(5)

10x4=40